

Post Earnings Announcement Drift on The JSE Top 40: A Study on Longer Term Holding Periods

Master of Commerce (50% Research) in Finance

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Abstract

This paper studies the existence of the post-earnings announcement drift (PEAD) on the JSE top 40. The sample period used was from 2000-2020. The measures of surprise earnings used in this paper were the standardised unexpected earnings (SUE) and the initial 2-day returns (IR). The existence of PEAD was determined using portfolios sorted half yearly by the surprise measure of which the high minus low quantile spread (QS) was computed. A cross-sectional regression is run to determine if firm characteristics affect the PEAD. Cumulative abnormal returns (CARs) were used as a proxy PEAD and computed using the market model. PEAD drift exists on the JSE top 40, and the QS was found to be persistent for a 480-day trading window for both surprise measures. The PEAD anomaly found by QS was robust to a subsample period and the method of CAR computation. The IR-sorted portfolios generally outperformed the SUE-sorted portfolios. The SUE portfolio coefficients were insignificant in cross-sectional regression, while IR coefficients were up to the 360-day trading window.

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1. Introduction

1.1. Background

The post-earnings announcement drift (PEAD) is a market efficiency anomaly first observed by Ball and Brown (1968). In that paper, they found that abnormal returns increased (decreased) for weeks following the positive (negative) unexpected earnings announcement. PEAD is defined by the persistence of positive (negative) returns following a surprise positive (negative) quarterly earnings announcement (Ball & Brown, 1968; Foster, Olsen & Shevlin, 1984; Swart & Hoffman, 2013). PEAD is a market efficiency anomaly because it contradicts the notion that markets adjust instantaneously to new information. If they did, stock selection based on quarterly earnings should not return abnormal returns different from the market over time. A reason for the PEAD is analyst and investor underreaction (Bernard & Thomas, 1989). This means that investors are slow to react to the new information that is made public during the earnings announcements.

PEAD is a robust anomaly, with multiple papers proving its existence under multiple sample periods (Bernard & Thomas, 1989; Brandt et al., 2008; Foster, 1984; Ball, 1978). PEAD is also a Global anomaly on the JSE (Swart & Hoffman, 2013; Sojka, 2018; Fink, 2021). Swart and Hoffman (2013) are among the few papers that study PEAD in South Africa. This is possible because the PEAD anomaly is a data-intensive anomaly to investigate, and South Africa reports earnings half-yearly instead of quarterly. Despite these limitations, Swart and Hoffman (2013) found that PEAD exists on the JSE.

Unexpected earnings can be identified using a time series model, consensus analysis, and the initial returns to quarterly earnings. Standardised unexpected earnings (SUE) is the independent predictor of PEAD. Early literature used 4-quarters or 1-year lagged earnings as expected earnings, while Foster (1977) introduces a seasonally adjusted time series trend to the lagged earnings. Foster's (1977) expectation model is used by what is considered the seminal paper about PEAD by Bernard and Thomas (1989). Doyle, Lundholm and Soliman (2006) and Livnat and Mendenhall (2006) introduce consensus analyst forecasts as expected earnings. Brandt, Kishore, Santa-Clara and Venkatachalam (2008) assumed the initial market

reaction is the best measure of earnings surprise. This is because it is unbiased by any prediction model and contains all information in the financial report (Brandt et al., 2008). Livnat and Mendenhall (2006) found that the drift from consensus analysts is larger than the time series model. Bernard and Thomas found that drift exists for 240 days for a portfolio with the most extreme SUE and sees a significant return reversal. Using consensus analyst data, Doyle et al. (2006) found that in contrast, when using analyst forecast, the 1st earns significant abnormal returns even after year 2. Brandt et al. find that the abnormal stock returns drift toward the initial returns for four consecutive quarters. Using the time series model and initial returns, Swart and Hoffman (2013) found that PEAD persists for six months. They did not investigate if it could persist longer.

1.2. Motivation for study

PEAD is a robust market anomaly that seems to defy the efficient market. The anomaly is interesting because it is possibly a behavioural, namely, underreaction. What is also fascinating about this anomaly is its connection with earnings announcements and unexpected earnings. The excitement around earnings announcements in the markets means they are predictable large news events that can be studied to view investor behaviour when the unexpected happens. The existence of the PEAD anomaly on the JSE top 40 firms would mean that there are abnormal profits that can be made from trading on earnings surprises.

1.3. Knowledge Gap

PEAD literature is usually focused on the quarter following the quarterly announcements. Swart and Hoffman (2013) mention that little is written about PEAD in South Africa. In their paper, they find evidence of PEAD and underreaction in the JSE using a 6-month holding period. This is done using a sample from 1991-2010. In an earlier paper, Bhana (1995) found a reversal in the lowest earning surprise portfolio, which is evidence of overreaction using a holding period of a year and contradicts Swart and Hoffman (2013). Bernard and Thomas (1989) find that PEAD persists for 240 days using a time series trend, and Doyle et al. (2006) find abnormal returns can persist for two years. The knowledge gap this paper hopes to fill is the possibility of continuing to make abnormal returns on PEAD using different holding periods in South Africa, particularly with our different frequency of reporting from American

markets. The studies of PEAD focus on the quarter following earnings announcement.. which creates a good investigation point for South Africa as earnings reports are usually done bi-annually every six months.

1.4. Research Question

South African companies report their earnings twice yearly through the interim and final reports. This means that the final report would convey more information than if it were done quarterly. The JSE top 40 represents over 80% of JSE market cap. Given the different type of reporting and little PEAD literature for South Africa this paper seeks answer the question, does PEAD exist in the JSE using a sample from 2000-2020.

If PEAD does exist on the JSE, Does the drift persist for 2 years as in Doyle et al, (2006)? Is the drift robust to the Carhart 4-factor model generated returns. Does the PEAD remain when firm level factors are introduced.

This paper uses the time series model and initial return as they are possible. Both methods have been found to last four quarters after the earnings announcement and induce the question of how this will work on the JSE, where earnings announcements are made half-yearly.

1.5. Research Objectives

The research objectives of the study are as follows:

- To find if the PEAD anomaly exists in the JSE top 40 using the time series model and initial returns to calculate surprise.
- If it does exist to see if the persistence can last up to 2 years
- Test if firm characteristics explain PEAD.

1.6. Hypothesis

This paper follows the findings of Swart and Hoffman (2013) that the post earnings announcement drift exists in South African markets. The JSE top 40 can be used as the representative of South African returns because it represents 80% of the JSE market cap. Using the previously found existence of the top 40 as the South African market proxy this paper seeks to find the existence of PEAD using a different sample period from Swart and

Hoffman (2013). Bernard and Thomas (1989), Doyle et al. (2006) and Brandt et al. (2009) have found that the PEAD can persist for longer than a year and up to 2 years. This paper will find if the PEAD study also persists for that long. The PEAD has been found to be robust to firm characteristics (Swart & Hoffman, 2013). This paper will study the effect of firm characteristics on PEAD. This leads to the paper having the following hypothesis

The hypothesis of this study is as follows.

H₀: There is no evidence of post-earnings announcement drift on the JSE Top 40.

H_{1A}: Post-earnings announcement drift exists on the JSE Top 40

H_{1B}: post-earnings announcement drift persists for up to 2 years.

H_{1C}: post-earnings announcement drift is robust to Carhart generated abnormal returns.

H_{1D}: post-earnings announcement drift persists when firm level characteristics are included.

1.7. Section Break Down

This paper will use JSE announcement data from the sample period 2000-2020 to test the hypothesis. The announcements are then sorted into five portfolios based on the magnitude of their surprise earnings, and a quantile spread (QS) is computed from the difference of CARs of the highest and lowest surprise portfolio. The QS for the surprise measures was positive and significant for the 2-year trading window. These results were the same when the full sample period was split into four 5-year subsample periods. The PEAD was not found to be solely a size or value phenomenon. Further testing of the hypothesis was done using cross-section regression. Only for the initial returns measure was PEAD significant until the 360-day trading window.

The rest of the paper is organised as follows. Section 2 is a review of the past literature on the PEAD. Section 3 shows the data selection and methodology for the paper. Section 4 shows the discussion of the results. Section 5 is the conclusions.

2. Literature Review

2.1. Early Research

In Ball and Brown (1968), the authors investigated the meaning of the net income number for investors. They assumed capital markets are efficient and should adjust to new information quickly, leaving no opportunity for abnormal returns in the following periods. They used this assumption to prove that market prices adjusted in line with increased/decreased net income. In their research, they found that only 20% of information was conveyed by the report the month it was released, but they more intriguingly found that the stock prices drifted in the direction of earnings for another six months. This finding was left unanswered for further research. Since the discovery of this drift, it has been found that the phenomenon has survived robustness checks and more data at later periods (Fama,1998). After the initial discovery by Ball and brown, more research was done to widen the knowledge of unexpected earnings announcements.

Jones and Litzenberger (1970), using stock data from 1962-1967, defined unexpected earnings as 1.5 standard deviations apart from the expected level; they found that the companies with positive unexpected earnings had upward drift as they outperformed the S&P index. No difference was noted in those below expectations, probably due to quicker price adjustments after the profit announcement. Jones revisited the PEAD test (Latane & Jones, 1977) using Standardised Unexpected Earnings (SUE). SUE is based on estimated earnings calculated as seasonally adjusted earnings extrapolated from the 20 previous quarters. They ranked the stocks based on SUE and used a 3-month holding period. They found a positive spread between the highest and lowest SUE portfolios, even with portfolios constructed five months after the announcement month. They concluded that excess returns are related to unexpected earnings announcements and market adjustments are slow because unexpected earnings are serially correlated.

Ball (1978) sought to explain his discovery of quarterly drift in 1968. In trying to explain the excess returns found in literature after the earnings announcements, Ball asserts that the profit variable may be a proxy for an absent risk measure. Information processing and transaction costs are put forward and rejected as potential explanations. This is because, in his sample, he has found that they explain direction but not magnitude, concluding that the market shows inefficiencies. Watts (1978) proves that observed significant abnormal returns from earnings

surprises cannot cover transaction costs, and thus, transaction costs are the reason for abnormal returns. Watts (1978) contradicts Ball's (1978) assertion that it is due to a missing risk factor. Rendleman, Jones and Latane (1982) contradicted Reinganum (1981), who concluded that abnormal earnings could not earn abnormal returns as it was insignificant in his data sample of 1975-1977. Rendleman et al. (1982) used the SUE concept of Latane and Jones (1974, 1977) and Reinganum (1981) methodology of making portfolios 1-5 months after the quarter end and found that abnormal returns do exist and are significant in the 1- 5-month portfolio range. Rendleman et al. (1982) also try to find the relationship between portfolio risk and decile returns. They conclude that risk adjustment does not change with abnormal return estimations, and the explanation for PEAD is not in the market risk.

The difference in findings in conclusions for Reinganum (1981) and Rendleman et al. (1982) could be the short sample period of Reinganum (1981). Foster et al. (1984), on a sample period of 1974-1981, found abnormal returns after earnings surprises that persisted for 60 days when using models based on time series regression based on prior quarterly earnings. They found no evidence when using price performance prior to the announcement. Foster et al. also addressed critique by partitioning firms by size and found that the PEAD was statistically significant across all size quintiles. However, the smallest firms had more noticeable drift. Size explained 65% of portfolio variation in the ten deciles. The authors also found that the magnitude of the unexpected earnings change explains 80% of the variation in abnormal returns over the 60 Days. Firm size and surprise magnitude effect account for 85% of the variation across portfolios in their PEAD behaviour. Foster et al. (1984) put forward firm size and magnitude of unexpected earnings as possible omitted risks explaining PEAD.

In summary of and comparison of previous research, Bernard and Thomas (1989) present a paper in which they tried to find two broad explanations for PEAD, namely whether PEAD is a CAPM misspecification or is a product of price delay. In earlier papers, Ball (1978) and Foster (1984) suggest that PEAD abnormal returns are based on omitted risks. The results shown by the authors support their thesis but do not exclude other explanations. Bernard and Thomas (1989) are more preferential to the price delayed price response for the existence of PEAD but know they cannot fully explain why the market cannot respond immediately to earnings information. They split the price response into two groups, namely transaction costs and the inability of the market to fully understand the implications of current earnings for future earnings. Bernard and Thomas (1989) assume that if PEAD is a proxy for some risk measurement, which would show in some losses during the investment period. Using a long

1st decile and short 10th decile portfolio, they generated a profit in all 13 years in their sample and 92% of their observed quarters. They have a cumulative profit of 200% and a loss of 7%. They conclude that their positive results remove missing risk measures as a reason for PEAD. Bernard and Thomas (1989) also found transaction cost explanations to be inconsistent with their results. Using an upper bound of 2-4% for transaction costs each way, depending on firm size, also found that the magnitude of the drift exceeds the transaction costs. They also found that the long position decile does not have lower abnormal returns than short position abnormal returns. If transaction costs explained drift, then it would be the opposite as short positions are more expensive, thus leading me to reject transaction costs PEAD explanation. Like Foster, Bernard and Thomas (1989) found PEAD is more prominent in small firms but is still statistically significant at the 1% level.

Another aspect of PEAD that Bernard and Thomas (1989) looked at is longevity. They found that most drift occurs during the first 60 days, which they identify as the time between quarterly announcements. This means that time beyond 60 days is when the market is biased to the next quarterly data drift. The drift is statistically insignificant after 180 Days. This begs the question of whether drift behaves differently in a market where earnings are reported in a different frequency.

With earnings being serially correlated (Foster, 1977), Bernard and Thomas (1989) state that investors should adjust their next quarterly expectation after analysing the growth path presented in current earnings. This means that investors who ignore the new growth path will react positively to the next earnings report when it should align with their expectations. In A later paper, Bernard and Thomas (1990) looked at price relation to the next quarterly earnings in the period four days before the report to the day it is released. They found that the extreme SUE portfolios earned abnormal returns, which accounted for 40%-25% of the PEAD from small to large firms. Had PEAD been smooth, the five days should account for 10%. Bernard and Thomas (1990) conclude that the results match a market that does not fully adjust for the implications of current earnings to future earnings. Bartov's (1992) findings support this conclusion as he found PEAD disappears when controlling the last three quarterly reports in a LOGIT model earnings surprise forecast.

2.2. Analysts' role in PEAD

Abarbanell and Bernard (1992) studied whether analysts underreact or overreact to prior earnings information and whether that potential bias explains stock behaviour after the profit announcement. They find that analysts underreact to most recent earnings information, which agrees with a naïve seasonal random walk forecast presented by Bernard and Thomas (1989). Abarbanell and Bernard (1992) also find in their calculations that the analyst underreaction is not enough to explain PEAD. Ali et al. 1992 similarly found significant autocorrelation errors in 8-month and one-month forecast errors, which agree that analysts, on average, underestimate the permanence of earnings trends in their forecasts. Contrary to Bernard and Thomas (1989), Ball and Bartov (1995) prove that investors know about and include past earnings in their expectations. In a calculated regression of abnormal returns and past four unexpected earnings, they find that investors only consider 45% of the last quarterly earnings information. Ball and Bartov's (1995) findings show that underreaction might not completely explain PEAD.

Livnat and Mendenhall (2006) looked at earnings surprises between earnings surprises based on time series earnings forecasts and analysts' forecasts. Analyst forecast earnings surprises are the difference between reported earnings and IBES consensus analysts' earnings estimates. Livnat and Mendenhall (2006) repeated the test done by Bernard and Thomas (1989) using a sample from 1987-2003, ranked stocks based on SUE, and divided the ranking into deciles. For analyst forecasts, they found that PEAD was 5.17% per quarter while the time series earnings forecast drift was 4.01%. Both these abnormal returns are statistically significant. They also found that SUE based on time series earnings forecast has a declining positive autocorrelation for three quarters and a negative fourth quarter correlation, like Bernard and Thomas (1989). SUE based on analyst forecast (SUEAF) has a consistent positive correlation. Livnat and Mendenhall (2006) conclude that PEAD for earnings error based on analyst forecast is significantly higher than that of the time series earning error Lerman, Livnat, and Mendenhall. (2007), while adding revenue surprise and extending the data, used a similar methodology to find that a hedged portfolio found surprise using time series earned less abnormal returns than surprise using analyst forecast. The two strategies combined earned statistically significantly more.

Doyle et al. (2006), independently from Livnat and Mendenhall (2006), did similar studies that supported each other. Doyle et al. (2006), using a similar sample time and database,

focused more on the drift's long-term effects and used earnings expectations based on analyst forecasts. They found that firms tend to have persistent earnings surprises in the same direction three years after earnings surprises. Doyle et al. (2006) also found that the mean firm in the extreme decile portfolios is the smallest company, with low analyst coverage and high book-to-market. Doyle et al. (2006) The findings of Livnat and Mendenhall (2006), Doyle et al. (2006), and Lerman et al. (2007) show that analysts have larger forecasts than using time series models. This seems to imply that analysts are worse predictors of earnings than time-series model forecasts.

Clement, Lee, and Yong (2019) also find that the drift analysts forecast for surprise earnings is larger than that of random walk surprise. Their study of the relative drift ratio compared the delayed investor response to the total response. They found that the analyst forecast drift ratio is much smaller than the random walk drift ratio. This means there is less delay to analyst forecast surprises than random walk earnings surprises. They also find that large, sophisticated investors respond more quickly to analyst forecast surprises. This trend gets more prominent over time.

In more recent PEAD studies different types analysts and investor behaviours are studied. He (2023) found that firms that in which analysts had had long term growth forecast (LTG) found that PEAD was lower than those without. The author concluded negative relationship between LTGs and PEAD could be explained by the some previously uncaptured, unobservable firm characteristic. On the basis that short sellers are more informed traders Contreras and Marcet (2021) found that high short covering leads to more speculative markets and stock prices being more sensitive to news. This means that stocks with high covering overreact to good news this was also found for PEAD arbitrage. Another type investor that has been studied in PEAD literature is an algorithmic trader. Chen (2023) firstly, found a significant negative relationship between PEAD and algorithmic trading presence in his cross-country study. Secondly, found that algorithm activity created more efficient prices by mitigating differences, reducing investor distraction and reducing market friction. And finally, he found that the countries with strong investor protection, faster information spreading, and more stringent disclosure requirements had a greater effect on the relationship between algorithmic trading and PEAD.

The different analysts have differing effects on PEAD with analysts that have LTGs and algorithm traders reducing PEAD, and arbitragers cause price overreactions. This combined

with the effect of the difference of analyst forecasts to actual earnings shows that analysts play a large role in PEAD. In markets like South Africa, consensus analyst historical data is lacking, making it difficult to perform (Swart & Hoffman, 2013).

2.3. PEAD Momentum and Reversals

Kaestner (2006) aimed to research this possible hypothesis and, in doing so, find instances of simultaneous overreaction and underreaction. He used the difference between the consensus earnings estimate from the month before the earnings announcement and the actual earnings announcements as the unexpected earnings. He was motivated by Jegadeesh and Titman (1993), who found evidence of high returns for winners around earnings announcements but saw a reversal around 10-12 months after the period, which is consistent with the overreaction. This made Jegadeesh and Titman (1993) conclude that reversal is overreaction and return persistence is underreaction simplistic. This agrees with Abarbanell and Bernard (1992), who address the potential existence of overreaction and underreaction as an issue of methodology. Jegadeesh and Titman (1993) use portfolios of past winners from share returns and find a reversal. Abarbanell and Bernard (1992) state that literature which finds overreaction uses past returns to create portfolios, whereas underreaction literature uses past earnings and earnings surprises. Kaestner (2006), in turn, does measure further than a year while using analyst consensus unexpected earnings found evidence of PEAD, which is in line with past literature (Doyle et al., 2006; Lerman et al., 2007; Livnat & Mendenhall, 2006). He found that portfolios with high unexpected earnings had returns opposite their previous quarter's. This disagrees with Bernard and Thomas (1989) and Doyle et al. (2006), who found that earnings drift can persist up to 480 days after the announcement. Swart & Hoffman (2013) also disagree with the overreaction on the JSE. Evidence of underreaction was found using a sample from 1991-2010. This contrasts Bhana (1995), who found evidence of asymmetrical overreaction to earnings announcements with negative earnings surprises having a profit after 12 months while positive earnings did not.

Chordia and Shivakumar (2006) examined the relationship between earnings and price momentum. They used a zero-risk portfolio with exposure to the most extreme positive and negative deciles of unexpected earnings. They found that price momentum does not subsume earnings momentum, and the opposite is true. Azevedo (2023) also found, using a sample from January 1977 to December 2020, that the earnings momentum subsumes the returns momentum. Their results show that price momentum might be a manifestation of earnings

momentum, and the anomalies might be one. Chordia and Shivakumar (2006) also find that assessed the seasonality of the PEAD strategy. They found the strategy gives positive returns for every month but January. This is consistent with the January effect, where momentum strategies also fail to be profitable, as in Jegadeesh and Titman (1993). Guo and Holmes (2022) find that cultural cognitive dissonance is the reason for cross-country differences in returns for PEAD and momentum strategies. High individualism countries have positive returns on PEAD and momentum regardless of the optimistic or pessimistic state of markets. The returns are greater in an optimistic state for momentum and pessimistic state for PEAD. These findings mean that good news moves slowly in pessimistic times. Low individualism countries do not have significant returns.

Boussaidi and AlSaggaf (2023) found the existence of PEAD, momentum and long run reversal on the Saudi stock market using the sample of January 2010 to December 2019. The PEAD and momentum strategies had a formation holding periods of less than 12 months. The long run or contrarian strategy had formation and holding periods between 36 and 60 months. The PEAD findings were robust to the five-factor model. Momentum returns for the Saudi stock markets had an insignificant alpha when a PEAD variable was added to the Fama and French five-factor model. This means that PEAD explains price momentum. These finding are in line with Chordia and Shivakumar (2006) and Azevedo (2023) that price momentum could be a result of earnings momentum. The contrarian strategy alpha was significantly positive for multiple formation and holding periods even when there were 2,3 and 4 consecutive high earning surprises, which were significant, added to the Fama and French five-factor model. This implies that the abnormal returns of the contrarian strategy are not driven by earnings.

Swart and Hoffman (2013) found that by sorting momentum and initial return quartiles, the quartiles sorted by both had higher excess returns than momentum-sorted quartiles alone. This means the momentum is not an indicator of PEAD, but the inclusion of momentum helps separate winners and losers of excess PEAD returns. They also found that the prior six months' return is a significant and positive predictor of subsequent returns even when including the surprise factors of SUE and IR. Swart and Hoffman (2013) also found evidence of reversals ten days before announcements where losers' ten-day preannouncement had positive excess PEAD returns.

PEAD and momentum can both exist because of investor behaviour, but the literature shows that PEAD is the greater if not dominant effect. The reversals and PEAD anomalies seem to be able to coexist.

2.4. PEAD in Emerging markets

The PEAD is a documented global anomaly that affects both developed and emerging markets (Fink, 2021; Hung, Li & Wang, 2015; Griffen, Kelly & Nardari, 2010; Chen, 2023; Guo & Holmes, 2022). Griffen et al. found that firms with positive earnings surprises had higher returns than those with negative returns in 12 out of 14 emerging markets. The magnitude of excess returns was similar in emerging and developed countries.

At a country level, PEAD has been found in India (Singh & Yadav, 2018). Singh and Yadav (2018) found that PEAD has been found by Indian firms using regression and a paired t-test. The anomaly persisted even when value and size variables were added. South Korea also has evidence of PEAD (Goh & Jeon, 2017; Eom, Hahn & Sohn, 2019). Goh and Jeon (2017) found the returns of the highest SUE decile portfolio to be economically larger than the lowest decile portfolio. Eom et al. (2019) found that individual investors trade opposite to earnings news, which causes underreaction and PEAD. Chen Gao and Liu (2021), in their study of limited attention and PEAD, find that China has PEAD, with the SUE factor significantly contributing to abnormal earnings.

The overall findings of Griffen et al. and the country-level findings, which include the South African findings of Swart and Hoffman (2013), show that the PEAD anomaly is worth studying in an emerging market.

3. Data and Methodology

3.1. Data

The JSE share price data for the JSE top 40 was sourced from the Bloomberg terminal from 2000 to 2020. The JSE top 40 constitutes 80% and should provide a fair representation of the JSE. The top 40 was constructed using shares information of companies listed on the JSE in December 2022. The top 40 companies are sorted yearly using market cap at the end of June. June was selected because it is one of the dates in the top 40 that are balanced. This might create a survivorship bias, but this bias is not important in measuring PEAD (Benard

&Thomas, 1989; Swart & Hoffman, 2013). The Top 40 is used due to the tradability of the companies.

The JSE top 40 earnings announcements were sourced from SENS announcements via IRESS. Another reason for using the top 40 is the ability to get announcement data for the twenty-year sample period under review. The announcements are received from the announcements of the financial results. The sample period chosen is used to investigate the overreaction anomaly and PEAD anomaly that Bhana (1991) and Swart and Hoffman (2013) respectively found on a more recent sample period while still using 20 years like Swart and Hoffman (2013). This led to 1600 observations of earnings per share. The choice of earnings per share must be consistent.

3.2. Methodology

Finding the surprise value starts with computing an unexpected earnings amount. The difference between the expected and actual earnings is considered unexpected earnings, which are then scaled by the standard deviation (Bernard & Thomas, 1989), the absolute value of 1-year lagged earnings (Swart & Hoffman, 2013) or the price at the last quarter (Livnat & Mendenhall, 2006) over the estimation period to give standardised unexpected earnings or SUE. Another method is to use the initial reaction to the earnings announcement to compute surprise (Brandt et al., 2008; Swart & Hoffman, 2013)

After finding the quarterly earnings surprise/unexpected earnings, the standard procedure is to rank the results and split them into quantile portfolios. The highest quantile is the most positive unexpected earnings and the lowest is the most negative. This is known as the SUE strategy used by Bernard and Thomas (1989) and future papers. Swart and Hoffman (2013), in their study of PEAD on the JSE, used 1-year lagged earnings and the initial market reaction as their methods of calculating earnings surprise. This ranking procedure is Swart and Hoffman (2013) but split into quintiles. The holding period for these portfolios can vary, but 60 days is popular because of the time between quarterly earnings announcements. Swart and Hoffman (2013) used 120 days due to how JSE firms report.

3.2.1. Unexpected Earnings

To compute when earnings announcements surprise the market, it is important to determine the expected earnings (Swart & Hoffman, 2013). Livnat and Mendenhall (2006) used the consensus estimates sourced from analysts. For the JSE, there are no databases that track this

information, so different expectation models are needed (Swart & Hoffman, 2013). This paper follows Swart and Hoffman's (2013) methodology of using lagged one-year EPS as an expectation for unexpected earnings. The change in earnings is computed by.

$$UE_{i,t} = EPS_{i,t} - EPS_{i,t-1} \quad (1)$$

Where the EPS is the earnings per share and the $UE_{i,t}$ constitutes the change in earnings. It is important to note that the unexpected earnings (UE) may not be measuring surprise because the market's consensus earnings could be correct regardless of the change in earnings (Swart & Hoffman, 2013). To get the standardised unexpected earnings or SUE, the UE is scaled with the lagged absolute earnings per share value. This method is used by Swart and Hoffman (2013) and is one of the models whose findings showed the existence of PEAD Foster et al. (1984).

$$SUE = \frac{UE_{i,t}}{|EPS_{i,t-1}|} \quad (2)$$

The SUE measure is used because it can persist for four quarters after the earnings announcement (Bernard & Thomas, 1989). This is the same as the initial reaction measure (Brandt et al., 2008). This study computes surprise by using the initial two-day returns post-earnings announcement.

$$IR_i = \sum_{t=0}^2 R_{i,t} \quad (3)$$

The IR_i term is the initial reaction of a firm two days after the time $t = 0$, which is the announcement date with returns being computed by:

$$R_{i,t} = \ln \frac{P_{i,t}}{P_{i,t-1}} \quad (4)$$

3.2.2. Portfolio Construction

The portfolio creation will follow the SUE strategy used by Bernard and Thomas (1989). After computing the SUE, the stocks are ranked semi-annually at the end of June and December by their SUE to be split into quintiles. This creates a sort ranking procedure of portfolios where the most extreme positive SUE will be 5, and the most extreme negative will be 1. This ranking procedure will also be done for the Initial returns where the most positive

would be IR5 and the most negative IR1. The portfolios will then be held for half-year, one-year and two-year holding periods. The strategy to determine abnormal profits will be to long the most extreme portfolio.

3.2.3. Abnormal Returns

Abnormal returns will be needed to assess whether the PEAD anomaly exists. Zarowin (1989) calculated excess return as the return subtracted by the risk-adjusted return. Ingram and Margetis (2010) found that CAPM is an acceptable method for estimating the market to create an expected return. Though there is no unanimous agreement, CAPM is deemed appropriate for this study.

$$AR_{i,t} = R_{i,t} - (\alpha_{i,t} + \beta_{i,t}(R_{ALSI})) + \varepsilon_{i,t} \quad (5)$$

- $R_{i,t}$ is the daily return of share i at time t
- $\alpha_{i,t}$ is the alpha of share?
- $\beta_{i,t}$ is the beta of share i at time t
- $\varepsilon_{i,t}$ the error terms.

The Fama French and Carhart (1997) 4-factor model will also be used for robustness.

$$AR_{i,t} = R_{i,t} - (\alpha_{i,t} + \beta_{i,t}(R_{ALSI}) + \beta_{HML}(HML_t) + \beta_{SMB}SMB_t + \beta_{UMD}(UMD_t + \varepsilon_{i,t})) \quad (6)$$

- HML_t is the risk premium on the book to market factor.
- SMB_t is the risk premium on the size factor.
- UMD_t represents the momentum risk factor.

The data for the market, market cap, and book to market (BtoM) will be obtained from the Bloomberg terminal. The HML_t and SMB_t will be computed using the Fama and French (1993) methodology of sorting the sizes into 3-size portfolios using market cap and sorting value into 3-value portfolios so that you end up with six value-weighted portfolios formed on

size and value. Then, the average of the small-big portfolios forms SMB_t , and the average of the high minus low portfolios becomes HML_t . The momentum factor UMD_t is calculated by taking the previous year's return up to the month before the current date. This is then sorted into three portfolios, and then the average weighted value of the winner portfolio is subtracted from the loser portfolio.

The J203 index, also known as the FTSE/JSE All Share Index, is used as the market proxy. The literature supports its use as a market proxy (Van Rensburg & Robertson, 2003; Willow & Rockey, 2018; Mlonzi, Kruger & Nthoesane, 2011). Abnormal returns are the difference between expected returns and actual returns. The Fama French Carhart 4-factor model will be computed.

The cumulative abnormal returns (CAR) returns are calculated as follows:

$$CAR_{i,t}[p; q] = \sum_{t=p}^q AR_{i,t} \quad (7)$$

Where p and q are the dates relative to the announcement date, which is denoted as 0. $[p; q]$ is the trading window $[2; 480]$, which is split into four 120-day periods such that the windows are w 6-month, one year 1.5 year, and 2-year trading windows. This means $q = 120, 240, 360$ and 480. The other way of estimating abnormal returns is to use the market model or Carhart 4-factor model and compute the $CAR_{i,t}$ from there. The cumulative average abnormal returns (CAAR) are the $CAR_{i,t}[p; q]$ average for each trading window. What will be reported is the CAAR for each portfolio as created from either the SUE measure from equation (2) or the IR measure from equation (3). To check for the existence of PEAD, the difference between the CAARs of highest and lowest surprise will be tested in a pooled T-test. This is known as the high minus low quantile spread (QS) or the hedged return. The process of using a QS to determine PEAD is done by Gerard (2012) and Singh et al. (2018). Gerard (2012) and Clement et al (20) use CAR as proxy drift.

3.2.4. Cross-sectional regression

A Fama McBeth regression of the risk-adjusted return on the Characteristics of the stocks. This will follow Singh et al.'s (2018) methodology of using individual firms as test assets to avoid data snooping biases.

$$CAR_{i,t}[p; q] = c_{0t} + \sum_{m=1}^M c_{mt}Z_{mjt} + e_t \quad (8)$$

$CAR_{i,t}[p; q]$ is the cumulative abnormal returns determined in equation (7) using the market model. Z_{mjt} is the characteristic m at time t , and M is the number of characteristics. The time series averages of these characteristics will be presented. The characteristics will be presented like this:

1. Size, the natural log of the market cap selected at the previous end of June.
2. BtoM, the natural log of book-to-market, was selected at the end of June.
3. Vol, the ln of the rand value of volume
4. Ret12, the cumulative return of the last 12 months
5. D_IR is the half-yearly ranked IR based on (3) converted in codes ranging from 0 to 1 subtracted by -0.5, so the codes range from -0.5 to 0.5. This is done to assign 0 to possible median observation Clement et al. (2019) and Singh et al. (2018) uses coded surprise portfolios.
6. D_SUE Follows the same procedure as D_IR but with SUE, as shown by equation (2)

4. Results

4.1. Descriptive Statistics

Table 1 shows the descriptive statistics of company characteristics and surprise measures. Table 1 also shows the statistics of market model computed CARs for the 120-, 240-, 360- and 480-day trading windows.

Table 1 Descriptive Statistics

name	Mean	SD	Median	Min	5 th %	95 th %	Max
IR	0,00196	0,03907	0,00260	-0,32006	-0,05996	0,06199	0,21578
SUE	1,161	21,238	0,147	-76,787	-0,984	3,278	824,143
Ret12	0,17366	0,33927	0,20669	-1,47285	-0,43320	0,67127	1,33584
BtoM	0,49467	0,33693	0,42052	0,01064	0,10690	1,07128	2,54130
Size	101203	199607	45570	1015	3837	314822	1741716

Volume	3244309	4887792	1701292	211	114643	11844565	73581016
CAR [2,120]	0,00333	0,19314	0,00930	-1,30239	-0,30759	0,28603	1,04177
CAR [2,240]	0,00447	0,28477	0,01733	-1,83315	-0,47073	0,41073	1,48184
CAR [2,360]	-0,00288	0,35435	0,01477	-2,19636	-0,60725	0,53139	2,11517
CAR [2,480]	-0,01404	0,41266	0,01637	-2,81078	-0,71216	0,63182	2,17246

Note: The number of EPS announcements evaluated is 1623

The mean CARs for the 120- and 240- trading windows are positive, whilst those of the 360- and 480-day trading windows are negative. This means there is evidence of reversal from the 1-year and 6-month periods.

4.2. Unexpected earnings

After the announcement date, the initial results are the graphical CAARs of the quintile-sorted portfolios. Then the results are further shown in tables using 6 month increments up to 2 years. This is to get a both visual and numerical version of whether the PEAD exists.

Figure 1 shows the CAARs from the CAPM estimation of abnormal returns. The graph shows the cumulative returns 3 to 120 days after the announcement. The quintiles represent the SUE-sorted portfolios, with Q1 showing the least normalised earnings change and Q5 showing the most. Q1 has a downward trend, with the CAAR staying close to zero until day 50. The line then goes steeply down, with the lowest value happening after 100. The continual downward trend implies PEAD exists for the JSE top 40 for the lowest extreme earnings changes. The negative trend is in line with PEAD literature (Benard & Thomas, 1989; Foster et al., 1984) Q2, being the second least earnings change, has an increase in CAARs until t=50, then has a downward trend showing a short-term reversal to earnings announcement news.

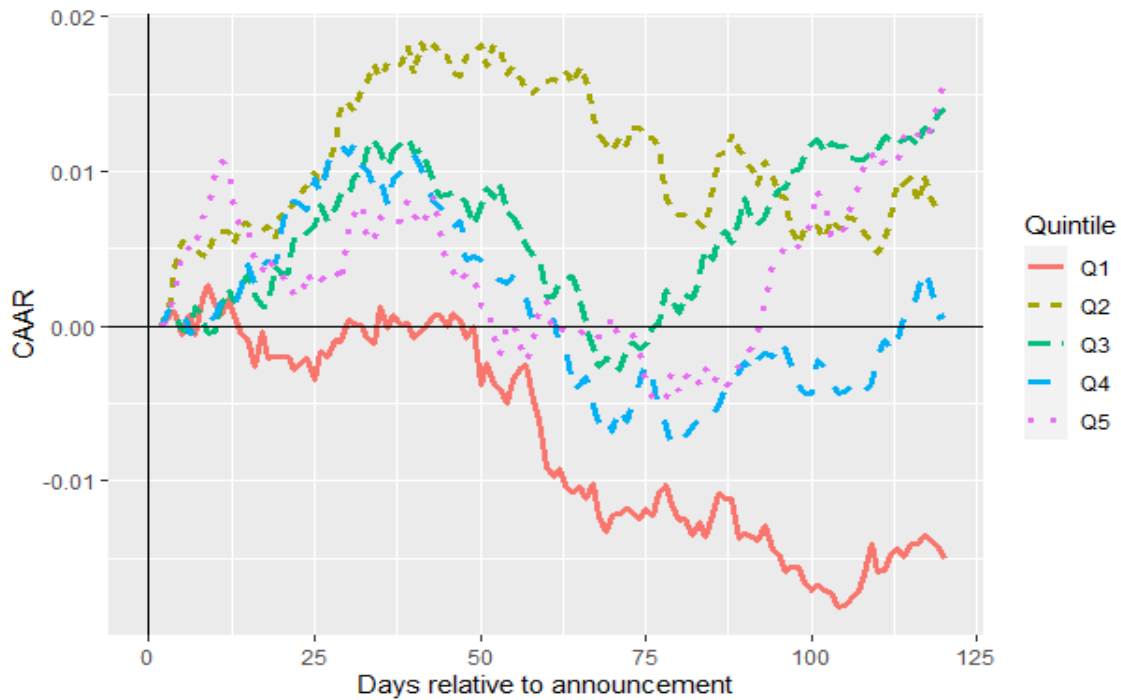


Figure 1 Market-adjusted CAARS sorted using the SUE measure.

As the second least extreme earnings change, it would be expected for Q2 to be like Q1, though reversal to a downward trend does happen at the same time, indicating that negative drift for earnings changes starts 50 days after the earnings announcement. Portfolio Q4's line seems to stay around zero, showing no effect of post-announcement drift. Q3 and Q5 have a similar trend, both increasing to above one percent returns before decreasing to 0. Q3 then has an upward 60 days after the announcement day. This differs from Swart and Hoffman (2013), who found the trend for the non-extreme portfolios to be around 0. Q5 has an upward trend from 87 days after the announcement and has the highest CAAR after 120 days. PEAD literature finds that the portfolio with the highest earnings change has the highest abnormal returns, which Q5 does without the generally positive trend.

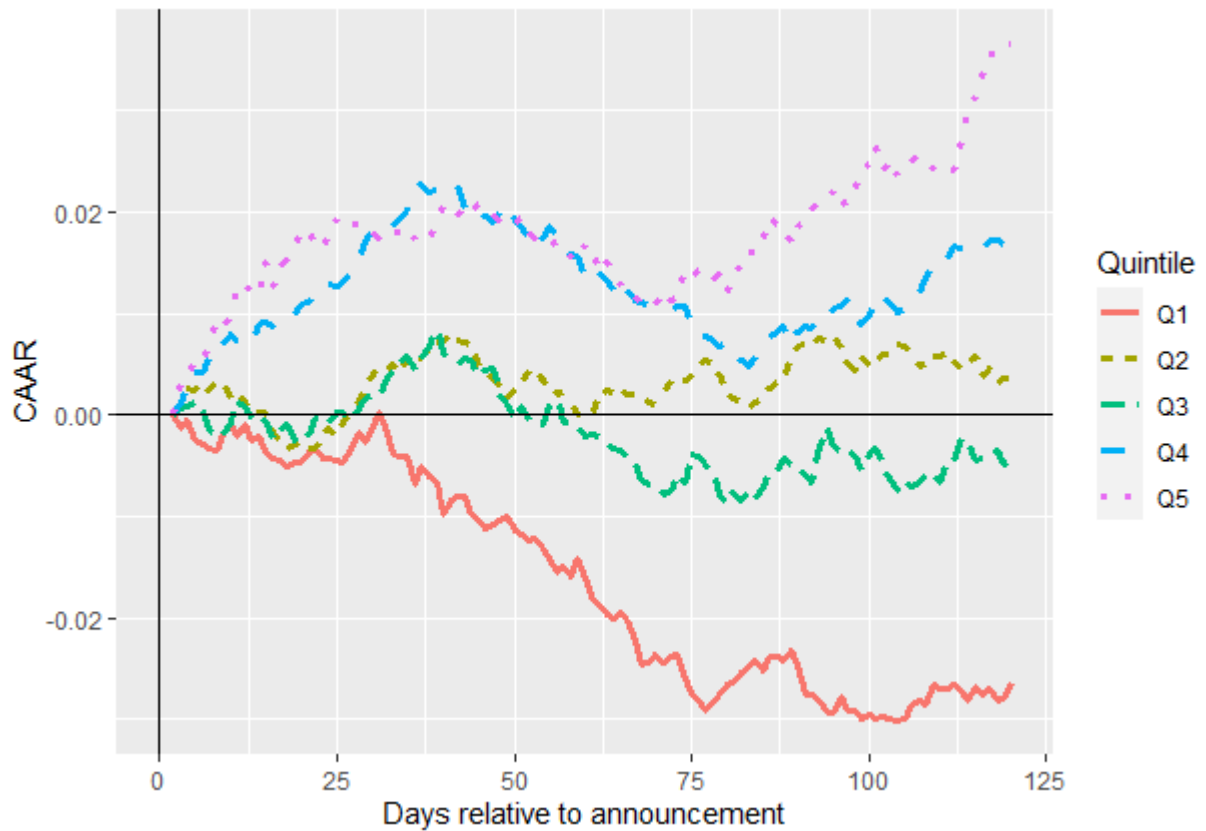


Figure 2 Market-adjusted CAARS sorted using the IR measure.

Figure 2 shows the CAARs from the market-adjusted abnormal return estimation. The quintiles are the IR portfolios sorted into five different portfolios. Q1 is the lowest initial return portfolio based on the cumulative returns of the first two days after the announcement. Q5 is the highest initial returns portfolio. The IR sorted Q1 portfolio has a negative downward trend like the SUE sorted Q1 portfolio. Like the SUE-sorted portfolio, the results show that PEAD does exist on the JSE for the most negative initial returns. Q2 and Q3 are portfolios with the least extreme two-day returns and have a flat trend close to 0% CAARs. Q5 has an upward trend for the 3 to 120 days after the announcement, which is the same as Swart and Hoffman (2013) for the IR measure. Q5 then supports the notion that there is PEAD on the top 40 JSE. The IR-sorted extreme portfolios have more pronounced CAARs than the SUE-sorted portfolios. This agrees with Swart and Hoffman (2013), who found that IR was a more robust measure of PEAD announcements. The conclusion from the market-adjusted CAARs over the 120 days after the announcement is that PEAD does exist on the JSE top 40.

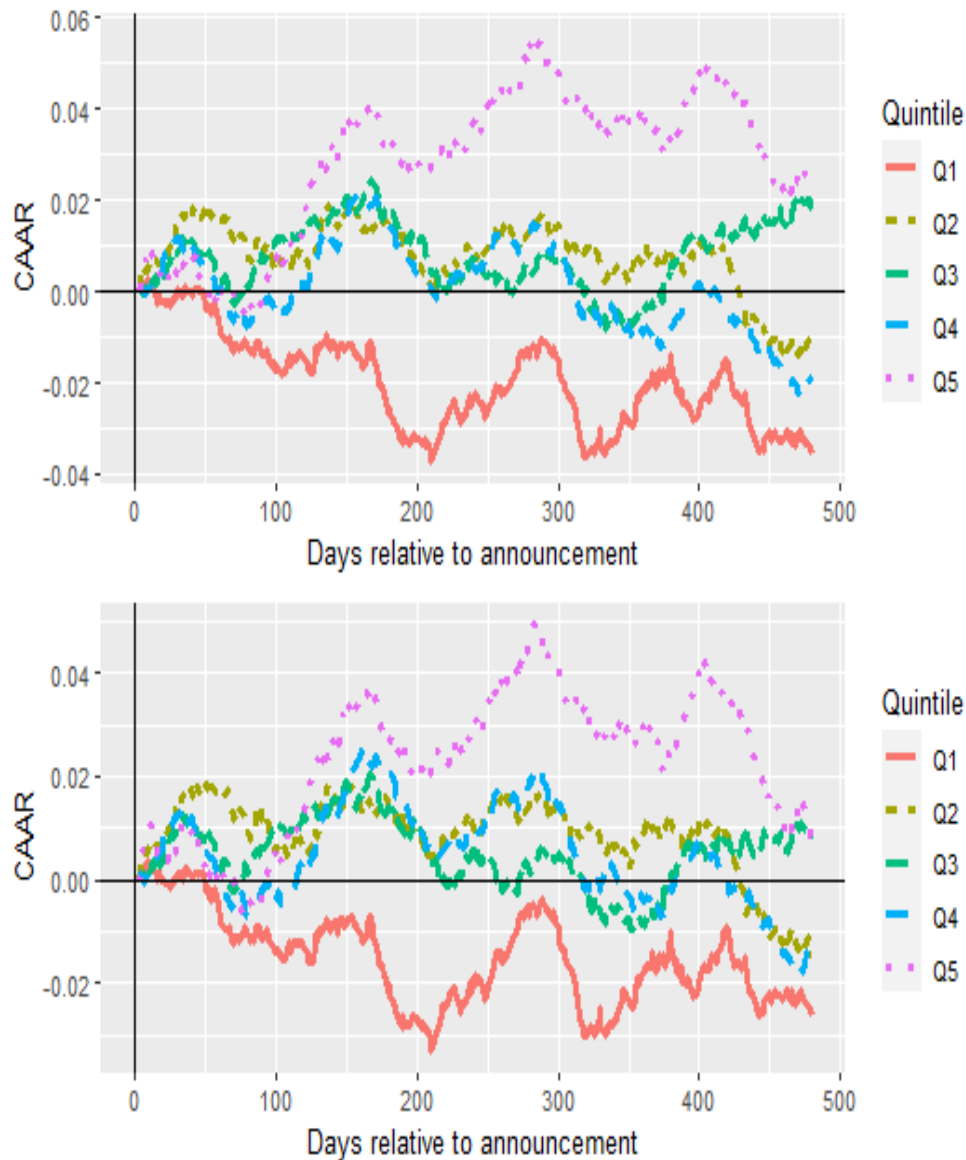


Figure 3 Market adjusted (top) and Carhart 4 factor adjusted (bottom) CAARs of SUE sorted portfolios.

Figure 3 shows the market and Carhart 4 factor adjusted returns of SUE measure sorted quintile portfolios for 480 days after the earnings announcement. The Q2, Q3 and Q4 portfolios remain in the -2% to 2 % range over the 480 days for both adjustment methods. The lowest SUE-sorted portfolio, Q1, has a downward trend, with its lowest value approximately 200 days after the announcement day. The CAARs of the portfolio then rise, peaking 290 days after the announcement and falling again after the peak. This rising and falling shape seems to be mirrored by the Q5 portfolio's CAARs over the 480 days, with peaks at 155, 290 and 400 days after the earnings announcements. The shape of the CAARs

for the Q1 and q5 portfolios shows that they seem to be reversals in the 480 days after the announcement, though the Q5 portfolio does have higher CAARs after day 120 compared to the others. This shows that the highest normalised earnings changes are persistently higher, and the lowest are persistently lower. This supports the hypothesis that the PEAD drift exists in the top 40. The Q5 portfolio does decrease to the other quintile portfolio 480 days after the announcement date after the 400-day peak. This shows that the PEAD might be decreasing as time moves forward.

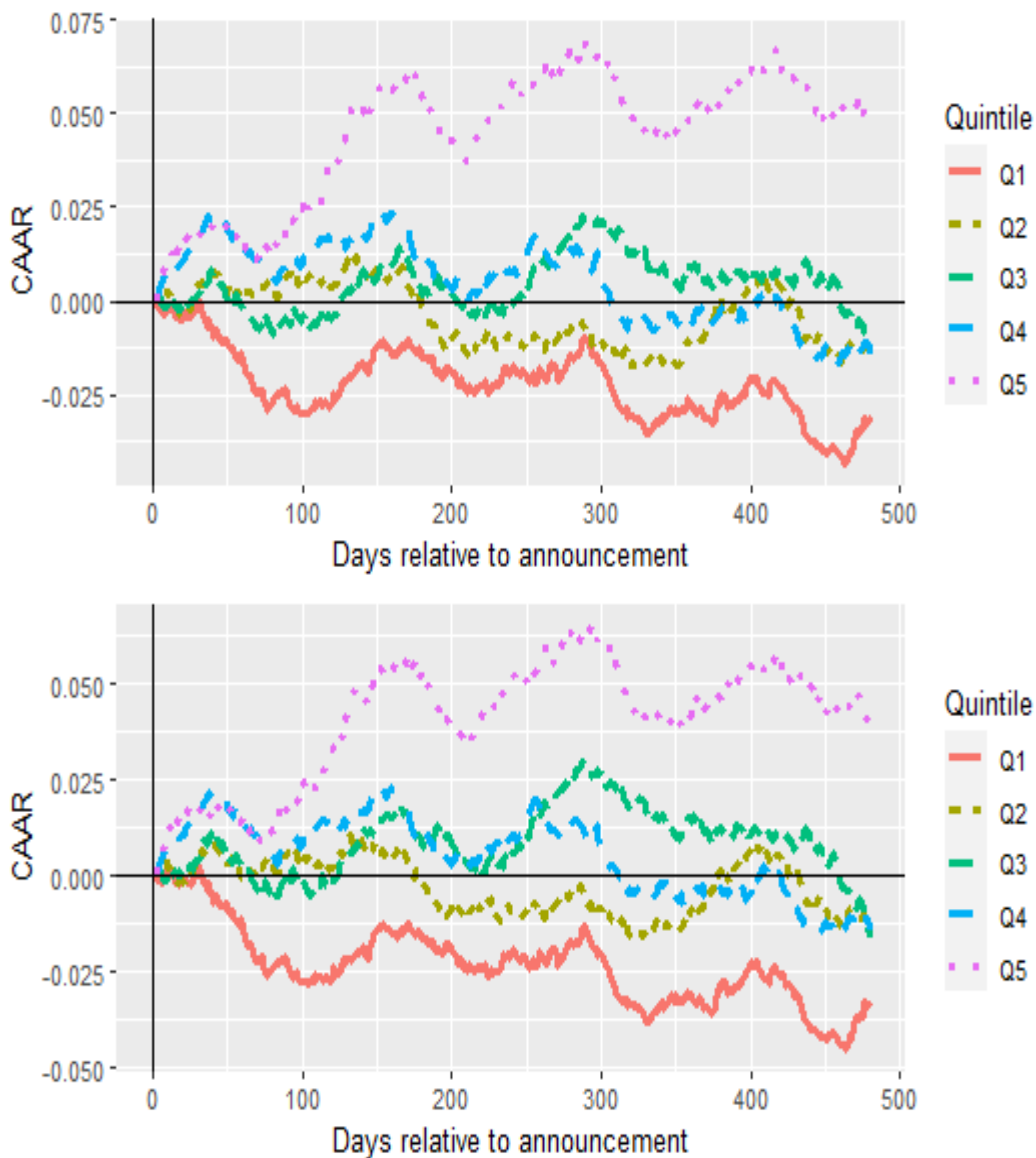


Figure 4 Market adjusted (top) and Carhart 4 factor adjusted (bottom) CAARs of IR sorted portfolios.

Figure 4 market and Carhart 4 factor adjusted CAARs for the IR measure sorted quintile portfolios. As in Figure 3, there is a separation between the middle portfolios of Q2, Q3 and Q4 and the extreme portfolios of Q1 and Q5. Q1 CAARs are consistently lower than the

other portfolio CAARs, and these CAARs are persistent for the 480 days after the earnings announcement. The CAARs for the Q5 portfolio remain consistently above those of the other portfolios up to 480 days or two years after the announcement date. This indicates that PEAD exists 480 days after the announcement date when using IR to measure earnings surprise. The results in Figure 4 show a more obvious sign of PEAD than in Figure 3, particularly for the Q5 portfolio. In Figure 4, the Q5 portfolios have a generally upward trend that peaks at approximately day 300, but the Q5 portfolios of Figure 4 do not converge to the other portfolios 480 days after the portfolio, meaning the IR measure of surprise is better than finding instances of PEAD. For both Figures 3 and 4, the shape of the CAARs is the same when using market abnormal returns compared to Carhart 4 factor model abnormal returns. This indicates that the PEAD anomaly is robust to the size, value and momentum risk factors even for longer returns.

Table 2 Market Model Carhart 4-factor CAAR percentages and for SUE Quintile portfolios

Window	method	SUE.1%	SUE.2	SUE.3	SUE.4	SUE.5	QS.SUE
120	Market	-1.5	0.78	1.41	0.07	1.58	3.08***
	Carhart	-1.31	0.7	1.26	0.1	1.23	2.53***
240	Market	-2.33	0.78	0.68	0.54	3.71**	6.04***
	Carhart	-1.98	1.03	0.56	0.88	3.02*	4.99***
360	Market	-2.2	0.71	-0.39	-0.93	3.89	6.09***
	Carhart	-1.79	0.86	-0.8	-0.43	2.97	4.76***
480	Market	-3.54	-1.41	1.89	-1.95	2.21	5.75***
	Carhart	-2.62	-1.41	0.85	-1.56	0.83	3.45***

Note: This table shows the average market and (Carhart 4 factor) models CAR determined by equations (5) and (7) ((6) and (7)) for SUE sorted portfolios, with 5 being high surprise earnings and 1 being low surprise earnings. QS represents the high minus low returns with their test of difference calculated using Welch's t-test. The trading windows are 6 months, 12 months, 18 months and 24 months after the announcement date. *, **, *** indicate significance at 0.1, 0.05, and 0.01, respectively. Individual portfolio t-tests are done using the student t-test.

Table 1 shows the market model and Carhart 4-factor model abnormal returns for the SUE sorted quintile portfolios for the 120, 240, 360- and 480-day periods after the announcement day. There is no qualitative difference between the market and Carhart models regarding PEAD significance. The magnitudes of the Carhart drifts are less extreme, showing that size value and momentum factors influence abnormal returns.

Focusing on the market model as the model used by Swart and Hoffman (2013), SUE shows the most extreme negative earnings surprise quintile.¹ and the most positive is shown by SUE.5. The SUE2 and SUE3 CAARS remain flat over the 480-day post-announcement period. SUE2 has the CAAR remain at 0.78% throughout the 480 days. SUE3 has CAARs of 1.41% and 1.89% for the 120- and 480-days post announcement, respectively, which is a difference of 0.48%, showing a slight change from six months to two years. SUE4 CAARs decrease from 0.07% to -1.95%. The non-extreme quintiles' CAARs stay within -2 % to 2%. None of the middle quintiles' p-values are less than 0.05 for the observation windows, meaning they are insignificant at the 5% level. This aligns with PEAD literature, which focuses on the extreme quintiles to find PEAD (Benard & Thomas,1989; Benard & Thomas, 1990; Swart & Hoffman, 2013).

SUE1 has CAARs that range from -1.5% to -3.54% 120 to 480 days, respectively, post announcement. This means that for the SUE measure of earnings surprise, the returns continue to decrease over 2years. None of the CAARs in the observation period for SUE1 have a p-value below 0.05, meaning they are insignificant at the 5% level. This means for the SUE measure, there is no evidence of PEAD in the lowest quintile. It is different for the most positive quintile. The magnitude decrease is inconsistent in the six-month intervals of the observation period. The CAARs increase from 1.58% in the first 120 days to 3.89% 360 days post-announcement and decrease to 2.21% by the time the two years are over. Most of the increase in CAARs takes place over the first 240 days of the 480-day post-announcement period. This is also the only period where the p-value is less than 0.05. However, the Carhart 4-factor model is only significant at the 10% level during this period. This means there is evidence of PEAD for the 1-year trading window on the most positive quintile when just going long on the most positive portfolio.

Neither extreme quintile is significant 120 days after the announcement using the SUE measure. The QS.SUE is the difference between positive portfolio CAARs and negative portfolio CAARs. The CAARs are significant for the entire trading window of 2 years for both methods used to compute CARs. This means the PEAD persists for the entire period regardless of how the CAR was computed, though the magnitude of the QS is lower for Carhart-computed CARs. For the market model CAARs, the QS goes from 6.09% to 5.75% in the 360 to 480-day trading period, showing the start of a potential reversal in abnormal returns. This start of a reversal happens after the 1-year mark for the Carhart CAARs.

The existence of the PEAD agrees with Swart and Hoffman (2013), and the persistence for more than 2 years means there is no reversal after one year. The lack of significance in the SUE5 portfolio means that the PEAD might not be as readily available due to stricter short-selling requirements in South Africa as the QS implies going long in the highest surprise portfolio and short on the lowest surprise portfolio.

Table 3 Market Carhart 4-factor model CAAR percentages for IR Quintile portfolios

	Method	IR.1	IR.2	IR.3	IR.4	IR.5	QS.IR
120	Market	-2.64**	0.37	-0.44	1.65*	3.67***	6.3***
	Carhart	-2.55**	0.22	-0.21	1.51	3.29***	5.84***
240	Market	-1.84	-0.99	0.01	0.77	5.69***	7.53***
	Carhart	-2.04	-0.9	0.66	0.98	5.12***	7.16***
360	Market	-2.72	-1.01	0.91	-0.64	4.8**	7.52***
	Carhart	-3.07	-0.84	1.53	-0.72	4.17**	7.24***
480	Market	-3.25	-1.2	-1.3	-1.44	4.83*	8.08***
	Carhart	-3.39	-1.04	-1.59	-1.43	4.05*	7.44***

Note: This table shows the average market and (Carhart 4 factor) models CAR in % determined by equations (5) and (7) ((6) and (7)) for IR sorted portfolios, with 5 being high surprise earnings and 1 being low surprise earnings. QS represents the high minus low returns with their test of difference calculated using Welch's t-test. The trading windows are six months, 12 months, 18 months, and 24 months after the announcement date. *, **, and *** indicate significance at 0.1, 0.05, and 0.01, respectively. Individual portfolio t-tests are done using the student t-test.

Table 2 shows the market model abnormal returns and p-values of the initial return measure quintile portfolios for 120-, 240-, 360- and 480-days post announcement. IR1 shows the lowest quintile, and the highest quintile is IR5. Like the SUE measure, IR2, IR3, and IR4 are within the +/- 2% range, with none of the p-values being lower than 0.05. This lends credence to studying only the extreme portfolios for PEAD, as the middle portfolios are not significant at the 5% level. As with the SUE-sorted portfolios, the IR-sorted portfolios have no qualitative differences in PEAD significance, and the differences in magnitude are not as pronounced.

IR1 has the most negative CAARs for each 120-day interval in the observation periods. This agrees with Swart and Hoffman (2013) and Brandt et al 2008 for the IR measure, who found that the lowest quantile has the lowest CAARs. Over the 2-year period, the PEAD is -3.25%, with 2.64% of the drift occurring within the first six months. The first six months is the only period where the p-value is lower than 0.05. These findings means the abnormal returns are significant at the 5% level, and PEAD exists.

IR5 has the highest CAARs for each 120-day interval post-announcement period. The 240-day period has the highest returns at 5.69%, but the first 120 days account for 3.67%, which is approximately 60% of the 1-year return. The 120-day period would have an annualised return of 7.24% if returns are reinvested every six months. The 120,240 and day returns are significant at the 5 percent level. The longer holding period after one year means the returns no longer increase but remain significant up to 360 days post-announcement. The abnormal returns lose significance at the 2-year holding period. The IR measure for the most positive quintile is persistently positive and significant 18 months after the announcement. This is evidence of PEAD drift on the JSE top 40 for longer holding periods.

There was evidence of PEAD found in both measures of earnings surprise. The 120,240- and 360-day post-announcement CAARs for IR5 were significant, whilst only the 240-day post-announcement was significant for SUE5. The 240-day post-announcement returns for the SUE5 are 1.98% lower than the corresponding IR5 returns, meaning the IR measure has a more pronounced drift. This matches the findings of Swart and Hoffman (2013) and Brandt et al. 2008 who found larger abnormal returns for IR and EAR compared to their respective SUE measures. The IR measure had both the highest and lowest quintile 120-day post-announcement abnormal returns, which were significant. This is in line with findings of PEAD literature, which find the PEAD lasts the period between earnings announcements (Benard & Thomas, 1989; Benard & Thomas, 1990; Kaestner, 2006).

The QS for Table 2 is significant for the entire trading window of two years for both ways of computing CARs. This means the PEAD is present in the JSE top 40 when using the IR measure of surprise earnings. The magnitude of the QS is larger than the SUE measure, which is consistent with Swart and Hoffman's (2013) and Brandt et al.'s (2008) findings on initial returns. The IR measure has a more pronounced PEAD than the SUE measure. Most of the Q'S drift occurs in the first 120 days, with the CAARs being 6.3% and 5.84% for the market and Carhart model and only increasing by 1.73% and 1,6% over the following 360 days. There is not as clear a sign of reversal when using the IR measure for the 2-year trading window. The difference between the market model and the Carhart 4 factor model for each period in the trading window is less pronounced for the IR measure than the SUE measure, showing a higher robustness to the size, value and momentum factors.

The results of Table 2 show that even when using the IR measure, the PEAD is persistent on the JSE top 40 regardless of how CARs are computed. The persistence of the IR5 portfolio

also means that the IR measure is a better measure to use when trying to extract profits in the South African market.

4.2.1. Subsample Period Unexpected Earnings

This sub-section looks at the CARs separated into subsamples. This is done to investigate the PEAD over time. The sample period for the announcement dates is separated into four 5-year subsample periods starting in June 2000 and ending at the end of May 2020. The research procedure is repeated on each subsample of announcement dates. Only the most negative/positive quintiles for the SUE and IR measures will be shown.

Table 4 shows the CAARs of 4 subsample periods for SUE1, SUE5, IR1 and IR5 portfolios. The SUE1 and IR1 are similar in terms of significance. Both portfolios have insignificant values for all subsample periods except 2010-2015. SUE1 has a significant positive CAAR of 11.31% two years post-announcement. The 2010-2015 subsample period has significantly negative CAARs for the 6-month separated post-announcement holding periods for SUE1 and IR1. The negative CAARs' magnitude is larger for SUE1 portfolio than the IR1 portfolio for all the post-announcement periods. The 2010-2015 subsample period being the only persistently negative subsample period means there was a potential shock that lowered returns for that period. This shows that when there is a negative returns environment, the lowest quintile portfolios will have negative returns for the 480-day post-announcement period without the reversal. The 240-day CAARs account for over 50% of 480-day post-announcement returns for SUE1 and IR1.

The 2010-2015 period has significantly negative CAARs for the 360 and 480-day post-announcement for the SUE5 portfolio, further showing negative returns during that subsample period. IR5 had no significant CAARs in the 2010-2015 subsample period, meaning it was not as affected by the negative return period. The only significantly positive CAARs for IR5 were during the 2000-2005 subsample period, and SUE5 also had significantly positive CAARs for all the post-announcement periods, excluding the 120-day post-announcement. SUE 5 had higher CAARs on average for announcements in the 2000-2005 period. SUE5 also had positive CAARs during the 2015 to 2020 subsample period for the 120- and 240-day post-announcement period. Announcements in the 2000-2005 subsample period seem to have experienced high returns been a period of high returns owing to a high-return environment caused by shocks.

Table 4 SUE and IR CAARs split into four 5-year subsample periods with quantile spreads.

Panel A: Subsample periods of the extreme SUE sorted portfolios								
	2000- 2005	2005- 2010	2010- 2015	2015- 2020	2000- 2005	2005- 2010	2010- 2015	2015- 2020
	SUE.1				SUE.5			
120	3.17	-0.63	-6.86***	-2.95	3.04	1.13	-2.08	7.35**
240	4.5	-1.92	-13.02***	-1.39	13***	2.68	-5.45*	9.19**
360	8.33*	-0.44	-15.12***	-3.8	23.1***	2.8	-12.15**	6.76
480	11.31**	0.92	-18.08***	-7.01	27.85***	-0.37	-20.32***	6.78
Panel B: Subsample periods of the extreme IR sorted portfolios								
	2000- 2005	2005- 2010	2010- 2015	2015- 2020	2000- 2005	2005- 2010	2010- 2015	2015- 2020
	IR1				IR5			
120	-2.9	-1.07	-5.28***	-2.26	8.09***	2.42	1.11	4.58*
240	-0.95	1.67	-7.94***	-2.48	11.31***	4.09	0.52	6.02
360	2.23	0.21	-11.96***	-4.64	15.68***	3.87	-2.45	3.07
480	7.42	-1.48	-15.32***	-3.39	20.6***	4.08	-3.35	-1.15
Panel C: The Quintile Spread of SUE and IR sorted portfolios								
	2000- 2005	2005- 2010	2010- 2015	2015- 2020	2000- 2005	2005- 2010	2010- 2015	2015- 2020
	QS.SUE				QS.IR			
120	-0.13	1.76***	4.77***	10.3***	10.98***	3.49***	6.39***	6.84***
240	8.49***	4.6***	7.58***	10.58***	12.26***	2.42***	8.45***	8.5***
360	14.77***	3.24***	2.97***	10.56***	13.45***	3.66***	9.51***	7.71***
480	16.55***	-1.29**	-2.24**	13.8***	13.18***	5.57***	11.98***	2.25**

Note: This table shows the average market model CARs in % calculated using equations (5) and (7) for the SUE and IR sorted portfolios, with 5 being high surprise earnings and 1 being low surprise earnings for the subsample periods split into 4, 5-year periods. QS represents the high minus low returns SUE and IR with their test of difference calculated using Welch's t-test. *, **, *** indicate significance at 0.1, 0.05, and 0.01, respectively. Individual portfolio t-tests are done using the student t-test.

Separating the full sample period into sub-periods shows that the periods of high positive (negative) returns are significant contributors to the sample PEAD. PEAD is not smooth over time and is vulnerable to the return environment. The SUE measure is more vulnerable to shocks that create high return (loss) periods than the IR measure. This is shown by the SUE5 having significantly negative CAARs during the 2010-2015 subsample period or SUE1 having positive abnormal returns two years post-announcement in the 2000-2005 subsample period. This explains why only the SUE5 240-day post-announcement was significant for the sample period using the SUE measure. The changes in CAARs over time also explain the differences (Swart & Hoffman, 2013). Swart and Hoffman (2013) did not have announcements in the 2010-2015 period, and they had significantly positive returns in the 2000-2005 period for both Q1 and Q4 using unexpected earnings. This could explain why

Swart and Hoffman found that SUE was significant for the 120 days for their sample period. The PEAD anomaly being more prominent in high (low) returns environment shows that the anomaly might be sensitive to outside information. This would match the findings of Liang and Zhang (2020), who found that the drift becomes stronger (weaker) when news agrees with prior earnings.

The only QS that is not significant is the SUE spread for the 2000-2005 period over the 120-day trading window. There is a reversal in drift after two years for the SUE QS for 2005-2010 and 2010-2015. The SUE and IR QS generally show that the positive high-surprise portfolios significantly outperform the low-surprise portfolios. This indicates that the PEAD is robust to the sub-periods, particularly when holding for a year. This is consistent with the findings of Singh et al. (2018) and Clement et al. (2019) for the random walk surprises. Whilst the results support the PEAD, there is also variation in the spreads for the sub-sample periods, meaning that the studied period could change the PEAD results. The QS returns were positive even when the markets were negative. The QS surprises do not show a constant decreasing trend from the earlier subsample periods to the later ones, and therefore, this paper cannot confidently say PEAD is decreasing over time. There is no qualitative difference in the significant findings in PEAD for Carhart 4-factor CARs.

4.3. Size and Value Effects

4.3.1. Size

The effects of size are a key feature in PEAD literature (Benard & Thomas, 1989, 1990). Benard and Thomas (1989) included size in their investigation of the PEAD to make sure that the drift was not just a size effect. Size is sorted into five portfolios, creating a combined surprise and size portfolio. CAARs are computed for each combination. Table 5 shows the difference in the two extreme portfolios for each size portfolio.

Table 5 shows that the QS are significant, meaning the high surprise and low surprise portfolios are significantly different from each other regardless of the size of the portfolio or the length of the trading window after two years. The QS of the smallest portfolio sorted by SUE is negative, meaning the hedged returns were negative. In the IR sorted hedged returns, the smallest portfolio shows significant reversal after the 1-year trading window, which remains that way. The IR QS spreads are also higher in the largest portfolio, meaning that for the JSE top 40, the PEAD is more prominent in the larger firms. This is different from the

findings in Swart and Hoffman (2013); the results of Table 5 show that PEAD is not solely a size effect.

Table 5 Size and Surprise sorted CAAR quantile spreads.

	1	2	3	4	5
	<u>QS.SUE</u>				
120	-0.38	9.43***	1.01	10.13***	8.09***
240	-2.14	5.62***	12.85***	16.09***	3.46***
360	1.93	-4.15**	14***	11.15***	-1.7
480	0.48	0.08	15.26***	1.11	4.65**
	1	2	3	4	5
	<u>QS.IR</u>				
120	-1.84	2.75***	0.05	8.24***	10.7***
240	-8.23***	9.82***	7.68***	12.36***	8.96***
360	-7.94***	1.5	6.78***	9.71***	9.14***
480	-17.51***	5.26***	4.37**	1.52	17.41***

Note: This table shows the average CAR in % calculated using equations (6) and (7) for portfolios sorted using surprise (SUE and IR) and the market cap of the previous end-of-June. QS represents the high minus low returns SUE and IR with their test of difference calculated using Welch's t-test. *, **, *** indicate significance at 0.1, 0.05, and 0.01, respectively.

4.3.2. Value

The value effect is also worth mentioning as a potential effect that affects PEAD. The same procedure used for size is used for BtoM, which is also sorted into five portfolios. Table 6 shows the QS for the BtoM portfolios, with 1 being low BtoM and 5 being high BtoM.

The QS is significant at the highest 10% for the SUE-sorted portfolio and at 1% for the IR-sorted portfolios for all the BtoM portfolios over the 120-day trading window. The magnitudes of the QS are also relatively flat, with less than 0.1% difference between the lowest and highest BtoM portfolios. For the SUE measure, the QS is significant and persistent for the whole 2-year window for portfolios 3,4 and 5. Portfolios 1 and 2 show significant reversal after the 6-month window. For the IR measure, only the Highest BtoM shows reversal after one year

Table 6 Value and Surprise sorted CAAR quantile spreads.

	1	2	3	4	5
	<u>QS.SUE</u>				
120	5.92***	1.76*	7.64***	5.24***	6.11***
240	-1.86	0.71	12.25***	6.86***	11.17***
360	-1.67	-7.97***	14.01***	7***	7.78***
480	1.97	-7.17***	12.36***	7.54***	8.95***
	1	2	3	4	5
	<u>QS.IR</u>				
120	6.49***	4.74***	4.98***	9.19***	6.41***
240	8.21***	7.91***	6.54***	18.61***	6.35***
360	14.89***	1.66	5.89***	33.05***	-8.29***
480	16.85***	3.5**	1.73	30.26***	-8.92***

Note: This table shows the average CAR in % calculated using equations (6) and (7) for portfolios sorted using surprise (SUE and IR) and the BtoM of the previous end-of-June. QS represents the high minus low returns SUE and IR with their test of difference calculated using Welch's t-test. *, **, *** indicate significance at 0.1, 0.05, and 0.01, respectively.

PEAD is robust to value sorting, and value does not explain the excess returns. The value sorts also do not seem to play a large factor in the pronouncement of the anomaly. For both the size and value sorts there is no qualitative difference in PEAD between CARs calculated using the market model or the Carhart 4-factor model see (Tables A- 2 and A- 3).

4.4. Cross-sectional regression

The cross-sectional regression is done to determine whether controlling for variables such as size, value in the form of BtoM, Momentum in the form of the previous 12-month returns, illiquidity from the Amihud illiquidity will reduce the significance of the CAR over the 120-, 240-, 360- and 480-day trading windows. This is shown in Table 7.

Table 7 Panel A shows that the coefficient on D_SUE portfolios is positive but not significant in almost all the trading windows. The only significant coefficient is the D_SUE model (2) coefficient, which is the CAR for the 240-day trading window at 10%. This means the only evidence of PEAD on SUE portfolios is for the 1-year trading window. The IR portfolios are significant for models (1), (2), and (3) of the results in panel A. The high surprise IR portfolios can expect to earn more CARs for the 120,240- and 360-day trading windows. This is evidence of the PEAD existing in the JSE top 40. The results for D_SUE and D_IR are not different when the controls are included. The D_SUE coefficients lose all significance. The surprise portfolios are never significant for the 480-day trading window. This means that surprise portfolios have less impact as time moves forward. The significance of the regression

results more closely resembles the behaviour of the individual portfolios as they get larger rather than the returns of QS, as Singh et al. (2018) suggest the Fama McBeth regression would.

Only the Size and BtoM coefficients are significant for the whole trading window. The negative coefficient on size means that relatively small JSE top 40 firms earn more profit than large firms. The positive coefficient for the BtoM portfolios shows that relative value firms in the JSE top 40 perform better than growth firms. These results are consistent with the findings of size and value premiums of Fama and French's (1993) model. There is no qualitative difference with Carhart computed CARs see (Table A- 4).

Table 7 Fama McBeth Regressions

Panel A: Regression				
	CAR [2;120]	CAR [2;240]	CAR [2;360]	CAR [2;480]
	(1)	(2)	(3)	(4)
(Intercept)	0.25 (0.2876)	-0.55 (-0.3006)	-1.12 (-0.582)	-1.28 (-0.677)
D_SUE	2.38 (1.3032)	5.15* (1.6886)	4.35 (1.3048)	4.65 (1.0759)
D_IR	5.5*** (4.459)	6.21*** (4.3395)	6.78*** (2.9271)	4.85 (1.5479)
Panel B				
	CAR [2;120]	CAR [2;240]	CAR [2;360]	CAR [2;480]
	(1)	(2)	(3)	(4)
(Intercept)	18.72* (1.9747)	24.55 (1.5511)	36.85 (1.4968)	48.76* (1.7874)
D_SUE	1.53 (0.8818)	4.48 (1.5748)	3.12 (1.024)	1.88 (0.4459)
D_IR	5.07*** (4.0589)	5.88*** (3.8423)	5.41** (2.2033)	4.14 (1.3655)
AI	-0.38 (-0.7218)	-1.03 (-1.4309)	-0.63 (-0.528)	-0.35 (-0.2585)
BtoM	1.8* (1.9405)	3.52** (2.5436)	4.67*** (2.715)	6.1*** (3.1473)
Rvol	-0.2 (-0.4953)	-0.59 (-0.8719)	-0.7 (-0.8522)	-0.92 (-0.8576)
Size	-1.98*** (-2.9535)	-2.9*** (-2.7697)	-3.36*** (-3.0924)	-3.77*** (-2.921)
Ret 12	4.87 (1.4974)	2.53 (0.4908)	3.11 (0.4791)	3.73 (0.4963)

Note: The half-yearly time series averages the characteristics of McBeth regressions. Market CAR is computed from equations (5) and (7). The coefficients are in percentage. T-statistics in parenthesis. *, **, *** indicate significance at 0.1, 0.05, and 0.01 respectively

5. Conclusion

The PEAD anomaly was first discovered by Ball and Brown (1968). It is a robust anomaly found globally in both emerging and developed markets (Fink, 2021; Hung et al., 2015; Griffen et al., 2010). The PEAD was also found in South Africa on the JSE by Swart and Hoffman (2013).

This paper set out to find whether PEAD exists in the JSE top 40 by using multiple measures and methods of determining PEAD. This paper also looked to see if the PEAD would persist for two years. Following Swart and Hoffman (2013), this paper used the SUE and IR measures of surprise to rank JSE's top 40 firms half-yearly and used both sorts and QS to determine if PEAD exists. A Fama McBeth regression was run to see the effects of size, value, liquidity and previous returns on the surprise portfolios.

The results from the individual SUE sorted portfolios indicate that the SUE measure does not have strong PEAD. The only significant CAAR was the highest portfolio over the 240-day trading window. In contrast, the IR measure sorted portfolio had significant returns for the lowest portfolio for the 120-day trading window and all the trading windows for the highest portfolio. The High minus low QS is significant for both measures and all trading portfolios. These results show that PEAD exists on the JSE top 40 for both measures, but the SUE measure does not capture surprise as well as the IR measure. The method of computing CARs did not change the qualitative results of the PEAD.

The PEAD anomaly might be sensitive to the selected sample period, as when a positive(negative) return environment exists, significant and persistent abnormal returns match the direction. This effect is larger for the SUE measure than the IR measure of surprise earnings. This is the same as the findings of Brandt et al. (2008). The QS for both measures was significant at the 120-, 240- and 360-day trading window. This shows that profits can be earned on hedged returns even in negative earning environments. There is a reversal for the 2005-2010 and 2010-2015 at the 480-day trading window for the SUE QS. The sorted portfolio subsample analysis results show that PEAD anomaly is robust to subsamples, but the different subsamples can impact its magnitude.

The cross-sectional regression results on CARs reaffirm that IR portfolios better capture PEAD than SUE portfolios. The D_SUE coefficient was only significant at 10% for the 240-day trading window in the regression with just the coded surprise portfolios. When the controls were introduced, the D_SUE lost all significance. The D_IR coefficient was

significantly positive for the 120- 240- and 360-day trading windows at the 1 % significant level. This significance remained even when controls were introduced. This means that PEAD exists for the IR measure of surprise, and size, liquidity, value and momentum characteristics do not subsume this surprise. The sorted by size and IR portfolios show that size impacts PEAD but is not the only explanation of the anomaly. The value IR sorted portfolios show that PEAD persists even when value is included.

PEAD is present in the JSE top 40 and can persist for one and a half years when measured by initial returns. The IR measure of returns better captures earnings surprise than the SUE measure. The PEAD anomaly is robust to how CARs are calculated. The anomaly is also robust to company characteristics.

This paper adds to PEAD literature using a more recent sample period in the South African context. It also introduces a longer trading window to see how long the PEAD anomaly persists. The paper also includes a subsample period to see the effects of time on the PEAD anomaly in South Africa. An area of study would be why the SUE sorted portfolios do not perform as well in detecting surprise. The effects of COVID-19 would also be interesting.

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Appendix A. Tables using Carhart 4-factor CARs.

Table A- 1 SUE and IR CAARs split into four 5-year subsample periods with quantile spreads.

Panel A: Subsample periods of the extreme SUE sorted portfolios								
	SUE.1				SUE.5			
	2000- 2005	2005- 2010	2010- 2015	2015- 2020	2000- 2005	2005- 2010	2010- 2015	2015- 2020
120	1.86	-0.19	-4.23**	-1.97	2.26	0.95	-0.75	6.85**
240	1.34	-0.69	-8.55**	-0.39	11.21***	2.24	-2.49	8.49**
360	4.62	0.82	-9.01**	-3.05	19.93***	2.97	-7.24	5.71
480	6.81	3.05	-10.49**	-6.34	23.21***	-0.2	-13.95**	4.22
Panel B: Subsample periods of the extreme IR sorted portfolios								
	IR1				IR5			
	2000- 2005	2005- 2010	2010- 2015	2015- 2020	2000- 2005	2005- 2010	2010- 2015	2015- 2020
120	-3.85*	-1.15	-3.65**	-1.56	8.36***	1.46	1.7	5.18*
240	-2.75	0.78	-5.17*	-1.82	9.37***	3.59	2.28	6.62*
360	-0.89	0.03	-7.93**	-4.68	12.81***	2.78	0.13	4.45
480	3.31	-1.12	-10.11**	-3.56	16.37***	2.68	-0.53	0.71
Panel C: The Quintile Spread of SUE and IR sorted portfolios								
	QS.SUE				QS.IR			
	2000- 2005	2005- 2010	2010- 2015	2015- 2020	2000- 2005	2005- 2010	2010- 2015	2015- 2020
120	0.41	1.14***	3.48***	8.82***	12.21***	2.61***	5.35***	6.75***
240	9.87***	2.93***	6.06***	8.88***	12.12***	2.81***	7.45***	8.44***
360	15.3***	2.14***	1.77**	8.76***	13.71***	2.75***	8.06***	9.13***
480	16.4***	-3.25***	-3.46***	10.56***	13.06***	3.81***	9.58***	4.27***

Note: This table shows the average Carhart 4-factor CARs in % calculated using equations (5) and (7) for the SUE and IR sorted portfolios, with 5 being high surprise earnings and 1 being low surprise earnings for the subsample periods split into 4, 5-year periods. QS represents the high minus low returns SUE and IR with their test of difference calculated using Welch's t-test. *, **, *** indicate significance at 0.1, 0.05, and 0.01, respectively. Individual portfolio t-tests are done using the student t-test.

Table A- 2 Size and Surprise sorted CAAR quantile spreads.

	1	2	3	4	5
	<u>QS.SUE</u>				
120	-0.18	8.88***	0.58	7.13***	6.88***
240	-1.24	4.08***	12.23***	11.85***	2.69***
360	2.19	-4.93***	12.38***	6.4***	-1.28
480	1.32	-1.99	9.49***	-4.17**	4.78**

	1	2	3	4	5
	<u>QS.IR</u>				
120	-2.19*	2.87***	0.93	7.43***	7.74***
240	-9***	11.16***	8.36***	10.47***	6.51***
360	-7.74***	5.86***	6***	7.38***	6.4***
480	-19.68***	10.45***	3.29*	-0.15	14.72***

Note: This table shows the average CAR in % calculated using equations (6) and (7) for portfolios sorted using surprise (SUE and IR) and the market cap of the previous end-of-June. QS represents the high minus low returns SUE and IR with their test of difference calculated using Welch's t-test. *, **, *** indicate significance at 0.1, 0.05, and 0.01, respectively.

Table A- 3 Value and Surprise sorted CAAR quantile spreads.

	1	2	3	4	5
	<u>QS.SUE</u>				
120	4.03***	0.72	7.75***	5.19***	4.7***
240	-4.83***	-1.06	11.67***	6.94***	10.21***
360	-4.21**	-11.66***	12.41***	7.45***	7.67***
480	-2.16	-10.95***	10.66***	6.02***	7.81***

	1	2	3	4	5
	<u>QS.IR</u>				
120	7***	3.82***	4.97***	8.18***	4.97***
240	10.75***	6.3***	7.42***	17.72***	3.13**
360	18.6***	-0.7	6.49***	32.15***	-9.47***
480	21.38***	-0.53	2.4	30.22***	-11.12***

Note: This table shows the average CAR in % calculated using equations (6) and (7) for portfolios sorted using surprise (SUE and IR) and the BtoM of the previous end-of-June. QS represents the high minus low returns SUE and IR with their test of difference calculated using Welch's t-test. *, **, *** indicate significance at 0.1, 0.05, and 0.01, respectively.

Table A- 4 Fama McBeth Regressions

Panel A				
	CAR [3,120]	CAR [3,240]	CAR [3,360]	CAR [3,480]
(Intercept)	0.48 (0.6494)	-0.38 (-0.2314)	-0.99 (-0.5777)	-1.27 (-0.852)
SUE	1.78 (0.9975)	4.19 (1.4903)	3.16 (1.0315)	2.92 (0.7366)
IR	5.23*** (4.0075)	6.16*** (4.0869)	6.53*** (3.1633)	4.42 (1.5657)
Panel B				
	CAR [2,120]	CAR [2,240]	CAR [2,360]	CAR [2,480]
(Intercept)	16.95* (1.8161)	18.06 (1.0917)	30.85 (1.2542)	40.49 (1.5311)
AI	-0.36 (-0.6451)	-1.26* (-1.6823)	-0.71 (-0.5903)	-0.53 (-0.4124)
BtoM	1.49* (1.7308)	3.19** (2.4556)	4.2** (2.6135)	5.57*** (3.0403)
Rvol	-0.2 (-0.4973)	-0.54 (-0.8291)	-0.61 (-0.8758)	-0.75 (-0.81)
Size	-1.76*** (-2.9952)	-2.58** (-2.481)	-2.89** (-2.6667)	-3.27*** (-2.6987)
Ret12	4.56 (1.4005)	1.92 (0.3806)	1.43 (0.2223)	2.49 (0.3471)
IR	4.94*** (3.9676)	6.08*** (3.8984)	5.73** (2.5601)	4.46 (1.6412)
SUE	1.19 (0.7131)	4.18 (1.5541)	2.83 (0.9772)	1.72 (0.4286)

Note: The half-yearly time series averages the characteristics of McBeth regressions. Carhart 4-factor CAR is computed from equations (6) and (7). The coefficients are in percentage. T-statistics in parenthesis. *, **, *** indicate significance at 0.1, 0.05, and 0.01 respectively