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A Review of the Post-Earnings-Announcement Drift

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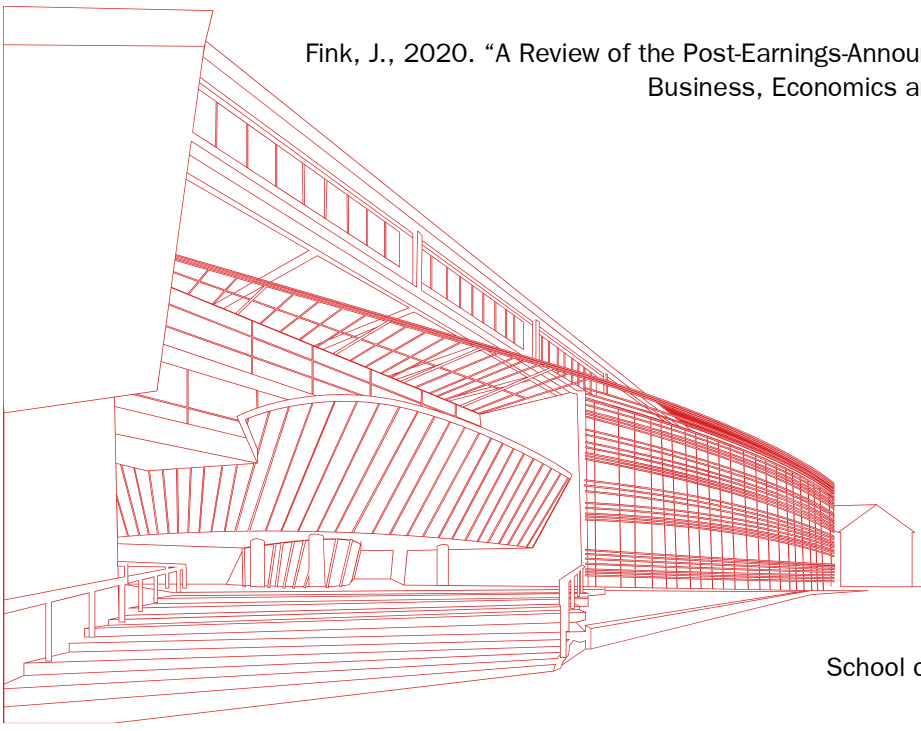

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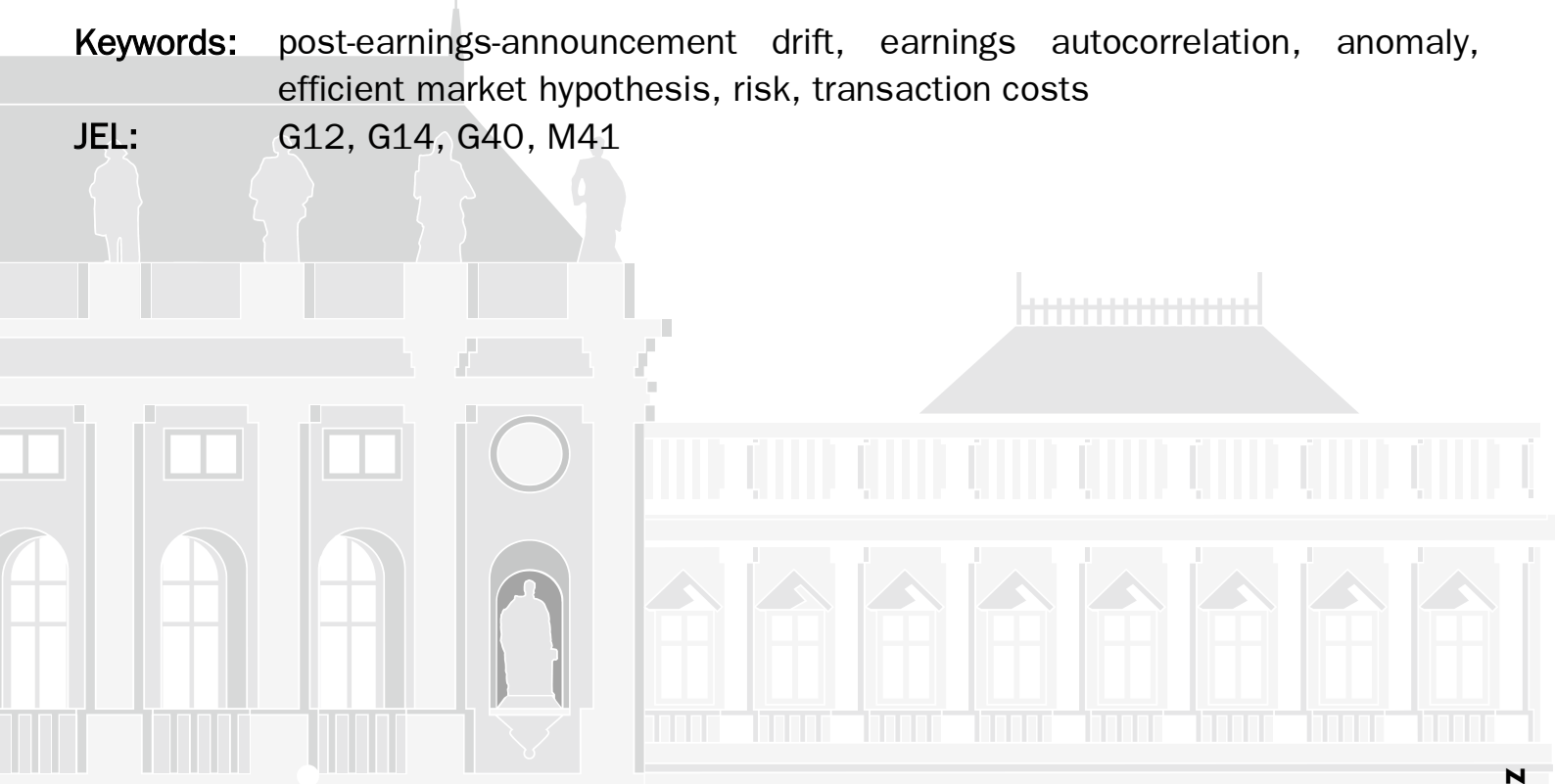
JEL: G12, G14, G40, M41



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A Review of the Post-Earnings-Announcement Drift

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The objective of this paper is to give an overview of the literature discussing the Post-Earnings-Announcement Drift (PEAD). It includes the findings from 215 published and 7 working papers, as well as a book chapter. The intention is to summarize the research conducted on the topic for more than 50 years now, give audiences unfamiliar with the topic an introduction, and give researchers a source of reference. The structure of the paper is as follows: Section 1 summarizes the main elements of the drift. Section 2 gives an overview of the different explanations for the drift brought forward so far. Section 3 summarizes and concludes.

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1. Introduction to the Post-Earnings-Announcement Drift

1.1. The efficient market hypothesis and the role of earnings

Earnings announcements provide investors with valuable information regarding a firm's market value. Thus, when earnings news are surprising in the sense that they exceed or fall short of expectations, a distinct stock market reaction should be observable. Ball and Brown (1968) report the first well-documented relationship between earnings surprises and stock market reactions. This launched "*the most concerted research effort in accounting history*" (Lev, 1989, p. 153). There are more than 1000 papers in three decades of research studying the relationship between capital markets and financial statements (Kothari, 2001), a research stream that originated with Ball and Brown (1968).

Earnings (surprises) have an impact on firm valuations. Consistent, abnormal returns, however, would be at odds with the efficient market hypothesis (Fama, 1970). According to the (semi-strong form of the) efficient market hypothesis (EMH), all publicly available information is instantaneously impounded into the price and, as a result, no market participant can expect abnormal excess returns in the long run. Evidence contradicting the well-established EMH, therefore, constitutes an anomaly.

1.2. Introduction to the PEAD

The Post-Earnings-Announcement Drift (PEAD), which Fama (1998, p. 286) calls the "*grand-daddy of underreaction events*", is one of the most puzzling anomalies in finance. PEAD refers to the phenomenon that stock prices tend to continue to drift upward (downward) following earnings announcements when the quarterly earnings were above (below) expectations. This is why the anomaly is often called the 'SUE-effect', for standardized unexpected earnings (others call it the 'earnings momentum effect'). The PEAD was most convincingly demonstrated by Bernard and Thomas (1989, 1990).[1]

Stocks react to earnings surprises with a price adjustment, reflecting the new information contained in the announcement. However, only a portion of the adjustment happens immediately. Empirical studies find that the adjustment can take months to level out, which leads to the distinct *drift* pattern of stock prices. The direction and magnitude of the drift and the earnings surprise are directly related. When grouping a universe of stocks into quantile portfolios by the magnitude of their earnings surprises (from most negative to most positive earnings surprise), the quantile appears to be strongly related to the drift direction and magnitude. The drift is also economically significant. Early evidence shows that a strategy of zero-investment portfolios, long (short) in stocks with the most positive (negative) earnings surprise, can generate annualized abnormal returns of 18% (Bernard and Thomas, 1989).

[1] There is evidence for a PEAD in REITs (Price et al., 2012b), and even more alternative markets such as baseball cards (Engelberg et al., 2017). This review, however, is focused on stocks.

1.3. General characteristics of the PEAD

Observation 1. The PEAD is a global phenomenon.

PEAD exists all over the world, both in highly and in less developed financial markets (Griffin et al., 2010; **?**). The magnitude of the effect appears surprisingly stable across developed and emerging markets.[2] Numerous country-level studies confirm a PEAD: Australia (Schneider and Gaunt, 2012), Canada (Chudek et al., 2011), China (Truong, 2011), Finland (Booth et al., 1997), Greece (Forbes and Giannopoulos, 2015), India (Sehgal and Jain, 2015; Sen, 2009; Singh et al., 2018), New Zealand (Truong, 2010), Saudi Arabia (Syed and Bajwa, 2018), South Africa (Swart and Hoffman, 2013), South Korea (Goh and Jeon, 2017), Spain (Forner et al., 2009), Tunisia (Bouteska and Regaieg, 2017), Turkey (Saleem and Yalaman, 2017; Yılmaz et al., 2020), and the UK (Liu et al., 2003 and Hew et al., 1996). The international picture, however, is not entirely conclusive. Studies from Belgium (Van Huffel et al., 1996)[3] or Singapore (Ariff et al., 1997), for example, find no drift. Nonetheless, there is little evidence against the notion that PEAD is a global phenomenon.

Observation 2. The abnormal return of the PEAD was around 4% per quarter in the past, but is weakening.

Ball and Brown (1968) use annual income measures (being more concerned with pre-announcement drift) and divide stocks into two groups (those above and those below expectations). The resulting PEAD is negligible. Ball (1978) gives a good summary of early studies with often varying PEAD definitions. The contemporary way to express the drift became the standard in the 1980s (Bernard and Thomas, 1989; Foster et al., 1984; Rendleman Jr et al., 1982). Researchers use quarterly earnings figures to divide stocks into quantiles (usually deciles), based on standardized unexpected earnings (SUE). They form a zero-investment portfolio long (short) in stocks from the highest (lowest) surprise decile[4] and record abnormal returns after earnings announcements. The results of Bernard and Thomas (1989) show a positive (negative) drift of around 2% over 60 trading days for the good (bad) news stocks. This amounts to about 4% (18%) in abnormal quarterly (annualized) excess returns.[5]

Surprisingly, the drift continues to exist even two decades after publication and across markets (Griffin et al., 2010). However, there is also evidence that the magnitude of PEAD returns has been declining (Chordia et al., 2014; Martineau, 2019; Richardson et al., 2010). This could be due to lower limits to arbitrage (Ng et al., 2008), more arbitrage activity (Chordia et al., 2014), improvements in the information environment (**?**) including the advent of the internet,[6] and more sophistication in processing earnings news by market participants (Martineau, 2019). It remains to be seen whether this development is permanent and/or extends globally. Additionally, the predictive

[2]There does not, however, seem to be PEAD in markets with very weak institutions (Afego, 2013).

[3]Van Huffel et al. (1996) use semi-annual instead of quarterly earnings announcements.

[4]To avoid look-ahead bias, they use the cut-off points for earnings surprise deciles from the preceding quarter.

[5]PEAD is typically measured in terms of abnormal returns but there are also specific measures of investor underreaction, one of the primary explanations for the drift (Chung et al., 2019; Yan et al., 2012).

[6]The net effect of the internet is not clear, as it improves the information environment (Chan et al., 2005), but also allows unsophisticated traders easier access to markets (Ahmed et al., 2003).

power of the SUE variable over returns appears to systematically vary alongside other variables (see Observations 14, 15, 16, 17, 19, 21, 22, and 23).

Observation 3. The PEAD is strongest in the quarter directly following the announcement, but persists for multiple quarters.

The most distinct characteristic of the PEAD is that a price adjustment that should happen relatively instantaneously takes weeks and often even multiple months to fully materialize. Initially, the focus was on annual earnings figures and longer time-frames (Ball and Brown, 1968). Since the 1980s, the focus is on quarterly figures and holding periods (Rendleman Jr et al., 1982; Foster et al., 1984; Bernard and Thomas, 1989). Early evidence shows that the adjustment is relatively constant throughout the quarter following the announcement, and only slightly steeper around announcements. A significant fraction of the PEAD return is concentrated in the three-day announcement window of the subsequent quarter. This could be characterized as a predictable pre-announcement drift for the subsequent quarter (Freeman and Tse, 1989; Rendleman et al., 1987). Overall, it appears that the adjustment happens more slowly for small firms (see Observation 4). An economically and statistically signficant PEAD can be observed for two to three quarters after the original announcement (Bernard and Thomas, 1989), but with alternative PEAD specifications, this period can extend even further (Doyle et al., 2006).

Observation 4. The strength of the PEAD is inversely related to firm size.

PEAD can be observed across all firm sizes, and the magnitude of abnormal returns appears to be inversely related to firm size (Foster et al., 1984; Rendleman et al., 1987; Bernard and Thomas, 1989). A number of factors related to firm size contribute to PEAD. These typically include higher trading frictions (see Observation 8) and worse information environments (see Observation 9) for small firms. Arguably, size seems to be subsumed by other factors and have little incremental explanatory power (Bhushan, 1994; Bartov et al., 2000). Still it can be seen as a convenient "catch-all variable for other influences" (Chan et al., 1996, p. 1701).

Observation 5. Earnings surprises used to detect PEAD can be defined via earnings time series, analyst forecasts, and returns.

The SUE-variable used as the independent variable to predict PEAD is the scaled difference between the actual earnings and the estimate of expected earnings. Early studies use time-series predictions to estimate earnings (such as Foster, 1977, Griffin, 1977, or Brown and Rozeff, 1979).[7] In their original study, Bernard and Thomas (1989) estimate expected earnings using the approach of Foster (1977), analogous to Foster et al. (1984). The unexpected earnings are the difference between actual earnings and expected earnings from the time-series estimate. These unexpected earnings are then standardized using a deflator, such as the standard deviation of forecast errors over the estimation period (e.g., Bernard and Thomas, 1989), or simply the end-of-quarter share price of the stock (e.g., Livnat and Mendenhall, 2006).

Another way to form earnings estimates is to use analyst forecasts, which tend to be more

[7] Bathke Jr and Lorek (1984) find that the model of Brown and Rozeff (1979) best describes the quarterly earnings process. It consists of a first-order autoregressive and a seasonal moving average term.

accurate than time series in predicting quarterly earnings (Brown et al., 1987). Initially, many studies built on Value Line earnings forecasts (Affleck-Graves and Mendenhall, 1992 and Bernard and Abarbanell, 1992), later on IBES analyst forecasts (Doyle et al., 2006, Livnat and Mendenhall, 2006). The magnitude of the drift is greater using analyst forecasts compared to time-series predictions (Doyle et al., 2006; Livnat and Mendenhall, 2006; Lerman et al., 2007; Freeman and Tse, 1989).[8] Given that the excess returns are accrued disproportionally from the long side of the portfolio and, unlike time series-based drifts, show no reversal around q_{t+4} (Doyle et al., 2006), these two drift measures might capture somewhat different phenomena. When combining time series- and analyst forecast-based surprises (two-way sort), the resulting PEAD is even stronger (Livnat and Mendenhall, 2006).

A third way to identify surprises is by using abnormal announcement window returns. Market participants react not only to earnings information but also to non-earnings information (Lipe, 1990; Liu and Thomas, 2000). Along with the release of new earnings figures, an earnings announcement is usually accompanied by more detailed components of earnings (e.g., sales, margins), less tangible information (e.g., investments, strategic information), and conference calls. Abnormal announcement window returns can be understood as a comprehensive surprise measure and predict subsequent price drift (Brandt et al., 2008; Chan et al., 1996; Zhou and Zhu, 2012; Gerard, 2012).[9]

Observation 6. PEAD is a separate anomaly, not subsumed by others.

Attempts to explain PEAD with other anomalies or phenomena have been unsuccessful. PEAD and price momentum are clearly distinct, both in the U.S. (Bernard et al., 1997; Chan et al., 1996, 1999; Chen et al., 2014) and internationally (Bohl et al., 2016; Leippold and Lohre, 2012). If anything, PEAD subsumes price momentum (Chordia and Shivakumar, 2006). PEAD is distinct from the accruals anomaly (Collins and Hribar, 2000; Louis and Sun, 2011). The Value Line enigma is also a distinct anomaly (Choi, 2000; Zhang et al., 2010; Nayar et al., 2011), or at best a manifestation of the PEAD (Affleck-Graves and Mendenhall, 1992). The value-glamour anomaly is distinct (Bernard et al., 1997; Yan and Zhao, 2011). Other anomalies based on fundamentals (earnings levels, earnings sign, or profitability measures[10]) do not explain PEAD (Balakrishnan et al., 2010; Bernard et al., 1997; Kausar, 2018). After controlling for PEAD, Daniel et al. (2020) find that none of the 12 short-term (<1 year) anomalies investigated are significant at the 5% level anymore.[11]

[8] The time series-based drift is not necessarily smaller than the analyst forecast-based drift. There is evidence that the delayed proportion of the drift is still higher for time series-based PEAD. In other words, the proportion of post-announcement return in relation to total returns (the sum of announcement window return and post-announcement window return) is higher for the time series-based drift, at least in more recent times (Clement et al., 2019).

[9] Also, analyst forecast revisions (Liu and Thomas, 2000; Zhang, 2007) and management guidance news (Milian, 2018) can produce PEAD-like effects.

[10] E.g., *Pr* anomalies, such as in Ou and Penman (1989)

[11] These include multiple specifications of the same anomalies (number of specifications): standardized unexpected earnings (2), cumulative abnormal returns around earnings announcements (2), revisions in analysts' earnings forecasts (1), price momentum (2), industry momentum (1), quarterly ROE and ROA (2), number of consecutive quarters with earnings increases (1), and failure probability (1).

2. Explanations for the Post-Earnings-Announcement Drift

There have been many attempts to explain the PEAD, which broadly fall into two categories: those that are compatible with the EMH (Section 2.1) and those that are not (Section 2.2).[12]

2.1. EMH-compatible explanations

Observation 7. Insufficient risk adjustment typically does not explain abnormal returns.

Ball et al. (1993) assert that betas increase for firms with high unexpected earnings and decrease for firms with low unexpected earnings. An increase or a decrease in beta (or risk) can then explain the seemingly abnormal returns after earnings announcements. However, while SUE-decile and beta seem to be rank-correlated, the effect is relatively weak and can only explain a small fraction of the abnormal returns. Also, returns of high-SUE (low-SUE) stocks are positive (negative) in both up and down markets. Finally, excess PEAD returns are concentrated in subsequent announcements windows (Bernard and Thomas, 1989). Explicit market adjustment of returns typically has no differential impact across SUE-sorted portfolios (Sadka, 2006). In other words, high-SUE minus low-SUE returns do not materially change with market adjustment. While there is evidence that betas implied in stock option valuations (partly) explain PEAD (Ho and Tsai, 2018),[13] depending on the type of market risk adjustment the PEAD might even be understated (Zolotoy, 2011).[14]

Extending the market model to the three factor model (Fama and French, 1993) only decreases excess returns by a small fraction or even increases them (Chordia et al., 2009; Francis et al., 2007; Sadka, 2006). There are further additions to the three-factor model, typically increasing explanatory power of returns while not substantially diminishing the effect: accruals quality (Francis et al., 2007), momentum (Francis et al., 2007; Chordia and Shivakumar, 2006), the APT risk factors of Chen et al. (1986),[15] dividend yield (Bernard and Thomas, 1989), and future inflation risk (Chordia and Shivakumar, 2005). An "Earning Surprise" risk factor by Kim and Kim (2003) can partly explain PEAD returns (it is constructed from pre-announcement information uncertainty, which is discussed in Observation 9). One factor that has the potential for high explanatory power over PEAD is liquidity risk. Unexpected variations in market-wide liquidity appear to be a priced risk factor (Sadka, 2006). Finally, arbitrage risk can be an issue. The idiosyncratic volatility (i.e., the risk that cannot be hedged) is related to PEAD (Brav et al., 2009; Mendenhall, 2004).[16]

[12] Early attempts to explain the PEAD as a product of research design flaws will not be discussed, given the broad literature acknowledging and analyzing the PEAD in many settings.

[13] Stock options markets can be used to derive option-implied betas which vary systematically with SUE (based on an approach by Chen et al., 2016, exploiting the forward-looking nature of information in option prices to estimate equity risk).

[14] Zolotoy (2011) finds that post-announcement betas for bad (good) news firms increase (decrease) due to increased (decreased) leverage.

[15] The macroeconomic risk factors associated with industrial production, changes in default risk premiums, changes in the term structure, unanticipated inflation, and changes in expected inflation.

[16] This affects some classes of investors differently than others: hedge fund managers are more comfortable with arbitrage risk as opposed to mutual fund managers, likely due to lock-up provisions for investors (Gurun and Coskun, 2012).

Any of these risk-adjustment models suffer from the joint-hypothesis problem. Different tests, however, are also unsuccessful in (fully) explaining PEAD with risk. Stochastic dominance tests show first-order stochastic dominance of high-SUE (top decile) over low-SUE (bottom decile) portfolios (Bernard and Seyhun, 1997). Using a stochastic discount factor approach (a discount factor constructed from a set of basis assets instead of employing a specified risk-adjustment model) can explain about a quarter of PEAD returns (Min and Kim, 2012).

Observation 8. Trading frictions (transaction costs, liquidity) are positively related to PEAD and partly explain it.

Trading frictions come in a variety of forms: from direct transaction costs (bid-ask spreads, commissions) to indirect transaction costs (illiquidity, market impact costs). Whether such frictions allow for profitable arbitrage opportunities is disputed and depends on the specifications of trading strategy and risk factors. While there are studies that find (close to) zero abnormal profits after accounting for trading frictions (Chordia et al., 2009; Ng et al., 2008; Zhang et al., 2013),[17] other studies find significant profits (Battalio and Mendenhall, 2011; Ke and Ramalingegowda, 2005).

Whether transaction costs are responsible for the persistence, and even the existence, of the PEAD is also debatable. If mispricing is within transaction costs then transaction costs might prevent trades and the impounding of information. Yet, there is mispricing in spite of trades occurring (Bernard and Thomas, 1990). So, transaction costs cannot explain PEAD.[18] On the other hand, Ng et al. (2008) argue that transaction costs can explain the incidence of the PEAD via the price adjustment mechanism.[19] What is undisputed is that, generally, trading frictions are positively related to PEAD.

PEAD is highest in the stocks with the highest direct (Bhushan, 1994; Doyle et al., 2006; Ng et al., 2008; Zhang et al., 2013) and indirect transaction costs (Chordia et al., 2009; Chung and Hrazdil, 2011).[20] Indirect transaction costs are frequently associated with illiquidity, which can be seen as a measure of information-based trading (Kyle, 1985). Liquidity risk can explain large portions of abnormal PEAD returns, resulting from unexpected variations in the aggregate ratio of informed traders to noise traders (Sadka, 2006). At the same time, higher abnormal order flow (a proxy for information-based trading as opposed to noise trading) leads to lower PEAD (Vega, 2006).[21] Information asymmetry and illiquidity around announcements are positively related (Kim

[17] Pavlova and Parhizgari (2011) employ a genetic algorithm to improve trading strategy specifications, but find very little potential for abnormal returns (after accounting for transaction costs).

[18] Ball (1992) notes that a large proportion of PEAD returns are concentrated around announcements and that there is relatively more trading around announcements, making transaction costs an unlikely explanation.

[19] Informed traders trade with market makers and bid up the price (in the case of a positive surprise), until further approximation of price to fundamental value is unprofitable because of transaction costs. This apparent underreaction increases with transaction costs. The second step in the price adjustment involves further news events in the post-announcement period. Random news events have a chance to increase or decrease fundamental value. In case of a further increase in fundamental value (continuing the example of a positive earnings surprise), the arbitrageur trades and pushes the price upwards. In case of a decline, the arbitrageur does not act. A series of random news events after the announcement eventually leads to a convergence of price and fundamental value, which is then perceived as drift.

[20] There is also evidence that PEAD returns are concentrated in a small sample of low-rated stocks facing deteriorating credit conditions (Avramov et al., 2013).

[21] Similar effects can play out between exchange and off-exchange trading (Cox, 2020).

and Verrecchia, 1994; Krinsky and Lee, 1996; Lee et al., 1993).[22,23] Interestingly, unexpected trading volume around earnings announcements, as a measure of opinion divergence, is positively related to PEAD (Garfinkel and Sokobin, 2006; Gerard, 2012). Liquidity risk is also positively related to PEAD via the link of accounting quality (Chen et al., 2017a).[24] There is also evidence, however, that transaction costs and PEAD can be negatively related via the earnings persistence channel. Firms with higher earnings persistence (i.e., lower ex ante earnings volatility) have lower trading frictions, but also a stronger drift per unit of earnings surprise (Cao and Narayanamoorthy, 2012).

Observation 9. Information uncertainty leads to an underreaction to earnings news, and the delayed reaction results in PEAD.

Information uncertainty can be seen as a behavioral factor, since investors underreact to information releases. However, in a rational learning model the underreaction can be justified when signals are noisy (for example, because of low earnings quality). Resolving the uncertainty subsequently leads to a (delayed) price correction.[25] Behavioral and rational explanations for asset pricing anomalies can be difficult to distinguish (Brav and Heaton, 2002; Liang and Zhang, 2019). A muted reaction to information releases means the earnings response coefficient is low. A number of studies show the negative association between different metrics of information uncertainty and the earnings response coefficient (and a positive association with PEAD). Firstly, they relate to the forecasting environment: data availability (Li et al., 2020; Schaub, 2018), persistence of earnings (Kormendi and Lipe, 1987), ability of past earnings to predict future earnings time-series (Lipe, 1990), forecasting difficulty (Zhang, 2012), and accuracy (Han et al., 2009).[26] Secondly, accounting quality: accruals quality, special items (Callen et al., 2013; Francis et al., 2007), and reputation of the auditor (Ferguson and Matolcsy, 2004). Thirdly, opinion divergence:[27] analyst forecast dispersion (Ayers et al., 2011; Han et al., 2009; Imhoff Jr and Lobo, 1992; Liang, 2003),[28] more active trading across market participants (Anderson et al., 2007), abnormal volume (Garfinkel and Sokobin, 2006),[29] firm age, and return volatility (Jiang et al., 2005). Yet, there is also evidence inconsistent with the idea of delayed reaction due to information uncertainty. Dische (2002) assumes a behavioral perspective and argues that low forecast dispersion means a higher information content of earnings news. Investors increasingly underreact to surprises with the degree

[22]The after-hours market, a very illiquid environment, provides some evidence. Spreads widen ahead of the announcement, to the point that they contain the post-announcement price (Gregoire and Martineau, 2019).

[23]Ali et al. (2020) find that actively managed funds trading on the PEAD are more successful when avoiding competition among each other, and that they achieve this by investing in illiquid stocks. Such funds appear to have an information advantage and are better able to find mispriced stocks.

[24]The intuition is that stocks with lower information quality are more sensitive to large shocks to market liquidity. Additionally, market makers are less willing to provide liquidity to such stocks.

[25]In the wake of noise (non-information based trading), it can be rational to hold off on trading at first (continuing to attach weight on one's prior beliefs). Prior beliefs are only gradually eliminated from equilibrium prices, leading to a PEAD (Dontoh et al., 2003).

[26]A similar effect can be observed for management forecasts. If they are more reliable, the immediate stock price response is stronger and the price drift over the 3 months following the forecast is weaker (Ng et al., 2013).

[27]If investors observe (via prices) others' private information that conflicts with their own private information (i.e., opinion divergence) they will update their beliefs, leading to PEAD (Choi et al., 2019).

[28]The "Earnings Surprise" risk factor by Kim and Kim (2003) is also based on analyst forecast dispersion.

[29]See Atiase and Gift (2015) and Atiase et al. (2016) for a number of information uncertainty factors that drive trading volume.

of forecast convergence (i.e., low uncertainty).[30] Zhang et al. (2013) have a similar intuition but come to a different result. In their model, high information uncertainty leads to less underreaction (because announcements are more important for such firms). They find, however, that this effect is dominated by transaction costs, which also increase with information uncertainty.

Information uncertainty exists on the firm and market levels. Generally, market-wide uncertainty in combination with sentiment significantly affects PEAD (Bird et al., 2014).[31] The media landscape also contributes to the information environment, with more reliable media leading to less PEAD.[32,33] Information shocks at the market level can reduce uncertainty: the introduction of common accounting standards (**?**), or requirements to submit computer-readable (XBRL) reports (Chen et al., 2017c; Efendi et al., 2014) contribute to weaker PEAD.[34] At the firm level, the introduction of conference calls reduces uncertainty and PEAD (Kimbrough, 2005).

Information uncertainty can be mitigated or resolved with the arrival of new information. Such signals can cause the price to converge more quickly to the fundamental value that the recent earnings information implies. Delayed disclosure of items that are withheld from the 10-Q filings lead to initial underreaction but there is a (partial) catch-up upon full disclosure (Li et al., 2020). Subsequent same-sign earnings innovations can indicate persistence of an initial earnings surprise (Freeman and Tse, 1989).[35] Post-announcement recommendations and forecasts by analysts facilitate impounding of information (Soffer and Lys, 1999), and when analysts are more responsive in revising their forecasts, the market adjusts more quickly, resulting in less PEAD (Zhang, 2008). Analysts revise their forecasts not just on the basis of new earnings but also based on non-earnings information like conference calls, private discussions with management, or weekly sales figures (Shane and Brous, 2001). Such softer factors can go as far as to the tone and sentiment in conference calls, which also impacts PEAD (Feldman et al., 2010; Price et al., 2012a; Milian and Smith, 2017).[36] Managers appear to be savvy about their company's valuation, and their post-announcement trades are related to the PEAD (Dargenidou et al., 2018; Kolasinski and Li, 2010), even if there is mixed evidence on whether they exploit stock price underreactions (Core et al., 2006). Corroborating information can also come from economically linked firms, such as competitors and customers (Kovacs, 2016; Baker et al., 2019; Zhu, 2014). Industry-related news

[30] Liang (2003) provides similar evidence.

[31] The market-wide uncertainty is measured by the implied volatility from the options market. Options trading itself can facilitate the pre-announcement impounding of private information into the stock price, pre-empting the information content of the announcement. Post-announcement, options trading helps incorporating public information into prices, reducing PEAD (Truong and Corrado, 2014). Regarding credit default swaps, these seem to anticipate earnings surprises too and typically do not exhibit PEAD themselves (Zhang and Zhang, 2013; Jenkins et al., 2016).

[32] The Chinese stock market, with partly state-controlled media, provides some evidence. However, whether politically captured media is perceived as less reliable, leading to more PEAD (Kim et al., 2019), or perceived as more reliable, leading to less PEAD (Guo and Huang, 2019) is not entirely clear.

[33] Lower levels of media attention to value stocks (as opposed to glamour stocks) could be a potential driver of information uncertainty and a more muted price reaction upon earnings announcements (Yan and Zhao, 2011).

[34] Regulation that gives prioritized access to news to certain market participants can pre-empt the information from earnings announcements prior to public release (Dong et al., 2015).

[35] How investors interpret streaks in earnings surprises is not entirely clear. There is evidence that they underreact to streaks of earnings changes in the same direction (potentially because of mean-reversion beliefs), leading to PEAD, but correctly react to streak-ending announcements (Loh and Warachka, 2012). There is also evidence, however, that streaks of same-sign earnings surprises lead to more intense trading (Shanthikumar, 2012).

[36] However, since the conference call tone affects announcement window return and PEAD in the same direction, the tone must have another function than just mitigating investor underreaction around the announcement.

in the post-announcement period leads to a stronger (weaker or reversed) drift if these news agree (disagree) with the firm-specific earnings surprise (Liang and Zhang, 2019).

Observation 10. Information processing costs cannot explain the PEAD.

Jones and Litzenberger (1970) observe the drift and interpret the delayed adjustment as a gradual dissemination of information about the fundamental value of a security from investment professionals to the public. The resulting excess returns from the slow adjustment can be seen as a normal compensation that accrues to investment professionals as part of their occupation. They are better (or more specialized) at processing information (i.e., have lower search and information processing costs). It is true, in fact, that timely analyst forecast revisions lead to more efficient pricing (Zhang, 2008). It also appears as if it is not always worthwhile or possible for analysts to actually incorporate all available information (Kothari, 2001). For example, analyst forecast errors for complex (Barinov et al., 2019) or internationally diversified firms (Kang et al., 2017) are larger and PEAD is stronger. Nonetheless, as Ball (1978) argues, these costs are at best negligible. This should be especially true with today's information technology and data availability.

Observation 11. Active institutional ownership weakens PEAD.

Small or individual traders appear to form expectations differently than larger, institutional, and supposedly more sophisticated investors (see Observation 13). Whether small traders cause the PEAD is not entirely clear. The evidence from studies of granular brokerage data is mixed (Eom et al., 2019; Hirshleifer et al., 2008). Overall, however, there is strong evidence that institutional ownership is negatively correlated with PEAD (Bartov et al., 2000; Chen et al., 2017a; Doyle et al., 2006; Jegadeesh and Livnat, 2006a; Ng et al., 2008; Son et al., 2018). When institutional investors enter a market, mispricing diminishes (Qin and Bai, 2014; Shin and Park, 2018). The effect of institutional trading volume might be an even stronger negative PEAD predictor than institutional holdings (Shu, 2013). Institutional investors and short-sellers tend to be informed and anticipate earnings surprises (Alexander et al., 2014; Campbell et al., 2009). In the post-announcement period too, they appear to increase (decrease) their exposure to good (bad) news stocks (Berkman and McKenzie, 2012). Short-selling can decrease (Boehmer and Wu, 2013) or increase PEAD (Lasser et al., 2010).[37]

Different classes of institutional investors affect PEAD differently. Active institutional investors contribute to making prices more efficient. Transient investors trade to exploit the PEAD and thereby reduce it (Ke and Ramalingegowda, 2005). High-frequency traders mitigate PEAD by supplying liquidity (Ke and Zhang, 2019). On the other hand, a higher share of passive institutional investors (ETFs, Index funds) reduces the informational efficiency of prices and increases PEAD (Qin and Singal, 2015). Similarly, institutional herding (the tendency of mutual funds to buy and sell the same stocks at the same time) may happen for reasons unrelated to financial information, such as career and reputational concerns as well as litigation risk (Chen et al., 2017b). There are other factors that lead to institutional ownership potentially exacerbating PEAD: high concentrations of

[37]Short-selling can accelerate price adjustment, especially for negative surprises. On the other hand, short-selling activity can be a bullish signal (short-sellers eventually have to buy back the shares to close the position). The pent-up demand for stocks after high short-selling activity leads to higher (lower) stock price response around earnings announcements and a weaker (stronger) PEAD for positive (negative) surprises.

(institutional) ownership can stifle price adjustment. It can lead to lower announcement returns and make short-selling and arbitrage activities more difficult, thus contributing to stronger PEAD (Porras Prado et al., 2016). Also, institutional investors face investment constraints such as the type of stocks in the portfolio, position limits on a stock, industry limits, or portfolio turnover. Institutions appear to be reluctant to buy good news stocks (sell bad news stocks) if these stocks are already overweighted (underweighted) in their portfolios, contributing to market underreaction (Cao et al., 2017).

2.2. EMH-incompatible explanations

Observation 12. Investors fail to incorporate, or underestimate earnings autocorrelation.

Quarterly earnings of companies can be forecasted with time-series models (Bathke Jr and Lorek, 1984; Brown and Rozeff, 1979; Foster, 1977; Griffin, 1977). The time-series pattern of earnings typically exhibits correlated seasonal differences in quarterly earnings. This correlation is strongest in adjacent quarters and levels off (but remains positive) at lags two and three. Correlation reverses at lag four. There is evidence that (at least some groups of) investors are (partly) unaware of this autocorrelation pattern and base their expectations on a seasonal random walk.[38,39] As a result, forecast errors and returns over time are predictable (Rendleman et al., 1987). The market is surprised again around subsequent announcements as evidenced by return spikes. The initial surprise has a positive but decaying correlation with returns around announcements q_{t+1} through q_{t+3}, and a negative correlation with returns around announcement q_{t+4} (Bernard and Thomas, 1990).[40]

It is also possible that investors understand the time-series pattern but do not correctly assess its parameters ("partially naive expectation model"). There is evidence that investors are aware of the correct sign of the correlation coefficient at lags 1-4 but that they underestimate the magnitude of the correlation coefficient by about 50% (Ball and Bartov, 1996). The underestimation of the autoregressive component is larger in some firms than in others, which coincides with a stronger drift (Lee and Rui, 2011). Experiments show that subjects (MBA students) generally underestimate autoregressive and moving-average components of a Brown-Rozeff time series (Maines and Hand, 1996).[41] This evidence extends to the (experimental) market level (Calegari and Fargher, 1997). Undergraduate business students also underestimate autocorrelation by about 40% in the first lag (but no later lag). A simple seasonal random walk model does not describe expectations for the majority of the subjects. In fact, they use somewhat more complex models.[42,43]

[38] See Enke and Zimmermann (2019) for more general evidence of correlation neglect.

[39] Jacob et al. (2000) argue that this is not necessarily the case. They point out that PEAD is also consistent with researchers over-differencing an already stationary earnings time series.

[40] Brown and Han (2000) show that investors appear to not fully understand an earnings process that follows an even simpler AR1 model, which applies to about 15-20% of firms. This suggests that the findings of Bernard and Thomas (1990) could not be driven by model complexity alone.

[41] Brown and Rozeff put forward a Box-Jenkins (1,0,0) x (0,1,1) model for the time series of quarterly accounting earnings that dominates other time-series models (Bathke Jr and Lorek, 1984; Brown and Rozeff, 1979).

[42] Experimental subjects (and potentially investors) overrely on old information and therefore do not adequately take into account new information (Bloomfield et al., 2003).

[43] Soffer and Lys (1999) have a different interpretation than Ball and Bartov (1996). At the beginning of the

The long-standing PEAD anomaly attracts arbitrageurs and Milian (2015) shows that they can disrupt the autocorrelation structure of stock returns. Those firms with active exchange-traded options (which are easiest to arbitrage) appear to attract a large number of (unsophisticated) arbitrageurs who overcompensate the well-documented underreaction to earnings surprises. For these firms, those that are in the highest decile of earnings surprises underperform those in the lowest decile in the following announcement window. As Milian (2015, p. 175) puts it, "... if anomalies arise due to unsophisticated investors' behavioral biases, then these same biases can also apply to unsophisticated arbitrageurs ...". Unsophisticated arbitrageurs appear to consistently underestimate the level of arbitrage by others.

Observation 13. Naive expectations are more prevalent in unsophisticated investors.

Empirical studies show that only a fraction of the traders in the market exhibits naive expectations. These are typically small or less sophisticated investors. Small traders, relative to large traders, tend to build expectations based on a seasonal random walk model, while large traders tend to rely on analyst forecasts (Ayers et al., 2011; Battalio and Mendenhall, 2005; Bhattacharya, 2001; Walther, 1997). If there is less institutional ownership and analyst following in a market, the reliance on seasonal random walk forecasts is greater (Zolotoy, 2012). Similarly, media coverage of earnings news is positively associated with time series-based PEAD. Typically, news outlets report earnings news compared to the same quarter in the preceding year. This presentation format does not consider autocorrelation between adjacent quarters and potentially reinforces the idea of a seasonal random walk for quarterly earnings for retail investors (Pinnuck, 2014). Of course, small traders do not exclusively employ naive expectation models. Experimental evidence shows that about 13% of subjects use a seasonal random walk expectation model when forecasting quarterly earnings. 56% employ either an autoregressive or a moving average component. For 31% of traders, a Brown-Rozeff model describes forecasts best (Calegari and Fargher, 1997).

Observation 14. Underestimation of earnings autocorrelation depends on the level of autocorrelation.

Experimental subjects correctly weight moderate autocorrelations, underweight large autocorrelations, and overweight small or nonexistent autocorrelations (Maines and Hand, 1996). Similar empirical evidence shows that for lags 1 and 4, where autocorrelation is highest in absolute terms, the market underestimates autocorrelation. For lags 2 and 3, where autocorrelation is low, the market correctly assesses autocorrelation. Investors also underestimate autocorrelation at lag 1 when autocorrelation is high, but not when it is moderate or low. (Bathke Jr et al., 2006). Firms with high earnings autocorrelation experience a stronger underreaction and subsequent PEAD (Bathke et al., 2014; Cao and Narayanamoorthy, 2012). For the subset of firms with no autocorrelation of seasonally differenced earnings, investors actually assume some autocorrelation, leading to return reversals (Bathke Jr et al., 2016). On the other hand, there is evidence that investors are quite

quarter (directly after the announcement), investors appear to expect earnings to follow a seasonal random walk. Later, the expectations of investors incorporate more and more of the properties of the actual, autocorrelated earnings time series. Just before the following announcement, about 50% of the autocorrelation is contained in expectations. Soffer and Lys (1999) argue that it is less plausible that investors change expectation models over the course of each quarter. Rather, information is disseminated which investors perceive to be new and they update their expectations accordingly. This information content could, however, have been discerned from the earnings announcement already.

capable of assessing earnings autocorrelation and how it varies accross firms (Mendenhall, 2002), even if not at the deepest level (Chen, 2013).[44]

Observation 15. SUE autocorrelation and drift are stronger when earnings surprises are driven by cash flow (as opposed to accruals) or revenue (as opposed to expense) surprises.

Unexpected cash flows have a higher predictive power over PEAD than unexpected accruals (Shivakumar, 2006). The market appears to underestimate (overestimate) the persistence of cash flows (accruals) for earnings (Collins and Hribar, 2000). High SUE and low (i.e., income decreasing) accruals lead to stronger positive drift, while low SUE and high (i.e., income increasing) accruals lead to stronger negative drift (Louis and Sun, 2011). PEAD is also significantly higher when considering revenue surprises, in addition to SUE. Revenue surprises appear to have a more persistent effect on earnings than expense surprises (Jegadeesh and Livnat, 2006a,b). Investors also underestimate the persistence of revenues on the persistence of earnings (i.e., the conditional persistence following Amir et al., 2011). They underreact to earnings surprises if the persistence in earnings is driven to a higher degree by revenue surprises (Amir et al., 2015). The effect of revenue surprises on the SUE-PEAD relationship is more pronounced for firms with high earnings volatility, such as R&D-intensive companies (Kama, 2009). On the other hand, if earnings surprise and announcement window returns have opposing signs, this is frequently driven by revenue surprises discordant with earnings surprises. This points to decreased earnings persistence and weakens PEAD (Johnson and Zhao, 2012).

Observation 16. PEAD returns can be affected by firm characteristics such as past PEAD, reputation, and celebrity status.

On a meta-level, firms with historically strong PEAD continue to exhibit stronger PEAD for future earnings surprises (Son et al., 2018). Also, "high-reputation" firms (firms publicly recognized for high quality of capabilities and output) are less likely, and "celebrity" firms (firms enjoying a high level of public attention and positive emotional responses from stakeholders) are more likely to deliver positive earnings surprises. Both types get higher return rewards for positive surprises and lower return penalties for negative surprises (Pfarrer et al., 2010).

Observation 17. Accounting practices and earnings management lead to variations in PEAD returns.

Accounting conservatism leads to predictable variation in SUE autocorrelations (Narayanamoorthy, 2006). Accounting principles typically demand that economic losses be more easily and more quickly recognized than profits. "Thus, earnings reflects [sic] bad news more quickly than good news" (Narayanamoorthy, 2006, p. 769). This also suggests that losses or earnings decreases have a stronger tendency to mean-revert than profits and earnings increases. Firms with losses or earnings decreases consequently have a lower autocorrelation coefficient.[45] The integral approach to quar-

[44]Chen (2013) constructs a model in which persistence is not constant, but determined by a number of accounting and economic parameters for each firm-quarter combination. For example, profit margin is a positive determinant of earnings persistence, extreme accruals are a negative predictor of persistence. While investors appear to appreciate time-series persistence of earnings, they do not seem to be aware of time-varying persistence of earnings, especially in complex information environments.

[45]The conditional probability of a quarterly loss following a loss in the preceding quarter, however, is higher than

terly reporting also has predictive power over SUE autocorrelations. Certain earnings components have to be smoothed across quarters of the same year and cannot be smoothed across quarters of different fiscal years. Autocorrelation is stronger between quarters in the same fiscal year than for quarters in different fiscal years (Rangan and Sloan, 1998). Beyond the impact of earnings surprises and accruals, the likelihood of earnings management also affects the magnitude of the PEAD (Louis and Sun, 2011).

Observation 18. Analysts (and managers) exhibit biases that are similar to those found in the market.

A large body of research examines the role of analysts who forecast earnings, their biases, incentives, and conflicts of interest (see discussion in Kothari, 2001). With respect to PEAD, analysts seem to underreact to earnings information, thereby contributing to the subsequent drift (Mendenhall, 1991).[46] Quarterly earnings forecasts by analysts share some of the properties of the naive model of a seasonal random walk. The degree of analysts' underreaction to earnings, however, is only half as large as it would have to be to explain the magnitude of the subsequent drift (Bernard and Abarbanell, 1992). This is consistent with the market in general (Ball and Bartov, 1996). The degree of underreaction among analysts depends on their experience and personality. Less experienced analysts (Mikhail et al., 2003), and those with a herd-to-consensus bias (Tamura, 2002) tend to exhibit larger forecast errors. Managers are prone to similar biases and their forecast errors also tend to be serially correlated (Xu, 2009).

Observation 19. Limited investor attention contributes to the PEAD.

Distractions can divert attention and can make it more difficult to analyze the implications of new information. A higher number of earnings releases on the same day makes earnings surprises harder to process for investors, leading to a delayed reaction and to PEAD (Hirshleifer et al., 2009; **?**).[47] Similarly, announcements on Fridays receive less attention and lead to higher PEAD (DellaVigna and Pollet, 2009; Michaely et al., 2016). On top of concurrent announcements and Fridays, less pre-earnings options trading points to lower attention and results in stronger PEAD (Wang et al., 2018b). Other situations that can divert attention and lead to more underreaction are: low turnover and down markets (Hou et al., 2009),[48] high market volatility (Kottimukkalur, 2019; Jacobs and Weber, 2016), changes in market sentiment (Mian and Sankaraguruswamy, 2012; Shin et al., 2019b), religious holidays (Pantzalis and Ucar, 2014), sports games (Pantzalis and Ucar, 2019), and seasonal affective disorder (Lin, 2015). Delayed disclosure of individual 10-Q filing items leads to an underreaction at the announcement date. However, once all items have been fully disclosed, the response catch-up remains incomplete. The evidence points to underreaction because of lower attention outside of focal periods (i.e., earnings announcement dates) by investors and

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the unconditional probability of a quarterly loss (Balakrishnan et al., 2010).

[46]This effect appears to be particularly pronounced for negative surprises when analysts have conflicts of interest (Constantinou et al., 2003).

[47]A contributing factor is that data providers such as First Call (Thompson Reuters) or IBES sometimes have a delay in disseminating earnings news. This delay is caused by manual validations, quality checks, and adjustments of figures. As a result, announcement window returns are significantly lower and PEAD is stronger. The abnormal post-announcement returns are concentrated on the day of the actual information dissemination (Schaub, 2018).

[48]There is evidence to the contrary, however: during the Great Recession, PEAD returns may have decreased or even reversed (Anderson et al., 2019).

analysts (Li et al., 2020). Generally, firms with fewer attention-grabbing events exhibit stronger PEAD (Lin et al., 2016).

A more complex information environment can lead to initial underreaction, as it might be harder to consider all relevant facts and relationships (Chen, 2013). Conglomerates, as opposed to single-segment firms (Barinov et al., 2019), and more internationally diversified firms as opposed to less internationally diversified firms (Kang et al., 2017) have a more muted initial reaction and a stronger PEAD (an effect that weakens with more transparent disclosure requirements). PEAD is more pronounced for firms that concurrently release earnings announcement and 10-K filings, as opposed to those issuing a stand-alone earnings announcement (Arif et al., 2018).[49] It also appears as if earnings management and the implications of accruals are partly overlooked because of cognitive limits or inattention (Louis and Sun, 2011). Economic links between different entities might be overlooked too. Investors are inattentive to the industry-wide implications of earnings announcements by individual firms for other firms and underreact to them (Kovacs, 2016). This effect is even more pronounced when earnings news are released on a day with a high volume of announcements (Baker et al., 2019). In industries with relatively homogeneous firms, on the other hand, this cross-firm information transfer appears easier, leading to less PEAD (Shin et al., 2019a). Information sharing networks among investors can also facilitate information diffusion and attenuate PEAD (Pantzalis and Wang, 2017). A similar effect of lack of attention to economic links can be observed in customer-supplier relationships (Zhu, 2014). In fact, there might be a whole range of economic links that predict earnings surprises but which investors do not pay sufficient attention to (Müller, 2019). Of course, for certain news events, concurrent announcements can reduce PEAD. If a firm has high macroeconomic exposure and announces concurrently with macroeconomic news, the market can better distinguish between systematic and firm-specific implications (Chen et al., 2018).

Investor information demand before and around the announcement can point to increased attention and mitigate underreaction: Increased searches for the SEC's EDGAR log files (Li et al., 2019) increased Social Media engagement (Wu, 2019), and increased Google searches (Drake et al., 2012; Fricke et al., 2018) can attenuate PEAD. However, increased Google searches, if done by local investors, can have different effects. They can point to more informed trading and reduce PEAD (Wang et al., 2018a), or to more familiarity bias and increase PEAD (Chi and Shanthikumar, 2017). Managers can also (opportunistically) boost headline salience of earnings news in the media. The added attention leads to a stronger price response in the announcement window and weaker PEAD (Huang et al., 2018).

Observation 20. Overconfidence bias and cultural dimensions contribute to the PEAD.

Liang (2003) provides evidence that investors rely overly much on private information and that they underweight reliable public information. High analyst opinion divergence leads to a stronger drift (as discussed in Observation 9). The reduction in uncertainty (i.e., the reduction in analyst forecast error from before to after the announcement) is a measure for the reliability of the earnings announcement. Liang (2003) finds a negative relationship between signal reliability and PEAD and interprets it as overconfidence in less reliable information and underconfidence in more reliable

[49]The conjecture is that concurrent information releases are harder to interpret due to limited attention and information processing capacity.

information (similar to Dische, 2002). In high-uncertainty information environments, investors appear to trade more on private information due to overconfidence, leading to a stronger drift (Jiang et al., 2005). Higher overconfidence can also stem from a higher degree of individualism in a society. It appears as if PEAD is positively correlated with individualism. Additionally, it is negatively correlated with uncertainty avoidance. High uncertainty avoidance individuals are uncomfortable with ambiguity and update their beliefs more quickly upon announcements (Dou et al., 2016).

Observation 21. The disposition effect affects the PEAD.

When stocks are (in the aggregate) in the gain domain investors disproportionally sell stocks to realize their gains. Conversely, when stocks are in the loss domain investors hold on to them in the hopes of breaking even. This disposition effect impedes upward (downward) price adjustment following positive (negative) surprises, contributing to PEAD (Frazzini, 2006). A similar effect can be observed for investor target prices (for long investors). If the stock price exceeds analysts' targets, selling pressure delays adjustment after positive earnings surprises (Huang et al., 2019).

Observation 22. Anchoring and recency bias affect PEAD.

A stock's 52-week high provides an anchor which contributes to the PEAD. The relative distance of a stock's price to its 52-week high (proximity), as well as the time passed since a stock reached its 52-week high (recency) each contribute incrementally. Investors underreact to positive (negative) surprises of stocks close to (far from) their 52-week highs, which leads to a stronger subsequent upward (downward) drift (George et al., 2015; Goh and Jeon, 2017). Similarly, if a stock's 52-week high occurred in the recent (distant) past, investors are reluctant to buy (sell) it following positive (negative) news. This recency effect is incremental to the proximity effect (Ma et al., 2014). Sophisticated investors are less prone to these types of behavioral biases (Shin and Park, 2018).

Observation 23. Sensitivity of earnings to inflation can partly explain the PEAD.

PEAD is related to the inflation illusion hypothesis of Modigliani and Cohn (1979). Investors consider the implications of inflation on the discount rate, but not on nominal earnings growth. In fact, the sensitivity of earnings to inflation varies monotonically across SUE-sorted portfolios. The predictive ability of inflation for future earnings and returns is incremental to that of current and past SUE (Chordia and Shivakumar, 2005). Return decomposition shows that PEAD results from slow incorporation of cash-flow news vs. discount rate news (Mao and Wei, 2014). Analysts also do not seem to (fully) incorporate the implications of inflation and sensitivity to inflation into their models (Basu et al., 2010).

3. Summary and conclusion

More than 50 years after the original paper by Ball and Brown (1968), and especially since Bernard and Thomas (1989, 1990), research around the PEAD has grown into a large body of literature. The PEAD continues to be one of the most prominent anomalies in financial markets and garners strong research interest. It is clear that anomalies often disappear or at least weaken

following their publication (Chordia et al., 2014). Remarkably, however, the PEAD has been studied for decades already.

Many explanations for the PEAD point to investor irrationality, posing a challenge to the EMH. Most notably, it appears as if investors, and even analysts, have difficulty processing earnings news accurately. Attention constraints and a host of behavioral biases also play a role. The decades-long persistence of the anomaly, however, makes researchers rightfully reluctant to accept an explanation based on irrationality. Explanations compatible with the EMH, therefore, have also been studied extensively. Insufficient risk-adjustment does not seem to be the driving force. Information uncertainty, however, is an important factor. Limits to arbitrage in general do play a role in the existence and persistence of the PEAD. Abnormal returns appear to be concentrated in stocks that are more difficult to arbitrage (i.e., small, low liquidity, low volume, high transaction cost stocks).

Given the long history of active PEAD research, there appears to be little room for entirely new factors that could explain the existence, persistence, and variations of the drift. Future research should thus focus on two areas: better isolating individual effects and assessing their relative importance. Firstly, studies on the PEAD so far rely almost exclusively on empirical data. This data is noisy and subject to omitted variable bias. Experimental asset markets could be useful in isolating individual effects while holding everything else constant. They would permit the researcher to control the fundamental value, the information supplied to traders, and the aggregate risk in a market. Secondly, the vast majority of papers are from either the EMH-compatible or EMH-incompatible perspective. Few studies use a broad, multifactorial approach. A comprehensive, empirical investigation into the relative importance of the most important factors could be worthwhile. This would require an interaction model, similar to Zhang et al. (2013), yet extended by behavioral components.

There is evidence that the PEAD has attenuated in recent years (Martineau, 2019), but whether this effect is geographically or temporally confined is not clear. A comprehensive appraisal across markets using the latest data available would be helpful. At the same time, researchers continue to come up with new ways of enhancing the predictive power of earnings surprises for delayed abnormal returns. A consensus on an all-encompassing explanation for the PEAD, therefore, remains elusive. Meanwhile, the PEAD, in one form or another, continues to exist despite highly publicized research and more than half a century of potential arbitrage activity. At the end of the day, given the evidence provided by both camps (EMH-compatible and -incompatible), it is most likely a combination of many factors that explains the anomaly.

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