Why Has PEAD Declined Over Time? The Role of Earnings News Persistence

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Abstract

Post-earnings-announcement drift (PEAD) has declined significantly in recent decades, and the prevailing explanation is that increased arbitraging activities have led to its attenuation. We propose a new explanation based on a decline in the persistence of earnings news, which causes a deterioration in the usefulness of the PEAD anomaly signal. In our empirical analyses, we show that the persistence of standardized unexpected earnings (SUE) declines over time and variation in SUE persistence significantly explains variation in PEAD over time. In fact, once we account for declining SUE persistence, the downward trend in PEAD is no longer significant. The role of SUE persistence in explaining declining PEAD survives when we control for several proxies for arbitraging activities. Overall, we conclude that the decline in the persistence of earnings news is a key driver behind the attenuation of PEAD.

Keywords: PEAD; Attenuation; SUE; Earnings Persistence; Arbitrage; Short Selling; Anomaly

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1. Introduction

Post-earnings-announcement drift (PEAD) is the oldest and most famous of all anomalies in accounting and finance (Fama 1998). Recent research finds that the magnitude of PEAD has declined significantly over the last four decades, and has perhaps even disappeared (e.g., Richardson et al. 2010; Martineau 2021). The prevailing explanation for the decline of PEAD is that increased liquidity has allowed arbitrage investors such as hedge funds to trade more aggressively on the PEAD signal or to price earnings more efficiently at the announcement date, thereby decreasing the price drift following earnings announcements (Chordia et al. 2014; Martineau 2021).

In this paper, we offer an alternative explanation for the attenuation of PEAD: a decline in the persistence of earnings news. The most common explanation for PEAD's existence is that investors fail to appreciate the implications of current earnings news for future earnings news and are surprised when firms with poor (good) current earnings news continue to have poor (good) earnings news in the future (e.g., Bernard and Thomas 1989). Meanwhile, a number of prior studies find that the earnings persistence has declined over time (e.g., Dichev and Tang 2008; Donelson et al. 2011; Bushman et al. 2016). Possible explanations from prior work include: a) more uncertain and unstable firms going public now compared to the past (Fama and French 2004; Srivastava 2014), b) changes in standard setting (Dichev and Tang 2008), or c) increased competition leading to more instability and special items (Donelson et al. 2011).

Regardless of the cause, if earnings have become less persistent over time, we conjecture that a major reason for the decline in PEAD is that, conditional on current earnings news, investors have less to be surprised about in the future. Or, put another way, the informativeness of the PEAD signal for future earnings news and returns may have declined. Exploring this explanation is important because PEAD is arguably the most researched anomaly in accounting. While there are several papers proposing various explanations for the demise of accruals anomaly (e.g., Green et al. 2011; Mohanram 2014; Bhojraj et al. 2017), exploration of the reasons behind the decline of PEAD is much more limited. If "PEAD is dead," then a proper postmortem to consider all possible causes is in order given the attention PEAD received while alive.

We begin our analyses by replicating recent findings that PEAD has declined. We form portfolios of stocks based upon standardized unexpected earnings (SUE), using a seasonal random walk expectations model. We define SUE based on quarterly earnings changes in our main tests rather than analyst forecasts in order to prevent the exclusion of smaller stocks without analyst coverage, where PEAD is most prevalent (see Fink 2021). Firms in the highest (lowest) decile of quarterly earnings changes form the long (short) leg of the PEAD strategy. We follow prior literature (e.g., Battalio et al. 2012; Chen et al. 2017) and cumulate buy-and-hold abnormal returns starting from the second trading date after the current quarterly earnings announcement to the first trading date after the subsequent announcement. Consistent with prior work, we find that the abnormal returns to a hedge portfolio long in high SUE stocks and short in low SUE stocks have declined significantly from 1974 to 2020 and are indistinguishable from zero at the end of our sample (i.e., after 2017).

In the second part of our empirical analyses, we show that the declining persistence of SUE (i.e., earnings news) is a key explanation for the attenuation of PEAD. By SUE persistence, we mean the tendency for firms with high (low) SUE currently to have high (low) SUE in the future. Consequently, every quarter we calculate the average SUE decile rank *next quarter* for firms in the top and bottom SUE deciles *this quarter*. This average future rank for the top (bottom) decile captures SUE persistence for the long (short) leg of the PEAD strategy each quarter. We use the difference in these average future ranks as our primary measure of SUE persistence for the hedge PEAD strategy. Intuitively, as these average future ranks get closer together – and firms with high (low) current SUE have lower (higher) SUE in the future – the persistence or "stickiness" of SUE is smaller.

Consistent with our conjecture, we find that SUE persistence declines significantly over time. In addition, we demonstrate that SUE persistence is significantly associated with variation in PEAD over time, and that declining SUE persistence helps explain declining PEAD. In fact, after controlling for declining SUE persistence, the declining trend in PEAD is cut by more than half and becomes statistically insignificant. As further corroboration, we show that (1) PEAD arises almost entirely from firms in extreme current SUE deciles (1 and 10) *staying* in the same extreme deciles of SUE next quarter (i.e., *Stayers*) and (2) the percentage of *Stayers* has declined dramatically over time. Taken together, this evidence is consistent with declining SUE persistence contributing to the attenuation of PEAD.

Our tests described above establish a robust relationship between declining SUE persistence and the attenuation of PEAD. However, we note this explanation for declining PEAD and the prevailing explanation in the literature related to increased arbitrage trading are not mutually exclusive. The two explanations are conceptually different, and it is possible (perhaps likely) that both contribute to declining PEAD. For completeness, in our third set of empirical analyses, we include proxies for increased arbitrage trading in our tests to ensure our findings are distinct from those in prior research. The trading explanation implies that, over time, arbitrage investors should increasingly: a) short low SUE stocks but avoid shorting high SUE stocks, b) buy put options for low SUE stocks but call options for high SUE stocks, c) buy high SUE stocks but avoid buying low SUE stocks, and d) react more strongly to earnings signals at the earnings announcement date. Thus, in our test of declining PEAD, we include average differences between top versus bottom SUE deciles each quarter in short interest, options trading, transient institutional ownership, and earnings-announcement price reaction as proxies for arbitraging trading. We find that controlling for these factors does not alter our inferences. In fact, in these tests, it appears that the declining SUE persistence better explains variation in PEAD over time than these trading proxies.

One drawback of these tests is that identifying and measuring arbitrage trading related to PEAD is challenging, particularly for the long leg. As a result, measurement error could reduce the power of the tests and bias against capturing the contribution of arbitrage trading in the decline of PEAD. To alleviate this concern, we focus on the short leg of PEAD and short selling. This setting has three advantages: 1) returns to the short leg of PEAD have declined consistently over time in magnitude, and 2) most forms of arbitrage trading related to low SUE stocks should involve short selling, and 3) we have comprehensive short interest data at the stock level, reported monthly or bi-monthly, going back to the 1970s. We find that declining SUE persistence, rather than increased short selling, seems to play a more important role in explaining declining PEAD in low SUE firms.

We conduct several supplemental analyses to reinforce our main findings. First, while our main analyses are based on quarterly time-series analyses, we confirm our main findings hold using firm-quarter panel data: (1) SUE persistence has declined over time and (2) the decline of SUE persistence explains the PEAD attenuation. Second, we show that short-term PEAD in the first few days right after the current earnings announcement has actually become *stronger* over time and the overall decline in PEAD happens later in the subsequent quarter. When we control for declining SUE persistence, the declining trend of later-window PEAD disappears, while the increasing trend of immediate-window PEAD becomes stronger. These results suggest that the decline in PEAD over time occurs when future earnings news is likely to arrive (Soffer and Lys 1999), further corroborating the role of declining persistence of earning news. Third, we split the sample into microcap firms and non-microcap firms and find that the SUE persistence plays a key role in explaining the decline in PEAD over time in both subsamples. Fourth, we confirm our key inferences hold when we calculate SUE based on analyst forecasts. Specifically, we find that the implications of current analyst-based SUE for future quarterly earnings changes has declined over time, and this declining persistence explains the decline in PEAD based on analyst forecast errors.

This study makes several contributions. First, we offer a new explanation for the decline in PEAD over time, therefore contributing to the vast literature on anomalies in general and the PEAD literature in particular. Researchers typically explore various reasons behind the demise of popular anomalies. For example, researchers have documented various reasons why the accrual anomaly has declined, including arbitraging activities (e.g., Richardson et al. 2010; Green et al. 2011; Chordia et al. 2014), the provision of cash flow forecasts (Mohanram 2014; Radhakrishnan and Wu 2014), and accounting rule changes (Bhojraj et al. 2017). By contrast, research on causes of the decline of PEAD, the oldest and most researched anomaly in accounting and finance (Fama 1998), is surprisingly rather limited and narrowly focused on the rise of liquidity and increase in arbitraging activities (Chordia et al. 2014; Martineau 2021). We present strong and consistent evidence that the decline of SUE persistence is a primary driver behind the attenuation of PEAD in the past four decades, even after explicitly controlling for the prevailing explanation (i.e., based on arbitraging activities) in various ways. This is an explanation that, to our knowledge, has not been explored by the prior literature, and we expect future research might explore other possible reasons behind the decline of PEAD as well as other anomalies.

Second, we contribute to the stream of literature on changes in earnings properties over time. Prior work finds that declining earnings persistence due to changes in accounting and/or economics has implications for the relation between cash flows and accruals (Bushman et al. 2016) and the value relevance of earnings (Srivastava 2014). We show in this study that declining persistence also has implications for earnings-based anomalies such as PEAD.

Third, our results have implications for future research. If the conventional wisdom in the literature is correct, and investor underreaction to earnings news is now routinely "traded away," it calls into question whether future research should continue to employ "drift-like" tests that assume delayed price response (Martineau 2021). Our findings that declining persistence in earnings news seems to be just as important as, if not more important than, arbitrage trading in explaining declining PEAD suggest that investor underreaction to informative earnings signals may still persist. In that case, it could be still appropriate to use "drift-like" tests such as PEAD to evaluate price efficiency.

2. Prior Literature and Testable Predictions

The literature on PEAD is vast (see Fink 2021 for a detailed review). PEAD was first documented in Ball and Brown (1968) but received significant attention much later (e.g., Foster et al. 1984; Bernard and Thomas 1989, 1990). Labeled as the "granddaddy of underreaction events" by Fama (1998), PEAD is one of the most prominent and puzzling anomalies, both in the U.S. and internationally (e.g., Hung et al. 2015).

<u>2.1 The Potential Drivers of PEAD</u>

There is a large literature on the potential drivers of PEAD starting from Bernard and Thomas (1989), who conclude that PEAD is less consistent with an incomplete risk adjustment explanation, and more consistent with delayed price response. However, they admit that "what is less clear is why a delayed price response would occur," and they discuss two main categories of explanations: transaction costs and prices failing to reflect full implications of current earnings for future earnings – two explanations that have been greatly expanded by subsequent researchers.

The first category of drivers is related to transaction costs and arbitraging activities. Bernard and Thomas (1989) find that the abnormal returns to trading on PEAD may be within the round-trip cost for small individual investors, consistent with this explanation. Later researchers argue that transaction and liquidity costs as well as the lack of sufficient arbitraging activities could contribute to PEAD in two distinct ways. On one hand, arbitrage costs (transaction and liquidity costs) make it unprofitable for informed arbitrageurs to fully correct prices to their fundamental values (e.g., Bhushan 1994; Chordia et al. 2009). In other words, trading frictions *prevent the correction* of PEAD that may arise from some investors behaving irrationally (discussed further below). On the other hand, Ng et al. (2008) argue that trading frictions can *create* PEAD in the first place, even absent irrational underreaction. The argument is essentially that rational investors reacting to earnings news will only keep trading until it is profitable to keep doing so, with trading costs acting as a wedge between fundamental value and market prices. Consistent with both channels through which arbitraging costs affect PEAD, prior research has documented that PEAD is stronger when the transaction costs are higher (e.g., Doyle et al. 2006) and when active institutional ownership is lower (e.g., Bartov et al. 2000), particularly when transient institutional ownership is low (e.g., Ke and Ramalingegowda 2005).

The second category of drivers is related to investor irrationality and the extent to which investors incorrectly assess the implications of current earnings on future earnings. Bernard and Thomas (1989, 1990) show that significant PEAD returns accrue around future earnings announcement dates, with signs and magnitudes that mimic the relation between current earnings changes and future earnings changes. These findings suggest PEAD arises, at least in part, from investors failing to appreciate the implications of current earnings news for future earnings news.[1] Subsequent research explores whether market understands the time-series properties of earnings (e.g., Ball and Bartov 1996; Soffer and Lys 1999; Brown and Han 2000; Burgstahler et al. 2002).

More recently, researchers have studied that different components of earnings could have distinct levels of persistence, therefore contributing to PEAD differently. Specifically, unexpected cash flows can predict PEAD better than unexpected accruals (Shivakumar 2006), and revenue surprises are more strongly associated with PEAD than expense surprises (Jegadeesh and Livnat 2006). Relatedly, due to accounting conservatism, losses or earnings decreases are more likely to mean-revert than profits and earnings increases, leading to predictable variation in earnings persistence and consequently PEAD (Narayanamoorthy 2006). Cao and Narayanamoorthy (2012) show that firms with lower ex ante earnings volatility have stronger PEAD.[2]

2.2 The Decline of PEAD

Despite the persistence of PEAD for many years, several recent studies document a decline in PEAD over time. For example, Chordia et al. (2014) examine the time trend of monthly hedge portfolio returns of 12 well-documented anomalies, and find that 10 of them, including PEAD, exhibit a significant declining trend from 1976 to 2011. Martineau (2021) finds that post-earnings announcement abnormal returns become less related or even unrelated to decile ranks of earnings surprises in recent years, suggesting a decline and disappearance of PEAD. It is worth noting that

[1] Maines and Hand (1996) use experiments and confirm that subjects underestimate the time-series autocorrelations in seasonally-differenced earnings, especially when actual autocorrelations are high. Calegari and Fargher (1997) extend the firm-level study and show that the underestimation bias in time-series earnings persistence is not removed by market aggregation.

[2] In addition to the earnings persistence perspective, researchers also examine that investors might not fully appreciate the valuation implications of earnings persistence, due to their lack of sophistication or general behavioral biases such as limited attention (e.g., Hirshleifer et al. 2009; Hung et al. 2015).

the overall attenuation trend does not mean that the PEAD has been declining in every year. For example, Richardson et al. (2010) find that while PEAD became weaker until 2002, this declining trend did not continue in the 2003-2008 period.

The prevailing explanation offered for this decline is increased arbitrage trading on the PEAD signal or around earnings announcements, but only Chordia et al. (2014) and Martineau (2021) offer evidence on this point. Specifically, Chordia et al. (2014) use market-wide variables such as the total short interest, total shares under management by hedge funds, and total market-wide trading volume to proxy for arbitrage trading, and find these variables are associated with time series variation in PEAD and other anomalies. Martineau (2021) shows the immediate market reactions to earnings on the announcement date have grown stronger in recent decades, and infers that the price discovery occurs more *around* earnings announcements, leaving less room for drifts *after* the earnings announcement.

In theory, a substantial shift over time in any of the drivers mentioned in the prior subsection could potentially explain the decline of PEAD. The prevailing explanation explored by Chordia et al. (2014) and Martineau (2021) focus on the shift in transaction costs and arbitraging activities. Motivated by prior studies showing that earnings persistence has declined over time (see below), we examine the second category of PEAD drivers and propose a new explanation for the attenuation of PEAD in recent decades: the declining persistence of earnings news.

2.3 Hypotheses Development

Bernard and Thomas (1990) conclude that PEAD arises at least partly because investors fail to appreciate the implications of current earnings news for future earnings news. As discussed in Section 2.1, prior research provides robust evidence that PEAD is stronger when the anomaly signal (e.g., current earnings news) is more informative (e.g., in predicting future earnings news) (e.g., Shivakumar 2006; Jegadeesh and Livnat 2006; Narayanamoorthy 2006; Cao and Narayanamoorthy 2012; Chen 2013).

Meanwhile, there is a separate stream of literature documenting that the persistence of earnings – and thus its implications for future earnings – has declined over time (e.g., Baginski et al. 2003), due to a combination of factors related to fundamental shifts in both economics and accounting. First, the constituents of the U.S. capital markets have changed over time. For example, Fama and French (2004) find that newly listed firms from 1980 to 2001 are progressively more left (right) skewed in their profitability (growth). They also find that survival rates for seasoned and newly listed firms decline dramatically over time. Overall, Fama and French (2004) conclude that more uncertain firms with distant expected payoffs are increasingly becoming publicly listed over time. Relatedly, Srivastava (2014) shows that in the 40 years from 1970-2009, each new cohort of listed firms exhibits higher intangible intensity, higher earnings volatility, and lower earnings quality than its predecessors.

Another factor is that accounting standard setting or accounting practice may have changed. Dichev and Tang (2008) argue that the FASB's "balance sheet" focus (Storey and Storey 1998) has led to a decline in the matching of revenues and expenses. Dichev and Tang (2008) document a substantial trend of increasing earnings volatility, decreasing earnings persistence, and an increasingly negative autocorrelation in earnings changes. Donelson et al. (2011) attribute these patterns not to standard setting, but instead to increasing competition causing firms to experience more distress and/or reorganization, leading to more one-time, special items. Relatedly, Bushman et al. (2016) also find a rise in one-time and non-operating items in earnings. Due to the non-recurring nature of these items, earnings changes related to these charges contain less information about future earnings news.

Taken together, while the extant literature does not agree on whether economic or accounting factors play a bigger role, one conclusion is clear – the earnings of US public companies have become less persistent in the past several decades. Further, prior work has documented a decline in the persistence of both annual earnings (Dichev and Tang 2008) as well as quarterly earnings changes (Baginski et al. 2003; Lorek and Willinger 2007). As a result, we expect that PEAD signals based upon "unexpected earnings" or "earnings news" have become increasingly less persistent as well (i.e., the signal informativeness of current unexpected earnings is declining). To the extent that one key reason why PEAD exists is investors' failing to understand the implications of current earnings news for future earnings news, we predict that this decline in signal informativeness could explain the attenuation trend of PEAD over time.

H1: The persistence of earnings news has declined over time.

H2: The declining persistence of earnings news contributes significantly to the declining trend in the magnitude of PEAD over time.

3. Sample, Design, and Results

3.1 Sample Selection and Variable Constructions

3.1.1 Sample Construction

We begin with the Compustat firm-quarter universe of 1,387,502 observations from 1974 to 2020, where the earnings announcement date (RDQ) is before 2021. Then we remove observations that are (1) missing or negative total assets or sales, (2) not listed in NYSE, AMEX, or NASDAQ, (3) missing price, (4) missing shares outstanding, (5) with closing share price smaller than $1, (6) with market value smaller than $5 million, (7) missing earnings announcement dates, (8) missing PERMNO therefore unable to merge with CRSP, (9) missing calendar quarter, (10) missing fiscal quarter, and (11) not assigned to a size/BTM portfolios. Table 1 Panel A describes the sample selection process and the resulting sample size. We have a final sample of 526,828 firm-quarter observations and 185 fiscal quarter observations for the PEAD analyses.

3.1.2 PEAD-related Variables

In this subsection, we describe how we construct PEAD-related variables. First, we follow prior literature (e.g., Bernard and Thomas 1989, 1990; Richardson et al. 2010; Martineau 2021) and construct Standardized Unexpected Earnings, or SUE, as the change in quarterly income before extraordinary items (IBQ) relative to the same quarter in the prior year scaled by the market value of equity at the quarter-end in the prior year. For our main tests, we base unexpected earnings on quarterly changes in earnings, rather than analyst forecasts, to avoid the exclusion of smaller firms without analyst coverage, where PEAD tends to be larger (Fink 2021). However, we examine SUE based on analyst forecasts in Section 3.7.4, and find similar inferences.

We then construct PEAD variables at the quarterly level. For each firm-quarter, we follow prior literature (e.g., Battalio et al. 2012; Chen et al. 2017; Feldman et al. 2010; Lasser et al. 2010) and cumulate the buy-and-hold abnormal return in the window starting from the second trading date after the current quarterly earnings announcement to the first trading date after the subsequent announcement (i.e., [+2, next EAD + 1], where day 0 is the quarterly earnings announcement date).[3] We follow Sloan (1996) to adjust for delisting returns. The buy-and-hold abnormal return (i.e., *BHAR[+2, next EAD+1]*) is calculated as the cumulative return in this window less the matching size/BTM portfolio return in the same window, as obtained from Professor Ken French's website.[4]

Following prior literature (e.g., Bernard and Thomas 1989), a PEAD trading strategy that

[3] We find similar results using (1) the last trading day prior to the subsequent quarterly earnings announcements (i.e., [+2, next EAD - 1]), or (2) a window of [+2, +60] as in Martineau (2021) (untabulated).
[4] See https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

goes long in firms with the high values of SUE and shorts firms with the low values of SUE will earn abnormal returns. We construct PEAD variables at the quarterly level to mimic this trading strategy. Consistent with prior PEAD research, for every fiscal quarter we assign firms into SUE deciles using the decile breakpoints of SUE from the prior fiscal quarter, where 1 is the lowest SUE decile and 10 is the highest SUE decile. Then we take the equal-weighted average of *BHAR[+2, next EAD + 1]* each fiscal quarter for all firms in the top and bottom SUE decile, and label them as *Long Leg PEAD* and *Short Leg PEAD*, respectively. We refer to their difference as *Hedge PEAD*.

In Table 1 Panel B, we present summary statistics for our fiscal quarter-level variables, including *Hedge PEAD* and other variables that will be defined below in further analyses. To calculate the quarter-level "short leg" ("long leg") variables, we average all firms in the lowest (highest) SUE decile for each fiscal quarter. For each fiscal quarter, we then take the long leg average less the short leg average to arrive at the hedge variables. All firm-quarter observations, except for *BHAR[+2, next EAD +1]* and ranked variables, are winsorized at the 1st and 99th percentile before taking the quarterly average to reduce the effect of outliers.

3.2 Confirming the Decline of PEAD

Before testing our hypotheses, we confirm in our sample that PEAD is indeed declining over time. Following the prior literature that studies time trends in anomalies or the information content of accounting (e.g., Collins et al. 1997; Chordia et al. 2014; Beaver et al. 2018, 2020), we formally test if there is a statistically significant trend in the attenuation of PEAD by estimating equation (1):

$$Hedge\ PEAD_q = \alpha + \beta Trend_q + \varepsilon \tag{1}$$

where *Trend* is a linear time variable that equals 1 for our first fiscal quarter (1974Q2) and increments by 1 for each subsequent fiscal quarter. Table 2 presents the results. The constant of 6.24% (t = 8.49) in Column 1 indicates strong PEAD in the beginning of our sample period and the significantly negative coefficient on *Trend* (Coeff. = -0.020; t = -3.06) shows that *Hedge PEAD* gets weaker during our sample period, by about 2 basis points each quarter. For robustness, we use the log of *Hedge PEAD* plus one as the dependent variable (Chordia et al. 2014), and find a similar declining trend. Overall, this is consistent with the findings in the recent literature that PEAD (as well as other well-known anomalies such as accrual anomaly) has attenuated in recent decades (e.g., Chordia et al. 2014; Martineau 2021).

To show the PEAD decline visually, we plot the five-year moving average of the quarterly *Hedge PEAD* in Figure 1. We use the five-year moving average to mitigate the impact of extreme quarters (e.g., the financial crises in 2007/8). It reveals two clear patterns. First, the hedge PEAD return has been consistently positive (i.e., higher than 2%), confirming the robustness of PEAD as documented in the prior literature. Second, we see an overall decline of hedge return from about 5% in 1980/1990s to about 4% in 2000s and early 2010s and finally to 3% or lower in late 2010s. Overall, the results in this section confirm a key finding documented in the prior literature: the PEAD anomaly, which was historically very robust, has gradually attenuated in the past four decades.

3.3 Earnings Persistence and the Decline of PEAD

3.3.1 Measuring Persistence of Earnings News

The main goal of this paper is to propose a new explanation for the decline of PEAD based on the declining persistence of earnings news. This idea relates to the fundamental reason why PEAD exists in the first place – current earnings news contains information about future earnings news, and investors do not react sufficiently to such information content. If the ability of current earnings news to predict future earnings news decreases, we would expect that PEAD attenuates.

We assess the ability of current earnings news to predict future earnings news through the stickiness of the SUE deciles across quarters. Intuitively, if a firm stays in the same SUE decile in the next quarter as in the current quarter, we view this firm having persistent earnings news. Given that we focus on firms in the two extreme SUE deciles in each quarter, the SUE decile ranks of those firms in the next quarter precisely reveal how much their SUE decile rankings persist.

Given this connection between earnings news persistence and SUE deciles in the next quarter, we label the average next-quarter SUE rank for firms in decile 1 of current SUE as *Short Leg SUE Pers.* Similarly, we label the average next-quarter SUE rank for firms in decile 10 of current SUE as *Long Leg SUE Pers.* We label the difference between *Long Leg SUE Pers* and *Short Leg SUE Pers* as *Hedge SUE Pers.* Table 1 Panel B shows that the mean of *Short Leg SUE Pers (Long Leg SUE Pers*) is 4.040 (7.229). This can be interpreted as firms in the lowest (highest) SUE decile this quarter having an average SUE decile of 4.040 (7.229) in the following quarter. The difference between the average *Long Leg Pers* and average *Short Leg Pers* is the average *Hedge SUE Pers* (7.229 – 4.040 = 3.189). If the persistence of SUE is declining over time, we expect *Short Leg SUE Pers* and *Long Leg SUE Pers* to get closer to 5.5 (i.e., the midpoint of deciles 1 and 10) over time, and we likewise expect *Hedge SUE Pers* to get closer to 0 over time.[5]

3.3.2 Research Design

Using our fiscal quarter level sample of 185 observations, we estimate the following

[5] An alternative, yet econometrically equivalent, approach to calculating *SUE Pers* is running Fama-MacBeth regressions by fiscal quarter from 1974–2020: $Dec\_SUE_{i,q+1} = \alpha + \beta'$ (*Dec1*+*Dec2*+*Dec3*+*Dec4*+*Dec6*+*Dec7*+*Dec8*+*Dec9*+*Dec10*)+ε. The dependent variable is the SUE decile for the next fiscal quarter and the independent variables are a series of indicator variables for each SUE decile for the current fiscal quarter. Note, *Dec5* is left out to avoid collinearity issues; thus, the constant is the coefficient for *Dec5*. The coefficients shown are the average coefficients on each SUE decile from all quarterly level regressions. Thus, by construction, the average next quarter SUE decile rank for firms in the top (bottom) SUE decile this quarter equals the constant plus the coefficient on *Dec10* (*Dec1*).

regressions to test H1 and H2:

$$Hedge\,SUE\,Pers_q = \alpha + \beta_1 Trend_q + \varepsilon \quad (2a)$$

$$Hedge\,PEAD_q = \alpha + \beta_1 Trend_q + \beta_2 Hedge\,SUE\,Pers_q + \varepsilon \quad (2b)$$

If H1 is true, we expect a negative and significant coefficient on *Trend* in equation (2a), as the difference between *Long Leg SUE Pers* and *Short Leg SUE Pers* should be getting closer to zero (less persistent) over time. If H2 is true, *Hedge SUE Pers* should be positively associated with *Hedge PEAD*, and this association should survive after controlling for the trend in each variable and should reduce the magnitude of *Trend* relative to that in equation (1). In other words, as *Hedge SUE Pers* (i.e., the difference between *Long Leg Pers* and *Short Leg Pers*) gets closer to zero over time, the *Hedge PEAD* should get closer to zero over time as well, and the over-time variation in *Hedge SUE Pers* should help explain the over-time variation in *Hedge PEAD*. Intuitively, if the decline in SUE persistence is a key underlying driver of PEAD attenuation, *Hedge SUE Pers* should contain more information regarding PEAD attenuation than *Trend*. As a result, *Trend* should decline in magnitude and significance when *Hedge SUE Pers* is added to the regression. This approach is quite common in the prior literature. For example, Collins et al. (1997) use this approach when explaining the declining value relevance of earnings and Beaver et al. (2018; 2019) use this approach to explore the drivers of the increased market response to earnings announcements over time. Note that in equation (2b), we include forward-looking information about future earnings news not known at time t, which would be problematic if we were seeking to *predict* PEAD returns or form a trading strategy. However, our goal is simply to *explain* declining anomaly returns after the fact, and the inclusion of realized earnings news over the return cumulation window helps in this regard. Hribar and McInnis (2012) use a similar approach.

3.3.3 Results

Table 3 Panel A presents results from estimating equations (2a) above. We regress *Hedge SUE Pers* on *Trend* in Column 1 and find the coefficient is significantly negative (Coeff. = -0.011; t = -9.73). This result shows that the *Hedge SUE Pers* declines significantly during our sample period, supporting H1. As *Hedge SUE Pers* is constructed as the difference between *Long Leg SUE Pers* and *Short Leg SUE Pers*, for completeness, in Columns 2 and 3 we regress *Short Leg SUE Pers* and *Long Leg SUE Pers*, respectively, on *Trend*. We find that the trend variable loads significantly positive (negative) in Column 2 (3), providing evidence that both legs have a decline in SUE persistence over time (i.e., predicted SUE for both legs is getting closer to the middle of the distribution in the next quarter).

To show the trend visually, Figure 2 Panel A plots the 5-year moving average of *Hedge SUE Pers* throughout our sample period. We find that the difference in the predicted next quarter SUE decile between the long leg and short leg decreases from 4.0 prior to mid-1980s to about 2.0 in 2010s. In Panel B of Figure 2, we separate *Hedge SUE Pers* into the two legs. We see that *Long Leg Pers* decreases over time and *Short Leg Pers* increases over time, both getting closer to a predicted SUE rank of 5.5, leading to a smaller difference in SUE persistence between the two legs. These results taken together provide strong support for H1.

We next examine how *Hedge SUE Pers* impacts *Hedge PEAD* from estimating equations (2b) above in Table 3 Panel B. We first duplicate the regression from Table 2 Column 1 for ease of presentation; specifically, Column 1 shows that *Hedge PEAD* has declined over time (Coeff. = -0.020; t = -3.06). In Column 2 we regress *Hedge PEAD* on *Hedge SUE Pers* and find it loads significantly positive (Coeff. = 2.259; t = 7.64). In other words, the *Hedge PEAD* in a given period is smaller when the *Hedge SUE Pers* in that period is weaker, supporting H2. Next, we add *Trend* in the regression in Column 3 and find that *Hedge SUE Pers* remains significantly positive (Coeff.

= 2.521; t = 7.02). Note Column 1 shows that *Trend* loads significantly negative, confirming the attenuation of *Hedge PEAD*. However, in Column 3 it becomes insignificant and turns positive (Coeff. = 0.008; t = 1.08) when we add *Hedge SUE Pers* into the regression, further supporting H2.

Overall, these results indicate that the decline in SUE persistence is an important reason for PEAD's attenuation. In fact, once we account for the declining persistence of SUE over time, we no longer observe a significantly downward trend in PEAD over time.

3.4 Further Evidence Based on the Proportion of Firms with Persistent SUEs

In our main analyses, we focus on the decline of average SUE persistence (i.e., as captured by *Hedge SUE Pers*) each quarter over time. In this subsection, we reinforce these findings by offering evidence on the proportion of firms in each quarter with persistent SUE. We expect that firms staying in extreme SUE deciles should decline over time, and this decline should contribute to the attenuation of PEAD.

Specifically, we divide up our sample into "stayers" and "movers." Stayers are firm-quarter observations that are in SUE decile 1 (10) in quarter *q* and stay in SUE decile 1 (10) in quarter *q+1*. Movers are firm-quarter observations that are in SUE decile 1 (10) in quarter *q* and move out of SUE decile 1 (10) in quarter *q+1*. We first aggregate all stayers and all movers in quarter q separately in SUE decile 1 (i.e., short leg) and decile 10 (i.e., long leg), then test for the difference in future returns for stayers versus movers at the quarter level. Obviously, since we are conditioning on future earnings news, stayers (movers) in decile 10 should have higher (lower) future returns. Likewise, stayers (movers) in decile 1 should have lower (higher) future returns. Table 4 Panel A confirms these expectations. *Long Leg PEAD* for stayers is 0.087 and highly significant (t = 16.92), while for movers it is only 0.002 and insignificantly different from zero (t

= 0.74). Likewise, the average *Short Leg PEAD* for stayers is -0.054 and is highly significant (t = -13.73), while for movers it is 0.02 (t = 6.33). Not surprisingly, the two-sample t-tests show these differences are significant (t = 14.65 for the long leg; t = -14.67 for the short leg). Further, when we examine the difference in returns between the long leg and short leg, we again find that future returns for stayers (0.141; t = 25.85) are much higher than movers (-0.018; t = -5.77; t = 25.31 for the difference). Taken together, these results show that the PEAD returns are concentrated among firms who stay in the same extreme SUE deciles (i.e., stayers).

We next look at how the mix of stayers versus movers has changed over time. Using our fiscal quarter level sample of 185 observations we run the following regression:

$$\%Stayers_q = \alpha + \beta_1 Trend_q + \varepsilon \quad (3)$$

where *%Stayers* is the percentage of firm-quarter observations in extreme deciles that stay in their extreme decile for next quarter. If the percentage of stayers has gone down over time, we expect β_1 to be significantly negative. Table 4 Panel B presents the results. Columns 1 and 2 report the over-time trend in *%Stayers* for firm-quarters in the long and short legs, respectively. We find that the percentage of stayers has declined over time for both the long and short leg (Coeff. = -0.041 and t = -2.21 in Column 1; Coeff. = -0.054 and t = -2.89 in Column 2). Figure 3 visually shows the decline in *%Stayers* for the long leg and short leg separately. We see a sharp decline in *%Stayers* from mid-1980s through early 1990s for the short leg, and a more gradual and steady decline for the long leg through the sample period. The declining patterns for both legs triangulate the trend of *Hedge SUE Pers* in Figure 2. Overall, the results in this section show that the proportion of firms staying in the same extreme SUE deciles in each quarter has gone down over time, causing PEAD to decline over time.

3.5 Controlling for Arbitrage Trading

Thus far, we focus on establishing the decline of earnings persistence as a key explanation for the PEAD attenuation. However, as we discuss earlier, the prevailing explanation for the decline in PEAD is increased arbitrage trading. These two explanations are conceptually different and are both rooted in the seminal paper of Bernard and Thomas (1989). While it is possible (perhaps likely) that both contribute to the decline of PEAD, to establish earnings persistence as a distinct explanation, we need to show that our results hold after controlling for proxies of arbitrage trading. We run the following regression in our fiscal quarter sample:

$$Hedge\ PEAD_q = \alpha + \beta_1 Trend_q + \beta_2 Hedge\ SUE\ Pers_q + \sum Arb.Trading + \varepsilon \qquad (4a)$$

where ∑*Arb.Trading* is a vector of four control variables that proxy for arbitrage trading: *Hedge SIR* (e.g., Chordia et al. 2014), *Hedge Options* (Milian 2015), *Hedge Transient %* (e.g., Ke and Ramalingegowda, 2005), and *Hedge BHAR[0,+1]* (e.g., Ng et al. 2008; Martineau 2021). All four of these controls are calculated similarly to how we calculate *Hedge PEAD*, where each quarter we average the variable across all firms in the highest and lowest SUE decile (long leg and short leg) and then take the difference.

Our first control is *Hedge SIR* which captures variation in short selling activities using short interest data available from Compustat, which is available due to Financial Industry Regulatory Authority ("FINRA") Rule 4560. The advantage of this data is its long time series – it is available from January 1973 to now, enabling us to study the overall trend of short interest and its association with PEAD. As it is available in Compusat, this dataset is widely used in the prior literature (e.g., Senchack and Starks, 1993; Pownall and Simko, 2005). For each firm-quarter, we use the short interest ratio level (scaled by shares outstanding) for the closest settlement date to the earnings announcement date that falls within the window [+2, +31] days after the earnings announcement date. The idea with this variable is that arbitrage trading related to PEAD should encourage investors to short SUE decile 1 firms and avoid shorting SUE decile 10 firms. In other words, *Long Leg SIR* (*Short Leg SIR)* should be getting smaller (larger) over time as arbitrage trading increases. Thus, *Hedge SIR* should be growing more negative over time.

Our second control variable, *Hedge Options*, is the average open interest for call options for decile 10 firms each quarter plus the average open interest put options for decile 1 firms. This data is from OptionMetrics and we measure the open interest as of the EAD +1. Arbitrage trading related to PEAD should encourage investors to hold more call (put) options for the long (short) leg. Thus, *Hedge Options* should be growing more positive over time. Our third control variable, *Hedge Transient%*, is the average percentage of shares owned by transient institutions (defined by Bushee 1998) for decile 10 firms each quarter less the same average percentage for decile 1 firms. The ownership percentages are based on the first available 13F filings after the earnings announcement date. Arbitrage trading related to PEAD should motivate transient institutional investors to increase (decrease) ownership of firms in the SUE decile 10 (1). Thus, *Hedge Transient%* should be growing more positive over time. Our last arbitrage trading control variable is *Hedge BHAR[0,+1]*, which is the average earnings announcement day return for decile 10 firms each quarter less the average earnings announcement day return for decile 1 firms. This variable aims to measure price discovery around the earnings announcement date. If increased arbitrage trading is the primary driver of the decline in PEAD, then we should expect that there is more trading and greater price movement (i.e., price discovery) around the announcement date. Thus, *Hedge BHAR[0,+1]* should be increasing over time. The last three proxies are all positively associated with increased arbitrage trading and should be negatively related to PEAD.

Table 5 presents the results from equation (4a) where we regress *Hedge PEAD* on *Trend*, *Hedge SUE Pers*, and four arbitrage trading control variables. Columns 1 – 4 include only one arbitrage trading control at a time and column 5 includes all four of the controls. We see that *Hedge SUE Pers* continuously loads significantly positive at the 1% level across all columns. While the coefficients on the arbitrage trading control variables are all going in the direction expected (i.e., positive for *Hedge SIR* and negative for the other three controls), only *Hedge Transient%* in Columns 2 and 5 is significant. This evidence suggests that the decline in SUE persistence remains an important explanation for the decline in PEAD even after controlling for arbitrage trading.

3.6 Earnings Persistence and Arbitrage Trading in the Short-leg of PEAD

One may argue that Table 5 is insufficient to control for the role of arbitraging activities, because the noise in measuring arbitrage trading reduces the power of tests. Indeed, it is difficult to capture all forms of arbitraging trading related to PEAD, particularly for the long leg (e.g., institutional holding information is only available on a quarterly basis). To alleviate this concern, we focus in on the short leg of PEAD and short selling. This setting has three advantages. First, consistent with the decline of *Hedge PEAD,* returns to the short leg of PEAD have declined consistently over time in magnitude. Second, we have comprehensive short interest data at the stock level, reported monthly or bi-monthly, going back to the 1970s. Third, and most important, short selling is a key form of arbitrage trading related to low SUE stocks (Chordia et al. 2014). In fact, conceptually, most forms of arbitrage trading for firms with bad earnings news should involve short selling at or soon after the earnings announcement date.[6] We therefore estimate the following two regressions to control for the arbitrage trading explanation in the short leg:

$$Short\ Leg\ SIR_q = \alpha + \beta_1 Trend_q + \varepsilon \quad (4b)$$

$$Short\ Leg\ PEAD_q = \alpha + \beta_1 Trend_q + \beta_2 Short\ Leg\ SIR_q$$

[6] As mentioned earlier, arbitrageurs could also build bearish positions in low SUE stocks using put options. It is worth highlighting that options are not always available, expire quickly, and are potentially very expensive.

$$+\beta_3 Short\ Leg\ SUE\ Pers_q + \varepsilon \qquad (4c)$$

where equation (4b) tests for an increase in *Short Leg SIR* over time and equation (4c) tests whether *Short Leg SUE Pers* remains a strong predictor for the decline in *Short Leg PEAD* in the presence of *Short Leg SIR.* Since arbitrage trading is increasing over time, we expect that short sellers are increasingly targeting the short leg (positive β_1 in equation 4a). If the decline in SUE persistence is a valid explanation for the decline in PEAD, we expect β_3 in equation (4c) to remain significantly positive.

Table 6 reports the results. In Panel A, we regress *Short Leg SIR* on *Trend* in Column 1, which loads significantly positive (Coeff. = 0.022; t = 21.16).[7] This is consistent with prior papers that document an increase in arbitrage trading activities over time (e.g., Chordia et al. 2014). For ease of presentation, we again regress *Short Leg SUE Pers* on *Trend* in Column 2 (identical to the regression in Table 3 Panel A Column 2), showing that *Trend* loads significantly positive (Coeff. = 0.005; t = 6.61), indicating that SUE persistence in the short leg has declined over time (i.e., next quarter's predicted SUE decile is getting closer to the middle of the SUE distribution).

In Table 6 Panel B, we estimate equation (4c) to examine the impact of *Short Leg SIR* and *Short Leg SUE Pers* on *Short Leg PEAD.* Column 1 regresses *Short Leg PEAD* on *Trend,* which loads significantly positive (Coeff. = 0.018; t = 3.20), showing that *Short Leg PEAD* is getting closer to zero over time (i.e., less negative). In Column 2 (3) we regress *Short Leg PEAD* on *Short Leg SIR* (*Short Leg SUE Pers*) and find that both coefficients load significantly positive, suggesting that *Short Leg PEAD* in a given period is smaller (i.e., closer to zero) when the *Short Leg SIR* or *Short Leg SUE Pers* is higher. However, when we include the *Trend* variable in Column 4, *Short Leg SIR* becomes insignificant (Coeff. = 0.019; t = 0.06) while the *Trend* variable remains

[7] In untabulated analyses, we obtain qualitatively similar results by requiring the closest settlement date to the earnings announcement date that falls within the window [+2, +5] or [+2, +10] days after the earnings announcement date.

significant. In contrast, in Column 5, *Short Leg SUE Pers* continues to load (Coeff. = 2.708; t = 3.99), while the *Trend* variable becomes insignificant. In Column 6 we "horse race" the two explanations and find that only *Short Leg Pers* loads (Coeff. = 2.708; t = 3.99). Taken together, we find corroborating evidence the decline in SUE persistence is a strong explanation for the decline in PEAD after controlling for arbitrage trading. In fact, this evidence suggests that the decline in SUE Persistence may play a bigger role in PEAD's attenuation than increased arbitrage trading, at least in the short leg where we can better identify arbitraging activities.

3.7 Additional Tests on the SUE Persistence Explanation

3.7.1 Evidence Based on Firm-quarter Panel Data

In the main analyses, we collapse firm-quarter level observations into quarterly level observations to form hedge portfolios and conduct time-series analyses. We choose this research design over a panel-data approach because: a) we are interested primarily in the time-series decline of PEAD and b) it makes forming a hedge portfolio based on PEAD much easier. It also offers a statistical advantage: any effect of cross-firm correlation in returns on standard errors is accounted for by the time-series variation in average quarterly returns (Fama and MacBeth 1973). Nevertheless, we follow Beaver et al. (2018; 2020) in this subsection and repeat our main analyses using firm-quarter level panel data. As we cannot conduct "hedge" analyses at the firm-quarter level, we examine the observations in long and short legs separately in this subsection.

To measure PEAD and SUE persistence at a firm-quarter level, we simply take the firm-quarter level variables we use to construct the average quarterly level variables. Specifically, we use *BHAR[+2, next EAD+1]* to measure PEAD at the firm-quarter level. We label it for firm-quarters in the highest (lowest) SUE decile as *Long (Short) Leg BHAR[+2, next EAD+1]*. Similarly, we use a firm-quarter observation's SUE decile rank in q+1 to measure SUE persistence at the firm-quarter level. We label it for firm-quarters in the highest (lowest) SUE decile as *Long (Short) Leg SUE* $Pers_{Panel}$.

Table 7 presents the results based on firm-quarter level panel data. Panel A Column 1 (2) shows that firms in the SUE decile 1 (10) for the current quarter are increasingly moving to higher (lower) deciles next quarter over time, confirming the inference based on earlier time-series analyses that the persistence of earnings news has declined over time. Panel B reports the relation between *BHAR[+2, next EAD+1]* and *Trend* as well as firm-quarter level SUE persistence. For both the short leg in Columns 1-3 and long leg in Columns 4-6, we first confirm that PEAD becomes smaller over time, then we show that SUE persistence metric is significantly associated with PEAD, and finally we show that including SUE persistence eliminates the significance on *Trend.* Taken together, results in Table 7 confirm that our key inferences remain robust using firm-quarter level panel data.

3.7.2 PEAD in Immediate versus Later Windows

In our tests above, we follow the great majority of the PEAD literature starting from Bernard and Thomas (1989) and measure PEAD up to the subsequent earnings announcement.[8] Such a long window captures both the impact of arbitraging activities, which are more likely to take place right after the current earnings announcement, and the market's gradual reaction to future earnings news as it arrives over the following quarter. As an alternative way to assess the importance of declining SUE persistence, we split the entire PEAD window into an earlier versus later period. A decline in PEAD in the later part of the PEAD window is likely more attributable to the earnings persistence explanation, as investors have less to be surprised about over the next

[8] The PEAD window ends on the first trading date after the subsequent earnings announcements. Untabulated analyses confirm that our results are qualitatively the same if the window ends on the trading date prior to the subsequent earnings announcements, or 60 trading days after the current earnings announcements.

quarter as future earnings news arrives (e.g., Soffer and Lys 1999).

In Table 8 Panel A, we split the PEAD window into an immediate window of [+2, +6] as in Boehmer and Wu (2013) and a subsequent later window of [+7, next EAD + 1].[9] We then calculate the *Hedge PEAD* as the average buy-and-hold abnormal returns for the long leg less the short leg in those windows, respectively. We find that the decline of PEAD is concentrated in the later windows (Coeff. = -0.027; t = -4.68 in Column 3), and surprisingly, the immediate *Hedge PEAD* grows stronger over time (Coeff. = 0.006; t = 3.92 in Column 1). Further, when we include *Hedge SUE Pers* in the regressions, it loads significantly positive in both PEAD windows. Importantly, it eliminates the significance and greatly reduces the magnitude of *Trend* in Column 4 but does not do so in Column 2. Thus, the attenuation in PEAD happens much later in the quarter, when future earnings news more likely arrives. These results, which are new to the literature, provide additional evidence supporting the earnings persistence explanation.

3.7.3 Splitting Microcap versus non-Microcap Stocks

Market anomalies are usually more concentrated in smaller firms (e.g., Fama and French 2008; Hou et al. 2020). PEAD is no exception – Martineau (2021) shows that PEAD disappears earlier for larger firms than for microcap firms. To assess the role of firm size in our explanations for the decline of PEAD, we follow Martineau (2021) and split the sample into microcap firms and non-microcap firms based on the market cap of the 20th percentile for NYSE stocks. In Table 8 Panel B, we first show that there is a decline in *Hedge PEAD* for both subsamples (Columns 1 and 3), although insignificantly so for microcap firms based on a two-tailed test.[10] More importantly,

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[9] We confirm these results hold when we split the window as [+2, +11] and [+12, next EAD +1], again as in Boehmer and Wu (2013). We keep those results untabulated for brevity.

[10] It is worth noting that *Trend* is significant at the 10% level based on a one-tailed test as in Chordia et al. (2014). Further, when we winsorize the quarterly *Hedge PEAD* at 1/99% to limit the influence of extreme quarters (e.g., during the financial crisis), *Trend* becomes significant for microcap firms at the 5% level based on a two-tailed test.

Columns 2 and 4 show that *Hedge SUE Pers* is significant in both subsamples. For non-micro stocks, the role of earnings persistence seems to be less dramatic: the *Trend* variable continues to load significantly at the 10% after including *Hedge SUE Pers* in Column 4.[11] This is hardly surprising, as other factors such as increased arbitraging trading could also play important roles in explaining the decline of PEAD among larger firms.

3.7.4 Analyst-based SUE

Although most prior work on PEAD uses quarterly earnings changes to measure SUE, some more recent studies measure SUE based upon analyst forecast surprises and report significant, and often stronger, drift with this measure (e.g., Livnat and Mendenhall 2006). We decided to use a traditional random-walk-based PEAD in our main tests, rather than analyst-based PEAD, for two reasons. First, analyst-based PEAD requires analyst forecasts data and thus exclude smaller stocks without analyst coverage, where PEAD is most prevalent (see Fink 2021). Second, because analyst-based PEAD is driven by the long leg (Doyle et al. 2006), it is a related but distinct phenomenon from the traditional random-walk-based PEAD.

Nevertheless, our main inference remains robust even when we define SUE based on analyst forecasts. In Table 8 Panel C, we re-run our tests in Table 5 using analyst-based SUE to create SUE deciles and define SUE persistence.[12] We find that *Hedge PEAD* has declined over time (Column 1). Importantly, we find that *Hedge SUE Pers* is significantly associated with *Hedge PEAD* (Column 2), and drives away the significance of *Trend* (Column 3), even after controlling for arbitrage trading proxies (Column 4). Taken together, those results show that declining

[11] If we winsorize the quarterly *Hedge PEAD at 1/99%* in Column 4, *Trend* becomes insignificant for non-microcap firms at the 10% level based on a two-tailed test.

[12] To capture this, we regress the future change in quarterly earnings on decile ranks of current SUE based on analyst forecast errors (actual earnings less the most recent consensus). We predict changes in future earnings, rather than future analyst forecast errors, because: a) the former better captures the total future earnings news over the whole quarter while the latter captures news as of the end of the quarter, and b) we found that SUE-based on analyst forecasts predicts quarterly earnings changes more persistently than future analyst forecast errors.

persistence of earnings news is a key driver for the attenuation of analyst-based PEAD as well.

4. Conclusion

As the oldest and most famous of all anomalies (Fama 1998), PEAD has attracted enormous attention from researchers in both accounting and finance in the past several decades. Although prior work finds PEAD to be persistent and robust in different time periods and different markets (Fink 2021), recent research finds that the magnitude of PEAD has declined significantly in the past four decades, and has perhaps even disappeared (e.g., Richardson et al. 2010; Martineau 2021). The prevailing explanation for the attenuation of PEAD is that increased liquidity has allowed arbitrage investors like hedge funds to increasingly trade on the PEAD signal, thereby decreasing the price drift following earnings announcements.

After confirming the clear decline of PEAD, we propose an alternative explanation based on earnings news persistence. Due to the fundamental shifts in the real economy and accounting standards, prior researchers have documented that earnings persistence of US public firms have declined over time. As a result, the earnings news in the current fiscal periods should become less useful in predicting future earnings news, leaving the PEAD signal less informative. To test this explanation, we measure the persistence of earnings news using the average SUE decile ranks in the next quarter for those firms currently in the top and bottom SUE deciles. Based on this measure, we find declining earnings news persistence can explain away the declining trend of PEAD. As further triangulating evidence, we find that the proportion of firms staying in the extreme SUE deciles also declines over time, and those firms with persistent SUEs are the main source of PEAD.

To ensure that the newly-proposed explanation based on earnings persistence is distinct from the prevailing explanation based on arbitrage trading, we conduct two sets of analyses. First, we explicitly control for four different proxies of arbitraging trading used in the literature, and we find that our inferences remain. Second, we focus on the short leg of the anomaly, where we can better identify arbitraging activities based on short interest, and our inference continues to hold.

Taken together, we conclude that the decline of earnings persistence is a key driver behind the attenuation of PEAD, which is different from, and potentially stronger than, the explanation based increased arbitrage. Our findings may have implications for other anomalies as well, particularly those based on earnings signals.

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Appendix 1
Variable definitions

Quarter-Level Variables	
Trend	A linear time trend variable that increments by 1 for each subsequent fiscal quarter.
Short Leg PEAD	The cumulative buy-and-hold return from trading day [+2] after the earnings announcement date through the day [+1] after the next earnings announcement date, less the matching size/BTM portfolio return. This is averaged across firms in the lowest SUE decile for each fiscal quarter.
Long Leg PEAD	The cumulative buy-and-hold return from trading day [+2] after the earnings announcement date through the day [+1] after the next earnings announcement date, less the matching size/BTM portfolio return. This is averaged across firms in the highest SUE decile for each fiscal quarter.
Hedge PEAD	*Long Leg PEAD* minus *Short Leg PEAD.*
Short Leg SUE Pers	The average SUE decile ranks in the next quarter for all firms in the bottom SUE deciles in the current quarter
Long Leg SUE Pers	The average SUE decile ranks in the next quarter for all firms in the top SUE deciles in the current quarter
Hedge SUE Persistence	*Long Leg SUE Pers* minus *Short Leg SUE Pers*
Short Leg SIR	The short interest ratio level (scaled by shares outstanding) for the closest settlement date to the earnings announcement date that falls within the window [+2,+31] days after the earnings announcement date. This is averaged across firms in the lowest SUE decile for each fiscal quarter and multiplied by 100. This data is from Compustat's *sec_shortint* file. Observations with missing short interest data are excluded in constructing this variable.
Long Leg SIR	The short interest ratio level (scaled by shares outstanding) for the closest settlement date to the earnings announcement date that falls within the window [+2,+31] days after the earnings announcement date. This is averaged across firms in the highest SUE decile for each fiscal quarter and multiplied by 100. This data is from Compustat's *sec_shortint* file. Observations with missing short interest data are excluded in constructing this variable.
Hedge SIR	*Long Leg SIR* minus *Short Leg SIR*
Long Leg Call	The number of open interest contracts of call options as of the [+1] trading day after the current earnings announcement date, scaled by the number of shares outstanding as of the end of the fiscal quarter. This is averaged across firms in the highest SUE decile for each fiscal quarter.
Short Leg Put	The number of open interest contracts of put options as of the [+1] trading day after the current earnings announcement date, scaled by the number of shares outstanding as of the end of the fiscal quarter. This is averaged across firms in the lowest SUE decile for each fiscal quarter.
Hedge Options	*Long Leg Call* plus *Short Leg Put*
Long Leg Transient%	The transient institutional ownership as a percentage of total shares outstanding for the date after, but closest to, the earnings announcement. This is averaged across firms in the highest SUE decile for each fiscal quarter.
Short Leg Transient%	The transient institutional ownership as a percentage of total shares outstanding for the date after, but closest to, the earnings announcement. This is averaged across firms in the lowest SUE decile for each fiscal quarter.
Hedge Transient%	*Long Leg Transient%* minus *Short Leg Transient%*

Long Leg BHAR[0,+1]	The cumulative buy-and-hold return from the earnings announcement date [0] through the next trading day [+1], less the matching size/BTM portfolio return. This is averaged across firms in the highest SUE decile for each fiscal quarter.
Short Leg BHAR[0,+1]	The cumulative buy-and-hold return from the earnings announcement date [0] through the next trading day [+1], less the matching size/BTM portfolio return. This is averaged across firms in the lowest SUE decile for each fiscal quarter.
Hedge BHAR[0,+1]	*Long Leg BHAR[0,+1]* minus *Short Leg BHAR[0,+1]*

FIRM-QUARTER LEVEL VARIABLES	
SUE	The standardized unexpected earnings, calculated as the change in quarterly income before extraordinary items (IBQ) relative to the same quarter in the prior year scaled by the market value of equity at the quarter-end in the prior year.
Dec SUE	A categorical variable that takes a value of 1-10, as defined by the SUE decile a firm falls into in a given fiscal quarter.
Short Leg SUE $Pers_{Panel}$	The SUE decile in quarter q+1 for firms in the bottom SUE decile.
Long Leg SUE $Pers_{Panel}$	The SUE decile in quarter q+1 for firms in the top SUE decile.
Short Leg BHAR[+2, next EAD+1]	The cumulative buy-and-hold return from trading day [+2] after the earnings announcement date through the day [+1] after the next earnings announcement date, less the matching size/BTM portfolio return. This is for firm-quarters in SUE decile 1.
Long Leg BHAR[+2, next EAD+1]	The cumulative buy-and-hold return from trading day [+2] after the earnings announcement date through the day [+1] after the next earnings announcement date, less the matching size/BTM portfolio return. This is for firm-quarters in SUE decile 10.

Table 1: Sample selection and summary statistics

Panel A: Sample selection

Firm-Quarter Sample Selection:		
Criteria	Number of firm-quarters	
Compustat firm-quarter universe 1974-2020 where RDQ is before 2021		1,387,502
Drop if missing assets or sales <0	(103,530)	
Drop if exchange is not NYSE, AMEX, or NASDAQ	(511,405)	
Drop if missing share price	(98,948)	
Drop if share price is less than $1	(21,603)	
Drop if missing shares outstanding	(11,205)	
Drop if market value <$5M	(7,456)	
Drop if missing earnings announcement date (RDQ in Compustat)	(19,929)	
Drop if missing permno	(11,489)	
Drop if missing calendar quarter	(261)	
Drop if missing fiscal quarter	(52)	
Drop if firm-quarter not assigned a size/BTM portfolio	(74,796)	
Final firm-quarter sample		**526,828**

Quarter Sample Selection		
Criteria	Number of fiscal quarters	
Collapsed firm-quarter sample by fiscal quarter		189
Drop if missing variables for quarter-level regressions	(4)	
Final quarter sample		**185**

Panel B: Summary statistics for quarterly-level variables

Variables	N	Mean	P1	P25	P50	P75	P99	StDev
Hedge PEAD	185	0.044	-0.060	0.015	0.039	0.069	0.182	0.046
Hedge SUE Pers	185	3.189	0.584	2.451	3.344	3.904	5.524	0.973
Hedge SIR	185	-0.062	-2.589	-0.781	-0.109	0.572	2.540	0.969
Hedge Options	185	0.008	0.000	0.000	0.004	0.016	0.033	0.009
Hedge Transient %	185	0.007	-0.016	0.000	0.007	0.012	0.031	0.008
Hedge BHAR[0,+1]	185	0.035	0.001	0.024	0.033	0.042	0.090	0.019
Short Leg PEAD	185	-0.007	-0.097	-0.031	-0.010	0.008	0.162	0.044
Long Leg PEAD	185	0.036	-0.065	0.011	0.029	0.057	0.183	0.044
Short Leg SUE Pers	185	4.040	2.763	3.653	4.022	4.487	5.465	0.607
Long Leg SUE Pers	185	7.230	5.821	6.805	7.251	7.644	8.513	0.608
Short Leg SIR	185	2.975	0.234	1.842	2.929	3.942	6.431	1.456

This table presents the sample selection and summary statistics for our sample from 1974-2020. Panel A presents the sample selection. We have a final firm-quarter sample of 526,715 observations, which varies in subsequent tables due to missing variables. We have a final fiscal quarter sample of 185 observations. Panel B presents the summary statistics for the fiscal quarter-level variables.

Table 2: Trend of Hedge PEAD

	(1)	(2)
Dep. Var.	*Hedge PEAD*	*Log(1+Hedge PEAD)*
Trend	-0.020***	-0.019***
	(-3.06)	(-3.06)
Constant	6.238***	5.968***
	(8.49)	(8.57)
Observations	185	185
R-squared	0.054	0.054

This table presents the trend in *Hedge PEAD* (i.e., *Long Leg PEAD* minus *Short Leg PEAD*) at the quarterly level from 1974-2020. The *Hedge PEAD* is calculated as follows: the *BHAR[+2, next EAD +1]* is calculated for every firm-fiscal quarter observation; the *BHAR* is then averaged across each fiscal quarter and extreme SUE deciles; finally, the average *BHAR* for SUE Dec1 is subtracted from the average *BHAR* for SUE Dec10 in each fiscal quarter to arrive at the *Hedge PEAD*. We use *Hedge PEAD* (the log of *Hedge PEAD* plus one) as the dependent variable in Column 1 (2). *Trend* is a linear time trend variable. Coefficients are multiplied by 100 for ease of presentation. Robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are in Appendix A.

Table 3: SUE persistence as the explanation for the decline of PEAD

Panel A: Hedge SUE persistence over time

	(1)	(2)	(3)
Dep. Vars.	*Hedge SUE Pers*	*Short Leg SUE Pers*	*Long Leg SUE Pers*
Trend	-0.011***	0.005***	-0.006***
	(-9.73)	(6.61)	(-6.72)
Constant	4.233***	3.519***	7.752***
	(33.28)	(37.27)	(92.83)
Observations	185	185	185
R-squared	0.366	0.235	0.235

Panel B: Hedge SUE persistence and hedge PEAD

	(1)	(2)	(3)
Dep. Var.		*Hedge PEAD*	
Trend	-0.020***		0.008
	(-3.06)		(1.08)
Hedge SUE Pers		2.259***	2.521***
		(7.64)	(7.02)
Constant	6.238***	-2.853***	-4.432***
	(8.49)	(-3.11)	(-2.75)
Observations	185	185	185
R-squared	0.054	0.231	0.237

This table looks at the decline in SUE persistence as an explanation for the decline in PEAD. Panel A presents the trend of *Hedge SUE Pers* (*Long Leg SUE Pers* minus *Short Leg SUE Pers*), *Short Leg SUE Pers*, and *Long Leg SUE Pers*. Panel B presents the impact of *Hedge SUE Pers* on *Hedge PEAD.* Column (1) is a duplicate regression from Table 2 column (1) for ease of interpretation. In Panel B, the coefficients are multiplied by 100 for ease of presentation. Robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are in Appendix A.

Table 4: Hedge PEAD for stayers versus movers

Panel A: T-tests of PEAD for stayers versus movers

	Stayers (N = 185)		Movers (N = 185)		Diff	
	Mean	*t*-stat	Mean	*t*-stat	Mean	*t*-stat
Long Leg	0.087	16.915***	0.002	0.739	0.085	14.650***
Short Leg	-0.054	-13.729***	0.020	6.330***	-0.074	-14.668***
Hedge (Long – Short)	0.141	25.85***	-0.018	-5.77***	0.159	25.31***

Panel B: Trend in stayers

	(1)	(2)
Sub-sample	Dec 10	Dec 1
Dep. Var.	*% Stayers*	
Trend	-0.041**	-0.054***
	(-2.21)	(-2.89)
Constant	39.750***	37.770***
	(18.90)	(17.82)
Observations	185	185
R-squared	0.029	0.049

This table looks at *Hedge PEAD* broken out by "stayers" and "movers". Stayers are firm-quarter observations that are in SUE decile 1 (10) in quarter *q* and stay in SUE decile 1 (10) in quarter *q+1*. Movers are firm-quarter observations that are in SUE decile 1 (10) in quarter *q* and move out of SUE decile 1 (10) in quarter *q+1*. *Hedge PEAD* for stayers (movers) is calculated as the quarterly average *BHAR[+2, next EAD +1]* for SUE decile 10 stayers (movers) less the quarterly average *BHAR [+2, next EAD +1]* for SUE decile 1 stayers (movers). Panel A presents the t-tests of quarterly *Long Leg PEAD* for stayers versus movers, quarterly *Short Leg PEAD* for stayers versus movers, and the quarterly *Hedge PEAD* for the stayers versus movers. Panel B presents the trend in the % of observations that are stayers. The *%Stayers* is calculated as the percentage of observations each quarter that are in SUE decile 1 (column 1) or decile 10 (column 2) and stay in that same extreme decile next quarter. The coefficients in Panel B are multiplied by 100 for ease of presentation. Robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively Variable definitions are in Appendix.

Table 5: Controlling for arbitrage trading proxies

	(1)	(2)	(3)	(4)	(5)
Dep. Var.			*Hedge PEAD*		
Trend	0.012	0.008	-0.001	0.013	0.026
	(1.47)	(0.33)	(-0.11)	(1.46)	(0.98)
Hedge SUE Pers	2.453***	2.614***	2.544***	2.640***	3.312***
	(7.00)	(4.32)	(6.19)	(6.89)	(4.33)
Hedge SIR	0.582				0.558
	(1.50)				(0.98)
Hedge Options		-23.552			-57.628
		(-0.36)			(-0.90)
Hedge Transient %			-65.144*		-88.658**
			(-1.90)		(-2.33)
Hedge BHAR[0,+1]				-22.966	-6.273
				(-0.93)	(-0.12)
Constant	-4.528***	-4.524	-2.886*	-4.549***	-7.342*
	(-2.87)	(-1.15)	(-1.78)	(-2.79)	(-1.81)
Observations	185	103	155	185	96
R-squared	0.249	0.241	0.268	0.243	0.304

This table presents the impact of *Hedge SUE Pers* on *Hedge PEAD* while controlling for various proxies of arbitrage trading. Column (1) controls for hedge short interest levels, column (2) controls for hedge options, column (3) controls for hedge transient percentage ownership, column (4) controls for the hedge returns at the earnings announcement date (defined using the cumulation window *BHAR[0,+1]*), and column (5) includes all arbitrage trading proxies. Sample size varies due to missing data. Robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. The coefficients are multiplied by 100 for ease of presentation. Variable definitions are in Appendix A.

Table 6: Time series analyses focused on the short leg

Panel A: Trend in Short Leg SIR and Short Leg SUE Pers

	(1)	(2)
Dep. Vars.	*Short Leg SIR*	*Short Leg SUE Pers*
Trend	0.022***	0.005***
	(21.16)	(6.61)
Constant	0.868***	3.519***
	(7.62)	(37.27)
Observations	185	185
R-squared	0.666	0.235

Panel B: The impact of Short Leg SIR and Short Leg SUE Pers on Short Leg PEAD

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	*Short Leg PEAD*					
Trend	0.018***			0.017*	0.003	0.002
	(3.20)			(1.86)	(0.49)	(0.27)
Short Leg SIR		0.541**		0.019		0.026
		(2.58)		(0.06)		(0.08)
Short Leg SUE Pers			2.833***		2.708***	2.708***
			(4.70)		(3.99)	(3.98)
Constant	-2.388***	-2.307***	-12.144***	-2.404***	-11.915***	-11.938***
	(-4.68)	(-3.71)	(-5.20)	(-3.95)	(-4.88)	(-4.89)
Observations	185	185	185	185	185	185
R-squared	0.047	0.032	0.152	0.047	0.153	0.153

This table presents time series analyses focused on the short leg. Panel A presents the trend in *Short Leg SIR* (column 1) and *Short Leg SUE Pers* (column 2). Column (2) is a duplicate regression from Table 3 Panel B column (2) for ease of interpretation. Panel B column 1 presents the trend in *Short Leg PEAD*. Columns (2) – (6) show the impact *Short Leg SIR* and *Short Leg SUE Pers* have on *Short Leg PEAD* over time. The coefficients in Panel B are multiplied by 100 for ease of presentation. In both panels, robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are in Appendix A.

Table 7: Results based on firm-quarter level panel data

Panel A: Trend in SUE Persistence using panel data

	(1)	(2)
Dep. Vars.	*Short Leg SUE Pers$_{Panel}$*	*Long Leg SUE Pers$_{Panel}$*
Trend	0.005***	-0.006***
	(6.37)	(-5.55)
Constant	3.576***	7.765***
	(37.90)	(70.65)
Observations	47,711	46,536
R-squared	0.006	0.008

Panel B: Trend in BHAR using panel data

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Vars.	*Short Leg BHAR[+2, next EAD+1]*			*Long Leg BHAR[+2, next EAD+1]*		
Trend	0.017**		0.011	-0.013**		-0.005
	(2.21)		(1.46)	(-2.41)		(-0.84)
Short Leg SUE Pers$_{Panel}$		1.223***	1.212***			
		(16.95)	(17.63)			
Long Leg SUE Pers$_{Panel}$					1.339***	1.333***
					(19.94)	(19.60)
Constant	-1.666***	-4.891***	-6.029***	5.105***	-5.856***	-5.286***
	(-2.68)	(-9.92)	(-8.67)	(7.94)	(-14.70)	(-7.30)
Observations	46,570	46,552	46,552	45,722	45,703	45,703
R-squared	0.001	0.017	0.017	0.000	0.018	0.018

This table looks at the decline in SUE persistence as an explanation for the decile in PEAD using panel data at the firm-quarter level. Results are presented separately for firm-quarters in SUE decile 1 versus SUE decile 10. Panel A presents the trend of *Short Leg SUE Pers$_{Panel}$* and *Long Leg SUE Pers$_{Panel}$* using observations at the firm quarter level. Panel B presents the impact of *Short Leg SUE Pers$_{Panel}$* on *Short Leg BHAR[+2, next EAD +1]* in columns 1-3 and the impact of *Long Leg SUE Pers$_{Panel}$* on *Long Leg BHAR[+2, next EAD +1]* in columns 4-6. In Panel B, coefficients are multiplied by 100 for ease of presentation. In both panels, standard errors are clustered by firm and fiscal quarter and are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are in Appendix A.

Table 8: Additional analyses

Panel A: PEAD in immediate versus later windows

	(1)	(2)	(3)	(4)
BHAR cum. window	[+2, +6]		[+7, next EAD+1]	
Dep. Var.	*Hedge PEAD*			
Trend	0.006***	0.009***	-0.027***	-0.003
	(3.92)	(4.21)	(-4.68)	(-0.46)
Hedge SUE Pers		0.289***		2.201***
		(2.77)		(7.10)
Constant	-0.207	-1.430***	6.450***	-2.867**
	(-1.41)	(-2.89)	(9.61)	(-2.08)
Observations	185	185	185	185
R-squared	0.088	0.129	0.115	0.276

Panel B: Microcap versus non-microcap split

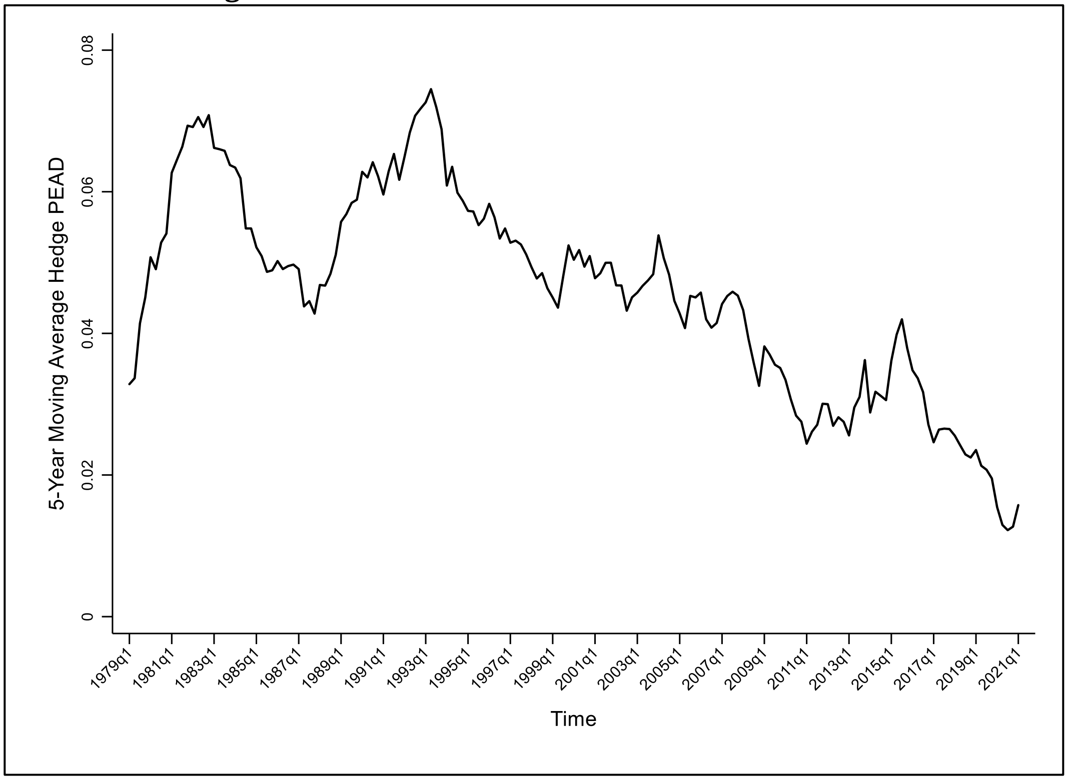
	(1)	(2)	(3)	(4)
Sub-Sample	Microcap	Microcap	Non-Microcap	Non-Microcap
Dep. Var.	*Hedge PEAD*			
Trend	-0.014	0.015	-0.031***	-0.019*
	(-1.42)	(1.30)	(-3.57)	(-1.66)
Hedge SUE Pers		2.780***		0.959**
		(5.11)		(2.08)
Constant	7.107***	-4.502*	4.719***	0.636
	(6.43)	(-1.79)	(5.12)	(0.28)
Observations	184	184	185	185
R-squared	0.014	0.145	0.075	0.098

Panel C: Analyst-based SUE

	(1)	(2)	(3)	(4)
Dep. Var.		*Hedge PEAD*		
Trend	-0.026***		-0.013	-0.008
	(-2.94)		(-1.44)	(-0.39)
Hedge SUE Pers		2.486***	2.258***	3.090***
		(3.92)	(3.60)	(3.32)
Hedge SIR				41.581
				(1.25)
Hedge Options				20.127
				(0.42)
Hedge Transient %				-5.685
				(-0.10)
Hedge BHAR[0,+1]				-9.281
				(-0.32)
Constant	6.922***	-0.183	1.697	-0.131
	(6.29)	(-0.16)	(0.91)	(-0.05)
Observations	148	148	148	95
R-squared	0.063	0.190	0.205	0.268

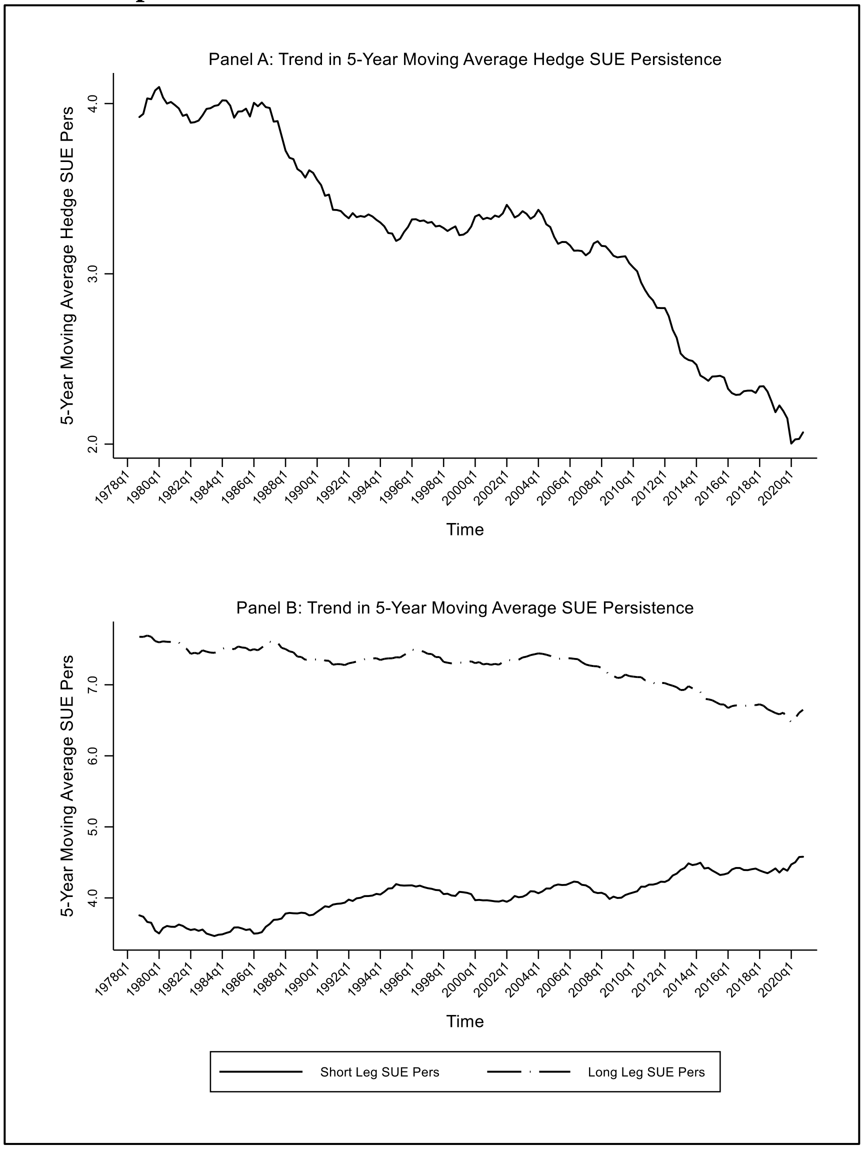
This table present additional analyses. Panel A presents the trend in short-window and long-window *Hedge PEAD*; the shorter-window dependent variable in columns (1) and (2) is calculated using *BHAR[+2, +6]* and the longer-window dependent variable in columns (3) and (4) is calculated using *BHAR[+7, next EAD +1]*. Panel B presents the trend in *Hedge PEAD*, defined using the cumulation window *BHAR[+2, next EAD +1]* split between microcap and non-microcap firms. Panel C presents the time series analyses of *Hedge PEAD* defined based on analyst-based SUE. For all panels, robust t-statistics are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. The coefficients are multiplied by 100 for ease of presentation. Variable definitions are in Appendix A.

Figure 1: Trend in Hedge PEAD



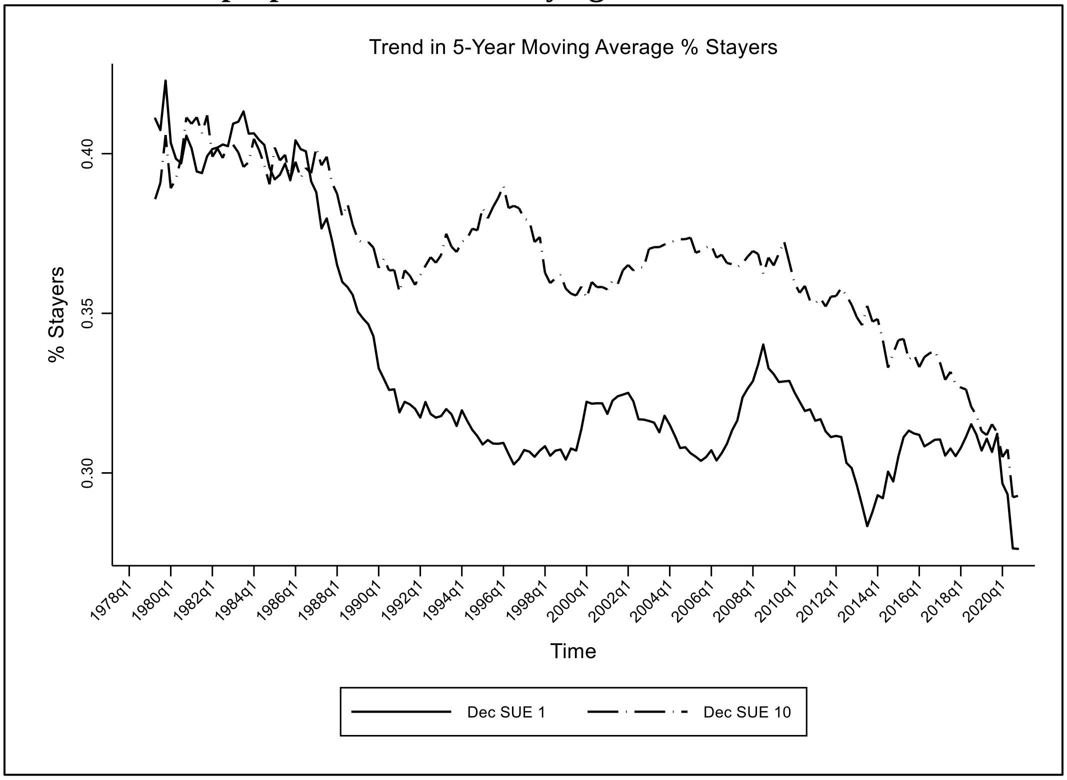
This figure presents the trend in the 5-year moving average of *Hedge PEAD* calculated using cumulation window *BHAR[+2, next EAD +1]* from 1978Q1 – 2020Q4. The figure starts in 1978Q1 to allow for 5 years (i.e., 20 quarters) of data to compute the 5-year moving average.

Figure 2: Trend in SUE persistence



This figure presents the trend in the 5-year moving average of SUE persistence from 1978Q1 – 2020Q4. The figure starts in 1978Q1 to allow for 5 years (i.e., 20 quarters) of data to compute the 5-year moving average. SUE persistence is defined as the average SUE decile in q+1. Thus, the y-axis represents the average next-quarter decile rank. Panel A presents the trend in *Hedge SUE Pers* (*Long Leg SUE Pers* minus *Short Leg SUE Pers*). In Panel B, the solid line is the 5-year moving average of *Short Leg SUE Pers* and the dash-dot line is the 5-year moving average of *Long Leg SUE Pers*.

Figure 3: Trend in the proportions of firms staying in the extreme SUE deciles



This figure presents the trend in the 5-year moving average of *%Stayers* from 1978Q1 – 2020Q4. The figure starts in 1978Q1 to allow for 5 years (i.e., 20 quarters) of data to compute the 5-year moving average. The *%Stayers* is calculated as the percentage of observations each quarter that are in SUE decile 1 (solid line) or decile 10 (dash-dot line) and stay in that same extreme decile next quarter.