

FULL OF SURPRISES

**A QUANTITATIVE STUDY ON LIMITS TO ARBITRAGE AND
POST-EARNINGS-ANNOUNCEMENT DRIFT IN SWEDEN**

ANNA ASGEIRSDOTTIR

SOFIA DERNINGER

Master Thesis

Stockholm School of Economics

2024



Full of Surprises: A Quantitative Study on Limits to Arbitrage and Post-Earnings-Announcement Drift in Sweden

Abstract:

This paper investigates whether the post-earnings-announcement drift anomaly still is present in the Swedish stock market and if the size of the drift can be attributed to limits to arbitrage. Using market data from the Stockholm Stock Exchange, we provide evidence of stock prices drifting after positive earnings surprises. The asymmetry of the drift thus reveals stock prices reacting differently to positive versus negative earnings shocks. We show that the returns from a hedge strategy exploiting the drift stem from the long position in positive earnings surprises and that 11% on average can be earned annually based on a three-month holding period. The lack of a downward drift discloses that short-sale constraints do not prevent arbitrageurs from exploiting the drift. Instead, we find that the magnitude of the drift is affected by limits to arbitrage proxied by investor sophistication, firm size and transaction costs. Our results are robust to the Fama-French (1993) and Carhart (1997) four-factor model. This study contributes to an understanding of market efficiency and how it is influenced by market frictions.

Keywords:

Limits to Arbitrage, Market Frictions, Post-Earnings-Announcement Drift

Authors:

Anna Asgeirsdottir (42358)
Sofia Derninger (24720)

Tutors:

Anders Anderson, Associate Professor, Department of Finance

Examiner:

Anders Anderson, Associate Professor, Department of Finance

Acknowledgements:

We wish to direct our gratitude towards Anders Anderson for his feedback, guidance and support.

Master Thesis

Master Program in Finance

Stockholm School of Economics

© Anna Asgeirsdottir and Sofia Derninger, 2024

Contents

1. Introduction	3
2. Post-earnings-announcement drift and limits to arbitrage	5
2.1. Post-earnings-announcement drift	5
2.1.1. A global phenomenon	5
2.1.2. Returns from trading strategies	5
2.1.3. Variation in earnings surprise methodologies	6
2.1.4. First hypothesis	6
2.2. Explanations of the drift	7
2.2.1. Limits to arbitrage	8
2.2.2. Second hypothesis	10
2.2.3. Description of limits to arbitrage variables	11
3. Data	14
4. Methodology	15
4.1. Post-earnings-announcement drift	15
4.1.1. Earnings surprise measure	15
4.1.2. Portfolio formation	16
4.1.3. Event analysis	17
4.1.4. Regression analysis	18
4.2. Limits to arbitrage and post-earnings-announcement drift	20
4.2.1. Descriptive statistics of arbitrage proxies	20
4.2.2. Limits to arbitrage analysis	21
5. Empirical results	23
5.1. Post-earnings-announcement drift findings	23
5.1.1. Indicative drift results	23
5.1.2. PEAD strategy findings	25
5.1.3. Additional robustness test	30
5.2. Limits to arbitrage findings	31
5.2.1. Indicative arbitrage results	31
5.2.2. Regression results for arbitrage strategies	33
6. Conclusion	36
References	38
Appendix	43

1. Introduction

Post-earnings-announcement drift describes the tendency for a stock's price to move in line with an earnings surprise for a period of time after an earnings announcement. Studies by Foster et al. (1984) and Bernard and Thomas (1989, 1990) belong to some of the prominent papers in determining the drift as an anomaly. Anomalies contradict established asset pricing theories and signal that the market might be inefficient (Novy-Marx and Velikov, 2016). Counter to the semi-strong form of the efficient market hypothesis in which prices react fast and correctly to new information (Fama, 1970), anomalies constitute predictable patterns in stock prices which can yield abnormal returns (Fama and French, 2008).

Nevertheless, once research regarding anomalies is published, they tend to disappear, become weaker in power or change direction (McLean and Pontiff, 2016; Schwert, 2003). For example, the anomaly called the January effect, which is the tendency to earn abnormal returns in the month of January, became weaker after the 1990s and later could not be found for certain periods (Anginer et al., 2024). Chordia et al. (2014) show that firm characteristics related to anomalies such as momentum, size and short-term reversals have considerably lower returns after being recorded. Unlike other anomalies, the post-earnings-announcement drift continues to be found and is claimed to be one of the most persistent anomalies (Livnat and Mendenhall, 2006; Zhang and Gregoriou, 2020). In addition, studies show that significant returns of around 10% on an annual basis can be earned from trading strategies exploiting the drift (e.g., Battalio and Mendenhall, 2011; Liu et al., 2003; Setterberg, 2011). The phenomenon poses the question of why arbitrageurs do not exploit the well-known drift and ensure market efficiency.

The answer may lie in impediments to arbitrage preventing arbitrageurs from leveraging mispricings (Barberis et al., 2002). Arbitrageurs are for instance exposed to arbitrage risk in the form of idiosyncratic volatility which cannot be hedged (Mendenhall, 2004; Pontiff, 2006; Wurgler and Zhuravskaya, 2002). Moreover, transaction costs can make arbitrage difficult to execute and reduce the profitability of exploiting mispricings (Ng et al., 2008).

In this paper, we investigate whether the drift still exists in the Swedish stock market as well as if the anomaly can be attributed to limits to arbitrage. Our sample consists of listed companies on Nasdaq Stockholm during the period 2004-2021. We hypothesize that arbitrage in practice is risky and costly. Based on proxies of arbitrage risk, transaction costs, investor sophistication and size, we explore whether limits to arbitrage prevent arbitrageurs from eroding the drift.

Despite the attention and long-lived nature of the drift, there is a void in the research about the anomaly in the Nordic market. Hitherto, Setterberg's (2011) study based on the period 1990-2005 remains the only published article studying the drift in Sweden. We contribute to the existing research on post-earnings-announcement drift by filling the gap in the literature regarding the anomaly in the Swedish market. Our updated dataset on the Swedish market enables us to investigate how the drift has developed over time. In addition, our paper contributes to the current literature regarding market frictions and limits to arbitrage. To our knowledge, we are the first to study limits to arbitrage in a post-earnings-

announcement setting on the Swedish stock market and we thus provide sought-after research in the field concerning market frictions. A better understanding of these market frictions is valuable to all research regarding the efficiency of the Swedish stock market (Setterberg, 2011).

We provide evidence of the post-earnings-announcement drift still being present in the Swedish stock market. Our results show that the drift is asymmetric around earnings announcements and that stock prices drift following positive earnings surprises. Accordingly, our findings disclose that stock prices react differently to firms exceeding and firms falling short of their quarterly earnings expectations. We discuss how this finding may be related to investor behavior. Given the asymmetry of the anomaly, we show that the long position in stocks with the most positive earnings surprises drives the return of our long-short strategy based on the drift. Robust to the market, size, value and momentum effects, we document that a mean return of 11% annually can be earned based on a three-month holding period. The results hence confirm our first hypothesis of the anomaly existing in Sweden, yet only for positive earnings surprises.

Considering the lack of a drift after negative earnings surprises, our results suggest that limits to arbitrage in the form of short-sale constraints do not constitute a force of the drift. By using proxies of arbitrage risk, trading costs, investor sophistication and size, we try to capture the barriers to arbitrage that may remain in the long leg of our trading strategy. Our results show that hedge positions in more difficult to arbitrage stocks over a three-month holding period yield mean returns that exceed a trading strategy based solely on earnings surprises. We thus find support for our second hypothesis of the drift's magnitude being attributable to limits to arbitrage. Specifically, 7% more on average per year can be earned from sorting the strategy on low institutional ownership and firm size. Moreover, our results indicate no drift for corresponding positions in stocks that are easier for arbitrageurs to trade on. These findings are robust to the Fama-French (1993) and Carhart (1997) four-factor model.

Our results of a downward drift are in line with the study by Setterberg (2011) which documents a drift in the Swedish stock market pertaining to positive earnings surprises. She also finds that a hedge strategy exploiting the anomaly generates a yearly return of 11%. Additionally, our study aligns with previous research advocating that mispricings are more likely to prevail in stocks that are more difficult for arbitrageurs to trade on and that impediment to arbitrage affects the size of the drift (e.g., Bhushan, 1994; Gerard, 2012; Ng et al., 2008; Mendenhall, 2004; Zhang et al., 2013).

The remainder of our paper is structured as follows. In section 2, we review the literature on post-earnings-announcement drift and the drift's relation to limits to arbitrage as well as present our hypotheses. In section 3, we describe the data and sample followed by our methodology in section 4. In section 5, our empirical results are shown and explained. Lastly, in section 6, we provide concluding remarks and suggestions for future research.

2. Post-earnings-announcement drift and limits to arbitrage

This section is structured accordingly. Firstly, we review the literature surrounding the post-earnings-announcement drift and develop our first hypothesis. Secondly, we discuss potential drivers of the drift and describe limits to arbitrage in relation to the anomaly. We also develop the second hypothesis and present our proxies of limits to arbitrage.

2.1. Post-earnings-announcement drift

The post-earnings-announcement drift (PEAD) was first documented by Ball and Brown (1968) and has since then continued to be recorded across geographies and industries (e.g., Doyle et al., 2006; Hung et al., 2015).

2.1.1. A global phenomenon

The drift is a global occurrence and found in established as well as emerging financial markets (Griffin et al., 2010; Hung et al., 2015). Although most studies are conducted on American stock exchanges (e.g., Battalio and Mendenhall, 2011; Bernard and Thomas, 1990; Chan et al., 1996; Foster et al., 1984; Hirshleifer et al., 2009; Kim and Kim, 2003), several country-specific examinations have been made. Zhang and Gregoriou (2020) show that the drift is present in the UK. Dische (2002) reports proof of the anomaly in Germany. Forbes and Giannopoulos (2015) find the anomaly in Greece. Forner and Sanabria (2010) provide evidence in support of the drift in Spain. In Turkey, the drift is found by Yilmaz et al. (2020). Outside of Europe, Truong (2010) documents the anomaly in New Zealand. Chudek et al. (2011) present evidence of the anomaly in Canada. In Asia, the stock price pattern is for example found in South Korea (Goh and Jeon, 2017), China (Truong, 2011) and India (Harshita et al., 2018). However, some studies do not find the drift in certain markets. Among these papers are Ariff et al. (1997) and Van et al. (1996) who fail to find the anomaly in Singapore and Belgium respectively.

Despite being a widely analyzed anomaly, not least in Europe, the drift has been studied to a limited extent in the Nordic capital markets. To our knowledge, Setterberg (2011) remains the only paper covering the drift in the Swedish market. She finds evidence of the anomaly during the period 1990-2005. Setterberg shows that the drift is more protracted in the Swedish stock market and significant for a twelve-month holding period which is longer compared to other financial markets. The only other country-level studies from the Nordics are based on the Finnish stock market. Booth et al. (2011) find evidence of the drift over their research period 1995-2003. Contrary to Setterberg, Booth et al. show that the drift is more powerful for negative earnings surprises.

2.1.2. Returns from trading strategies

PEAD is not only a widespread anomaly that has existed for a long time, studies show that trading strategies based on the drift can generate substantial returns. Setterberg (2011) documents that a hedge portfolio also known as a long-short strategy, long stocks with the most positive earnings surprises and short stocks with the most negative earnings surprises, in Sweden yields a monthly return of 0.9% which

corresponds to an annual return of about 11%. In addition, she finds that the returns of the strategy only are generated by the long position. From a strategy based on the same long-short logic, Liu et al. (2003) obtain a 10.8% twelve-month return in the UK. Dische (2002) shows that abnormal cumulative returns of 6.64% can be earned over a six-month holding period in the German market. In the U.S. market, Battalio and Mendenhall (2011) show that a yearly return of 14% can be generated through a hedge portfolio net of transaction costs. Nonetheless, lower average returns of 6.3% by Bernard et al. (1997) have also been found in the U.S. stock market. In Spain, Forner et al. (2009) generate an average cumulative return of 7.3% in one year. Truong (2010) attains 6% in excess return during the first quarter after portfolio formation in the New Zealand stock market.

2.1.3. Variation in earnings surprise methodologies

The methodologies used to investigate the drift differ among studies. One domain in which methods differ from each other regards the construction of the earnings surprise measure. The idea is to capture the difference between actual earnings and an estimate of expected earnings. This difference gives the unexpected earnings and by scaling the metric, using for example price or standard deviation, the earnings surprise measure is formed. Several early studies use a time-series model approach in which expected earnings are estimated through a time-series regression (Bernard and Thomas, 1989; Foster, 1977; Foster et al., 1984; Hew et al., 1996). Another common time-series forecast method is to base the earnings surprise measure on a seasonal random walk (Ayers et al., 2011; Battalio and Mendenhall, 2011; Jegadeesh and Livnat, 2006; Zhang et al., 2013). In the seasonal random walk model, the forecasted earnings equal the reported earnings per share for the same period one year prior.

A later stream of literature uses analysts' consensus forecasts as expected earnings (Battalio and Mendenhall, 2011; Milian, 2015; Wang et al., 2018). Doyle et al. (2006) argue that the returns following this expected earnings estimate method are larger and last for a longer period compared to the seasonal random walk approach. Livnat and Mendenhall (2006) also find that the drift is larger with analysts' forecasts. However, using analysts' forecasts has implications for a study's sample. Since smaller and less liquid stocks are covered by analysts to a lower extent the approach yields samples containing firms with larger market capitalizations and share prices (Battalio and Mendenhall, 2011).

Several studies further use an indirect price-based earnings surprise measure often referred to as earnings announcement return (EAR) (e.g., Brandt et al., 2008; Booth et al., 2011; Gerard, 2012; Liu et al., 2003; Milian, 2015). This approach includes calculating a buy-and-hold abnormal return around each earnings announcement date. How many days the return is calculated over can vary, usually a short return window of around two to four days is applied. An advantage of this method is that it reflects how value-relevant the earnings surprise is. The measure can be interpreted as more complete since it incorporates all valuable new information communicated to the market (Gerard, 2012).

2.1.4. First hypothesis

The study by Setterberg (2011) which documents a PEAD in the Swedish stock market provides support for a drift still prevailing in Sweden. Nevertheless, Setterberg's study was based on the period 1990-2005. Yet, the drift in general has shown perseverance and is still being documented (Zhang and

Gregoriou, 2020). Additionally, numerous country-level studies in Europe with updated research periods that find a drift (e.g., Forbes and Giannopoulos, 2015; Forner et al., 2009; Yılmaz et al., 2020; Zhang and Gregoriou, 2020), lend further support for the anomaly continuing to be present in Sweden. Consequently, our first hypothesis is the following:

H1: There exists a statistically significant post-earnings-announcement drift in the Swedish stock market.

2.2. Explanations of the drift

There is a lack of agreement on what causes the post-earnings-announcement drift. Overall, explanations of the drift can be grouped into rational explanations, that revolve around the drift being a compensation for risk, and behavioral explanations, that draw on investor underreaction. Our paper builds on the second strand of literature. PEAD has been referred to as the “granddaddy of underreaction events” by Fama (1998, p. 286). If investors underreact to earnings news, stock prices will update with a delay which subsequently leads to the pattern of the drift. Nonetheless, the origin of the underreaction has been attempted to be attributed to various phenomena such as investor inattention, psychological biases and limits to arbitrage.

The body of literature that relates limited attention to investor underreaction argues that investors are exposed to a vast amount of information which makes them distracted and restricts their attention (Kempf et al., 2017). As a result, investors react slower to earnings news leading to the drift. The delayed reaction from investors is especially true if many companies publish earnings information around the same time or if the earnings announcements also contain other news (Hirshleifer et al., 2009; Hung et al., 2015). However, by creating attention around an earnings announcement through headline salience investors may react faster and consequently dampen the drift (Huang et al., 2018).

Part of the explanations surrounding investor underreaction involve psychological biases that affect investors’ information processing behavior. Among these biases is overconfidence. PEAD has in part been tried to be ascribed to overconfident investors who value private information more relative to public information and are overconfident in less trustworthy information (Liang, 2003). The tendency to rely more on private information is heightened in environments with high information uncertainty which in turn amplifies the drift (Jiang et al., 2015). Another bias called the disposition effect describes the habit of investors to realize returns and endure losses. The disposition effect can cause investors to underreact because the trading behavior prevents prices from declining after negative earnings surprises and rising after positive earnings surprises subsequently enhancing the drift (Frazzini, 2006). The anchoring effect is a psychological bias in which people use reference points often entailing that they overly rely on the first piece of information they receive (Epley, 2004). Huang et al. (2019) propose that investors have defined “target prices” for stocks which constitute foreseeing anchors. Investors are more probable to sell when the target price is surpassed. The resistance to sell until a certain price is reached

and the propensity to sell after a specific price point can create slow reactions to earnings news and hence lead to a post-earnings drift in stocks' prices according to Huang et al.

2.2.1. Limits to arbitrage

Any behavioral explanation of PEAD relies on the absence of arbitrageurs exploiting the drift (e.g., Forner and Sanabria, 2010). The concept of market efficiency proposed by Fama (1970) rests upon arbitrageurs, also known as unbiased or rational investors (e.g., Mendenhall, 2004; Pontiff, 2006), eroding arbitrage opportunities in which security prices deviate from their fundamental value. Arbitrageurs hence enforce market efficiency through their trading activity (Akbas et al., 2016). The reason why the drift exists and has been able to persist thus relates to limits to arbitrage, which is the aim of this paper to investigate.

An arbitrage opportunity is widely considered a risk-free profit available at zero cost. However, the arbitrage theory proposed by textbooks is less clear-cut to execute in the real stock market as arbitrage may involve costs and risk. Hence, prices that do not equate with their fundamental value do not automatically entail profitable investment prospects. As a result, mispricings can persevere and the idea that there exists "no free lunch" can thus hold in efficient as well as inefficient markets (Barberis et al., 2002).

Arbitrage risk

Arbitrage risk is commonly defined as a stock's idiosyncratic volatility which investors cannot hedge. Idiosyncratic risk is a holding cost, that is the cost investors face during the period they hold a stock. Since arbitrage risk cannot be offset, arbitrageurs are forced to take the risk into account and may hence not be able to exploit mispricings in stocks with higher idiosyncratic risk. Idiosyncratic risk is further argued to be the largest impediment to arbitrage (Pontiff, 2006).

Some suggest that arbitrageurs are specialized and undiversified (Mendenhall, 2004; Shleifer and Vishny, 1997; Wurgler and Zhuravskaya, 2002). This view implies that arbitrageurs to a lower extent can diversify away idiosyncratic risk making the risk of significance to arbitrageurs. However, Pontiff (2006) states that idiosyncratic risk is important irrespective of whether arbitrageurs are diversified or not.

One of the often-cited papers on limits to arbitrage is by Shleifer and Vishny (1997). They study noise trader risk which is the risk that prices move against the arbitrageur's position in the short run. Shleifer and Vishny include agency problems in their study because, in reality, arbitrageurs are often portfolio managers investing other people's capital. Closing a position early can be costly and thus prevent arbitrageurs from taking certain positions which in turn can cause mispricings. Wurgler and Zhuravskaya (2002) examine limits to arbitrage in relation to S&P 500 index inclusions using a measure of arbitrage risk resembling idiosyncratic volatility. Their research shows that stocks with high arbitrage risk exhibit higher average price jumps when being included in the index compared to stocks with low arbitrage risk.

Arbitrage risk has further been found to be positively correlated with PEAD. The arbitrage risk measure created by Wurgler and Zhuravskaya is used by Mendenhall (2004) who investigates arbitrage risk in relation to quarterly earnings announcements. Mendenhall shows that arbitrage risk has a significant impact on the drift. Research by Ng et al. (2008) also finds that arbitrage risk reduces arbitrageurs' trading on PEAD. In Europe, Gerard (2012) finds that PEAD is stronger for stocks with higher idiosyncratic volatility. In addition, Gerard documents that the returns of trading strategies based on the drift are mainly generated in times of high total idiosyncratic risk. A more recent paper by Hung et al. (2015) investigates PEAD pre and post the compulsory enactment of the International Financial Reporting Standards (IFRS) in 2005. With idiosyncratic volatility as a proxy for arbitrage risk, they record that limits to arbitrage comprise a significant force of the drift.

Transaction costs

Transaction costs compose another obstacle for arbitrageurs. If investors react slower to news regarding stocks that are more costly to trade this underreaction can help explain the post-earnings-announcement drift. Several studies find transaction costs to be positively correlated with the drift (e.g., Hung et al., 2015; Ng et al., 2008; Mendenhall, 2004; Zhang et al., 2013). Research by Ng et al. (2008) for example shows that high drift stocks, i.e. stocks with a higher degree of mispricing, exhibit higher transaction costs and vice versa. Nevertheless, Doyle et al. (2006) argue that market frictions can shed light on why the anomaly is difficult to profit from but may not explain why the drift exists. However, Ng et al. oppose this view and claim that transaction costs can indeed explain the persistence as well as the occurrence of the anomaly.

Transaction costs are often excluded in research investigating the drift (Setterberg, 2011) and there exists disagreement regarding whether PEAD strategies are profitable after considering transaction costs. Novy-Marx and Velikov (2016) and Zhang et al. (2013) argue that trading strategies aimed at capturing the drift have considerably lower returns once transaction costs are taken into account. A number of other papers in contrast report significant returns net of transaction costs (e.g., Battalio and Mendenhall, 2011; Ke and Ramalingegowda, 2005; Li, 2016).

Several proxies are used to measure direct and indirect transaction costs. Some of the more common proxies include the illiquidity measure by Amihud (2002) (e.g., Chordia et al., 2009; Hung et al., 2015), share price and trading volume (e.g., Bhushan, 1994; Mendenhall, 2004; Truong, 2010) as well as bid-ask spread (e.g., Battalio and Mendenhall, 2011; Li, 2016).

Investor sophistication

Stocks that have a higher share of sophisticated investors are argued to be mispriced to a lower extent (Bartov et al., 2000). One of the more common proxies of investor sophistication is institutional ownership. Bartov et al. (2000) argue that institutional investors are more sophisticated because they are less prone to underreact to earnings news. They show that the drift is smaller for higher degrees of investor sophistication. Hung et al. (2015) find that after a wide adoption of IFRS, the drift is reduced more for stocks with a higher proportion of institutional ownership. Institutional holding is further

researched by Doyle et al. (2006) who show that market frictions prevent sophisticated investors from taking advantage of mispricings. Moreover, in the paper by Booth et al. (2011) foreign institutional investors constitute sophisticated investors. They find that foreign institutional investors respond faster to earnings news compared to domestic investors. Booth et al. suggest that PEAD is partly attributed to investors' unlike ability in processing information. Ke and Ramalingegowda (2005) divide institutional investors into three categories based on their investment horizon. They find that only the group called "transient institutional investors", that is institutional investors with short investment horizons, capture PEAD whilst the other two groups are unable to take advantage of the anomaly.

In addition, small investors have been hypothesized to constitute less sophisticated investors. Research by Battalio and Mendenhall (2005) and Ayers et al. (2011) suggests that the behavior of small investors may be the source of the drift. In a later study by Clement et al. (2019), several proxies for investor sophistication are used such as analyst following and institutional ownership. They show that firms with a higher degree of sophisticated investors have a higher responsiveness to earnings surprises based on analysts' forecasts.

Firm size

Like many anomalies, the magnitude of PEAD is inversely related to firm size (Bernard and Thomas, 1989; Foster et al., 1984). However, firm size is further connected to other characteristics that influence the drift (Bartov et al., 2000; Bhushan, 1994).

Firm size is for example related to the limits to arbitrage notion and is commonly used as a proxy for limits to arbitrage (Ali et al., 2003; Israel and Moskowitz, 2013; Lakonishok et al., 1994; Pontiff, 1996). Smaller stocks are for instance associated with greater trading frictions (Israel and Moskowitz, 2013) and the fact that the drift is lower for larger stocks has been argued to stem from larger stocks being easier for arbitrageurs to trade on (Milian, 2015). Moreover, firm size is connected to short-sale constraints and Wang et al. (2017) find that the drift is larger and lasts longer for stocks that are more difficult to sell short.

In addition, firm size is also related to limits to arbitrage through investor sophistication as smaller stocks tend to have a lower fraction of sophisticated owners. Apart from using firm size as a proxy for arbitrage costs, Lakonishok et al. (1994) estimate investor sophistication using firm size. Truong (2010) includes various arbitrage proxies in his study of PEAD and specifically relates firm size to investor sophistication as well as a size effect. Clement et al. (2019) use firm size as a proxy for investor sophistication and show that the drift is less pronounced for large firms.

2.2.2. Second hypothesis

Since previous studies find the anomaly to be driven by limits to arbitrage in the form of arbitrage risk (Gerard, 2012; Hung et al., 2015; Mendenhall, 2004; Pontiff, 2006), transaction costs (Hung et al., 2015; Ng et al., 2008; Zhang et al., 2013), investor sophistication (Ayers et al., 2011; Clement et al., 2019; Hung et al., 2015) and firm size (Bartov et al., 2000; Milian, 2015; Truong, 2010), we believe

impediment to arbitrage affects a possible drift in the Swedish stock market as well. Building on the notion of arbitrage being risky and costly, our second hypothesis is the following:

H2: The magnitude of the post-earnings-announcement drift in the Swedish stock market is attributable to measures of limits to arbitrage.

2.2.3. Description of limits to arbitrage variables

We use four variables to investigate the second hypothesis regarding whether limits to arbitrage drive PEAD in the Swedish stock market. The variables are based on proxies for arbitrage risk, transaction costs, investor sophistication and size. A summary of the variables along with the expected sign of each variable's impact on the drift is provided in Table 1.

We follow Wurgler and Zhuravskaya (2002) and use idiosyncratic volatility as a proxy for arbitrage risk. In line with Mendenhall (2004), we only consider one of Wurgler and Zhuravskaya's two measures of idiosyncratic risk since their two proxies are highly correlated with each other. We label the variable ARBRISK and calculate it as the residual variance from regressing a stock's return on the return of the OMXSPI over 48 months until one month before an earnings announcement. The residual variance is derived by subtracting the explained variance in the regression model from the total variance. The regression specification of the model used is:

$$R_{i,d} - Rf_d = \beta_i(R_{m,d} - Rf_d) + \varepsilon_{i,d} \quad (1)$$

where $R_{i,d}$ denotes the return of stock i on day d and Rf_d represents the risk-free rate on day d , proxied by the 1-month Swedish Treasury Bill. $R_{m,d}$ is the market return on day d , proxied by the OMX Stockholm PI (OMXSPI).

We use trading volume as an indication of transaction costs like Bhushan (1994) and Mendenhall (2004). VOLUME is calculated as a stock's daily adjusted closing price one month before an earnings announcement multiplied by the average number of stocks traded per day in the previous quarter divided by the average market capitalization in the previous quarter.

Consistent with previous studies (e.g., Bartov et al., 2000; Hung et al., 2015; Mendenhall, 2004), we proxy investor sophistication by institutional ownership. Institutional ownership, which we call INST, is computed as a stock's proportion of shares outstanding owned by institutions in the previous quarter. We use Capital IQ's ownership classification to categorize shareholders as institutional. In addition to institutional ownership, we tried including analyst coverage as a proxy for investor sophistication. However, analyst coverage in general in Sweden is relatively low (Setterberg, 2011) and there is scarce data availability regarding analyst coverage. As a consequence, we obtained an insufficient number of observations which led us to exclude the variable from our study.

In line with prior research (Bartov et al., 2000; Hung et al., 2015; Milian, 2015; Truong, 2010), we include a firm size variable as size is connected to impediment to arbitrage as well as to control for the drift being related to a size effect. We calculate SIZE as a company's average market capitalization from the previous quarter.

Table 1. Summary of Explored Limits to Arbitrage Variables

Variable name	Description	Proxy	Expected sign
ARBRISK	Residual variance from regressing a stock's return on the market over 48 months up until one month before an earnings announcement.	Arbitrage risk	+
VOLUME	Daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization.	Transaction costs	-
INST	Proportion of shares outstanding institutionally owned.	Investor sophistication	-
SIZE	Market capitalization.	Firm size	-

This table provides a summary description of the explanatory variables. VOLUME, INST and SIZE are based on prior quarter figures.

3. Data

The sample in this paper consists of companies listed on Nasdaq Stockholm during 2004-2021. The main source used to retrieve stock market data is Finbas at the Swedish House of Finance Research Data Center from which daily adjusted closing prices, daily trading volume and monthly market capitalizations are gathered. Finbas provides stock market data until 2021, which as a consequence constitutes the final year of our study. Additionally, the index OMX Stockholm PI (OMXSPI) is used to proxy the market return and is downloaded from Nasdaq Nordic's website. Given a lack of updated risk factors in the Fama-French (1993) and Carhart (1997) four-factor model on the Swedish market, the U.S. factor returns are used for the size, value and momentum factors. The daily value-weighted American risk factors are downloaded from Kenneth French's website at Dartmouth. We view this approximation as legitimate considering the universal nature of the four-factor model (Fama and French, 1993). We use Swedish stock market data for the market factor in which the OMXSPI is the market return proxy. The 1-month Swedish Treasury Bill available at Sveriges Riksbank's database is used as a proxy for the Swedish risk-free rate.

Earnings announcement dates are gathered from Refinitiv Eikon for which Thomson Reuters Datastream is the source. Missing observations in the earnings announcement date data are manually filled in using announcement dates provided by Nasdaq Nordic. The stocks in the dataset are further classified according to industry using Worldscope's industry classification. Finally, the proportion of institutional ownership for each stock is retrieved from Capital IQ. Ownership data is available from 2004 which thus limits our study to begin from 2004.

To preserve the comparability of the dataset, financial firms have been removed from the sample. Hence, we omit companies with a Global Industry Classification Standard of 4, which is six companies. In addition, the sample is adjusted for firms not reporting according to the calendar year. 34 companies are removed from the entire sample period and nine companies are removed for certain years as their fiscal year later coincides with the calendar year. This adjustment is in line with prior studies like Setterberg (2011) and facilitates the implementation of our methodology. Moreover, we only include the sample firms' common shares. Accordingly, the full sample in our paper consists of 503 unique firms and 16,270 quarterly observations between 2004 and 2021.

4. Methodology

In this section, we first describe the methodology concerning the post-earnings-announcement drift. Thence, we present the methodology for testing whether the drift is related to limits to arbitrage.

4.1. Post-earnings-announcement drift

In brief, the PEAD methodology is based on sorting stocks into quintiles according to the magnitude of the stocks' earnings surprises. We begin by studying the drift using an event study. After that, we conduct a regression analysis to evaluate how our long-short trading strategy, called the PEAD strategy, based on the drift performs.

4.1.1. Earnings surprise measure

In line with several previous studies (e.g., Booth et al., 2011; Gerard, 2012; Liu et al., 2003; Milian, 2015), we use the price-based earnings surprise measure called earnings announcement return (EAR). The measure is given by the buy-and-hold abnormal return (BHAR) following earnings announcements. Consistent with Liu et al. (2003), we calculate the BHAR over four days, -1 to +2 days around the earnings announcements where day zero is the announcement date. If the return window coincides with a non-trading day, the return of the subsequent trading day is used. The earnings surprise measure is calculated accordingly:

$$EAR_{i,d} = \prod_{d=-1}^2 (1 + R_{i,d}) - \prod_{d=-1}^2 (1 + R_{m,d}) \quad (2)$$

where $EAR_{i,d}$ is the four-day abnormal return for stock i on day d , $R_{i,d}$ represents the return of stock i on day d and $R_{m,d}$ is the market return proxied by OMXSPI on day d .

By constructing the surprise measure on market data, we avoid data issues that are otherwise common in European papers. For example, data on reported earnings per share and analysts' earnings per share forecasts for European countries are often deficient and with low reliability (Gerard, 2012). We further seize the aforementioned benefits of a price-based earnings surprise measure through employing EAR.

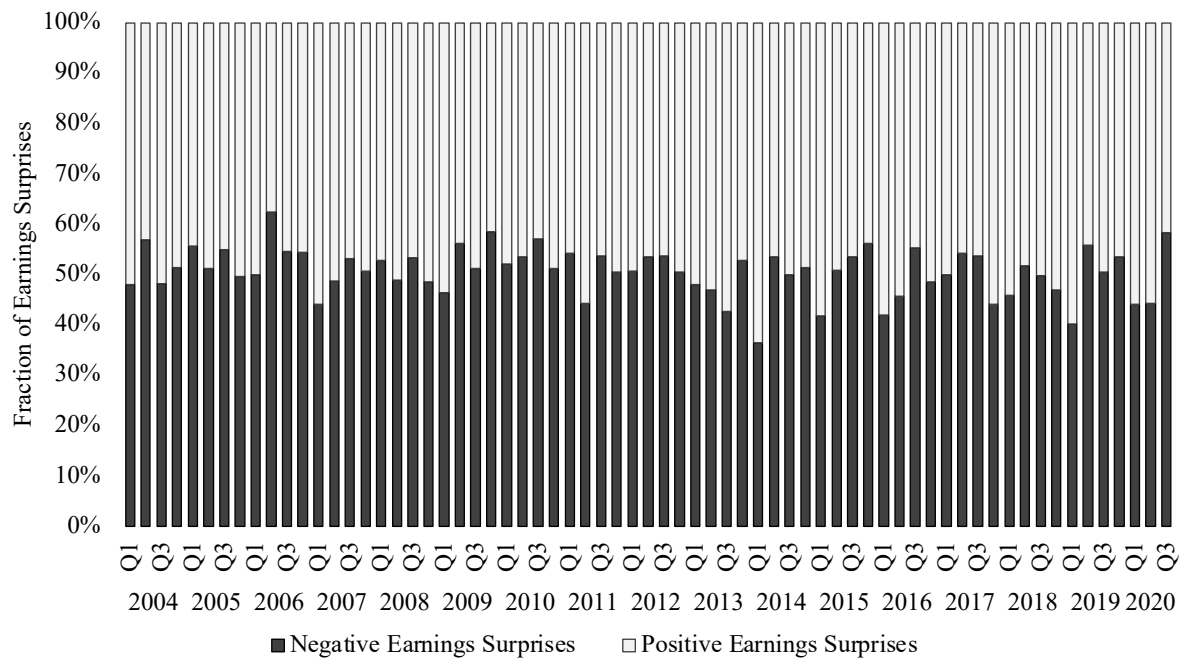


Figure 1. Share of Positive versus Negative Earnings Surprises

The figure illustrates the fraction of positive and negative earnings surprises per quarter over the sample period 2004-04-01 to 2020-10-01.

4.1.2. Portfolio formation

To begin, we divide the stocks into two groups based on the sign of the earnings surprise measure. We do this to isolate the positive earnings surprises from the negative surprises. Then, within each group, we rank the stocks and allocate them into quintiles per quarter based on the magnitude of their EAR. This can result in the portfolios deviating somewhat in size since the amount of positive versus negative surprises differ per quarter. Nevertheless, as can be seen in Figure 1, the distribution of earnings surprises per quarter is relatively even around a 50/50 split. Since we conduct our study on a smaller market relative to papers using deciles (e.g., Bernard and Thomas, 1990; Bhushan, 1994; Liu et al., 2003; Mendenhall, 2004), we ensure that there are a sufficient number of observations in each portfolio by merging the portfolios to form a total of five portfolios. The portfolio formation procedure can further be seen in Table 10 in the Appendix.

We base the portfolio formation date on the calendar-time method developed by Chan et al. (1996). By using the calendar-time research design, we avoid hindsight bias since the earnings surprises of all the stocks are known before the portfolios are formed. In this way, we ensure that the trading strategy is feasible to implement in reality (e.g., Brandt et al., 2008; Forner et al., 2009; Francis et al., 2007). The alternative to the calendar method is to use an event-based approach in which returns start being calculated after each firms' earnings announcement date. As a consequence, stocks would be traded ex-ante all firms' earnings surprises and before the portfolio sorting is known. Such a portfolio formation logic is thus not implementable.

Like Setterberg (2011), we set the portfolio formation date to the first day of the quarter that follows the quarter of the earnings announcement date. Thus, the first set of portfolios are formed on 2004-07-01 and the last set are formed on 2020-10-01. Hence, our sample consists of 66 portfolio formation dates.

Table 2. Descriptive statistics – Portfolio-level Earnings Surprises

EAR	N	Mean	Std.	Min.	25%	50%	75%	Max.
Total	15,634	0.001	0.101	-0.527	-0.041	-0.001	0.039	7.553
Portfolio								
1 (SHORT)	3,122	-0.101	0.053	-0.527	-0.121	-0.086	-0.065	-0.033
2	3,083	-0.032	0.012	-0.079	-0.040	-0.030	-0.022	-0.009
3	3,113	0.000	0.009	-0.027	-0.007	0.000	0.007	0.030
4	3,010	0.032	0.013	0.007	0.021	0.030	0.040	0.081
5 (LONG)	3,036	0.112	0.156	0.029	0.066	0.088	0.126	7.552
Direction								
Negative EAR	7,772	-0.055	0.052	-0.527	-0.074	-0.039	-0.018	-0.000
Positive EAR	7,592	0.058	0.108	0.000	0.017	0.040	0.077	7.553

This table summarizes the earnings surprise statistics per portfolio. EAR denotes the earnings surprise measure and is the four-day buy-and-hold abnormal return over the earnings announcement date. Portfolio 1 (SHORT) contains the most negative earnings surprises and Portfolio 5 (LONG) includes the most positive earnings surprises. N represents the number of earnings surprises. Based on period 2004-01-01 to 2020-10-01.

Table 2 displays the descriptive statistics of the earnings surprises on a portfolio level. As anticipated, Portfolio 1 includes the most negative earnings surprises and Portfolio 5 consists of the most positive earnings surprises. Hereon, we refer to Portfolio 5 as LONG and Portfolio 1 as SHORT, since these portfolios represent the respective short and long legs of our trading strategy.

4.1.3. Event analysis

To achieve a first indication of whether the drift exists, we compute BHARs for holding periods of one to twelve months. First, we calculate daily abnormal returns for each stock as the difference between a stocks daily return and the market return:

$$AR_{i,d} = R_{i,d} - R_{m,d} \quad (3)$$

where $AR_{i,d}$ is the abnormal return of stock i on day d . $R_{i,d}$ is the return of stock i on day d and $R_{m,d}$ is the market return on day d proxied by the OMXSPI.

Secondly, we compound the daily abnormal returns over the holding periods, assuming an average of 21 trading days per month (Mendenhall, 2004). Accordingly, the BHAR calculation for individual stocks per holding period is:

$$BHAR_{i,\tau} = \prod_{\tau=1}^{\tau_{max}} (1 + AR_{i,d}) - 1 \quad (4)$$

where $BHAR_{i,\tau}$ is the buy-and-hold abnormal return for stock i over the holding period τ . τ ranges from one to twelve months.

Lastly, we construct portfolio BHARs based on the portfolio formation process in section 4.1.2. We hold the portfolios for the duration of the respective holding periods and then liquidate the portfolios. We do not rebalance the portfolios (Setterberg, 2011) and stocks that get delisted during a holding period are not to be replaced until the next formation date. The portfolios are equally weighted and we thus sum the individual stocks' BHARs per portfolio and holding period and then divide the aggregate BHARs by the number of stocks in each portfolio. The portfolio-level BHAR formula is:

$$BHAR_{p,\tau,t} = \frac{1}{N} \sum_{i=1}^N BHAR_{i,\tau} \quad (5)$$

where $BHAR_{p,\tau,t}$ is the buy-and-hold return of portfolio p for holding period τ with formation date t . p denotes the portfolio, 1 (SHORT), 2, 3, 4 or 5 (LONG). t is the formation date. N is the number of stocks in the respective portfolio.

In addition, we study the drift using the long-short trading strategy, the PEAD strategy. To attain the BHAR of the PEAD position, the BHAR of the SHORT position is subtracted from the BHAR of the LONG position for the different holding periods. The return of the PEAD position is thus computed as:

$$BHAR_{PEAD,\tau,t} = BHAR_{LONG,\tau,t} - BHAR_{SHORT,\tau,t} \quad (6)$$

where $BHAR_{PEAD,\tau,t}$ is the buy-and-hold return for the holding period τ and formation date t . $BHAR_{SHORT,\tau,t}$ and $BHAR_{LONG,\tau,t}$ is the buy-and-hold return of the SHORT and LONG portfolios for holding period τ and formation date t respectively.

4.1.4. Regression analysis

We further investigate the drift through a regression analysis to determine the performance and robustness of our trading strategy. Unlike the event study, our trading strategy is based on holding periods of three months. Using a three-month holding period ensures that the portfolios formed on different formation dates do not overlap. In addition, the duration of the holding period means that there are no months without market exposure, as would be the case for holding periods shorter than three months. Accordingly, the trading strategy becomes more feasible to implement as investors can reinvest capital from the liquidated position each quarter and do not have to invest additional capital per formation date or risk suboptimal investment strategies by holding all-cash positions.

The portfolios of interest in the regressions are the extreme portfolios, SHORT and LONG, since they make up the trading strategy and are probable to appeal to arbitrageurs (Mendenhall, 2004). We compound the daily returns into three-month buy-and-hold returns, again assuming an average of 21 trading days per month. We use equally weighted portfolios. Accordingly, we obtain portfolio returns by aggregating the individual stocks' buy-and-hold returns and then dividing the summed returns by the number of stocks in the respective portfolios.

The dependent variable in the regressions is the excess portfolio return over the risk-free rate for the holding period. To ensure that our results do not constitute rewards for taking on risk, we regress the dependent variable while controlling for risk factors. We test the inclusion of risk factors in three steps. We begin by following Francis et al. (2007) and Setterberg (2011) and regress the dependent variable on the excess market return as in the Capital Asset Pricing Model (CAPM), this is denoted Model 1. Thereafter, consistent with previous studies (e.g., Ayers et al., 2011; Forner et al., 2009; Francis et al., 2007; Setterberg, 2011), we regress the returns while controlling for the three risk factors proposed by Fama and French (1993), namely the market risk premium (MRP), size premium (SMB) and value premium (HML). This we call Model 2. Lastly, we incorporate the momentum factor (MOM) proposed by Carhart (1997) as done in previous papers (Chan et al., 1996; Chordia and Shivakumar, 2005; Francis et al., 2007), as the drift has been found to be related to momentum (Chan et al., 1996; Chordia and Shivakumar, 2006). This regression we call Model 3. The regression used is a multi-factor model and is specified accordingly:

$$R_{\rho,t} - R_{f,t} = \alpha_{\rho} + \sum_{k=1}^K \beta_{\rho,k} \lambda_{k,t} + \varepsilon_{\rho,t} \quad (7)$$

where $R_{\rho,t}$ is the three-month buy-and-hold return of portfolio ρ with formation date t . ρ denotes the portfolio, SHORT or LONG. t is the formation date. $R_{f,t}$ represents the three-month buy-and-hold risk-free rate and is proxied by the 1-month Swedish Treasury Bill with formation date t . λ represents the three-month buy-and-hold risk premium for factor k , MRP, SMB, HML and MOM, with formation date t . K is the number of risk factors.

The dependent variable in the PEAD regression is the difference in return between the LONG and SHORT portfolios. The PEAD regression formula is defined as:

$$R_{PEAD,t} = \alpha_{PEAD} + \sum_{k=1}^K \beta_{PEAD,k} \lambda_{k,t} + \varepsilon_{PEAD,t} \quad (8)$$

where $R_{PEAD,t}$ is the three-month excess buy-and-hold return of the PEAD strategy with formation date t .

4.2. Limits to arbitrage and post-earnings-announcement drift

In short, we test whether limits to arbitrage drives the magnitude of PEAD by sorting the extreme portfolios on proxies of barriers to arbitrage. In line with the PEAD methodology, we perform an event study and regression analysis based on arbitrage strategies.

4.2.1. Descriptive statistics of arbitrage proxies

In Table 3, the descriptive statistics of the explanatory variables are presented. The mean value of our ARBRISK variable is close to but slightly higher compared to Wurgler and Zhuravskaya (2002), Mendenhall (2004) and Truong (2010). Note that Mendenhall's arbitrage risk variable is quoted on a monthly basis and our variable is in daily units. Hence, to compare our results we multiply our arbitrage risk statistic by 21, the approximate number of trading days per month. Seeing that Mendenhall and Wurgler and Zhuravskaya conduct their studies on U.S. data, their samples include larger stocks. Moreover, Wurgler and Zhuravskaya study stock inclusions in the S&P 500 index which is a large-cap index (S&P Global, 2024). Given the larger average firm size in their studies, it is reasonable that their mean arbitrage risk is lower compared to ours (Mendenhall, 2004).

Table 3. Descriptive statistics – Explanatory Variables

Variable	N	Mean	Std.	Min.	Max.
ARBRISK	10,584	0.001	0.001	0.000	0.024
VOLUME	14,665	59.545	179.706	0.10	3,865.833
INST	15,551	0.362	0.227	0.000	0.998
SIZE	14,758	18,792.356	60,867.424	0.102	1,227,678.532

This table provides summary statistics of the explanatory variables. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization (in MSEK). Based on period 2004-01-01 to 2020-10-01.

The descriptive statistics of VOLUME and SIZE are lower compared to prior studies (e.g., Bartov et al., 2000; Hung et al., 2015; Mendenhall, 2004; Milian, 2015) based on U.S. samples. This result is again expected since we are studying a smaller market with less trading volume and smaller firms compared to larger stock exchanges. Mean INST is similar yet slightly lower in our study. However, the variable's maximum value is aligned with the mentioned U.S. papers.

Table 4. Cross-correlation between Explanatory Variables

Variable	ARBRISK	VOLUME	INST	SIZE
ARBRISK	1.000			
VOLUME	-0.005	1.000		
INST	-0.213	0.011	1.000	
SIZE	-0.129	-0.006	0.178	1.000

This table provides Pearson correlation coefficients for the explanatory variables. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. Based on period 2004-01-01 to 2020-10-01.

Table 4 presents the Pearson cross-correlation coefficients between the arbitrage proxies. The magnitude of the correlation coefficient falls below 0.3 for all variables, indicating either a small or nonexistent correlation between them. The correlations suggests that each explanatory variable independently captures different aspects of limits to arbitrage in the context of the drift.

4.2.2. Limits to arbitrage analysis

In order to test our second hypothesis, we follow the methodology of previous studies (e.g., Dische, 2002; Francis et al., 2007; Liu et al., 2003) that examine potential drivers of the drift by organizing the stocks within the extreme earnings surprise-based portfolios. Accordingly, every quarter we divide the LONG and SHORT portfolios into two equally weighted sub-portfolios based on the magnitude of the limits to arbitrage proxies from the previous quarter. This procedure results in each extreme portfolio per explanatory variable having a high and low sub-portfolio respectively. These portfolios are presented in Table 5.

The high sub-portfolios based on ARBRISK include stocks expected to have a higher degree of limits to arbitrage. Arbitrage risk is positively correlated to PEAD (e.g., Gerard, 2012; Hung et al., 2015; Mendenhall, 2004) as higher levels of idiosyncratic risk can impede arbitrageurs from exploiting mispricings which amplifies the drift. For the explanatory variables VOLUME, INST and SIZE, the high sub-portfolios contain the stocks expected to have lower degrees of limits to arbitrage. This relationship stems from transaction costs having a positive correlation with PEAD (e.g., Hung et al., 2015; Ng et al., 2008; Mendenhall, 2004; Zhang et al., 2013). Since higher trading volume corresponds to lower transaction costs, VOLUME is expected to be negatively related to the magnitude of the drift. In addition, investor sophistication proxies have illustrated an inverse relationship to the drift (e.g., Bartov et al., 2000; Clement et al., 2019; Hung et al., 2015) and hence INST is also expected to be negatively related to the magnitude of PEAD. The anomaly is additionally recorded to be larger for smaller firms (Bernard and Thomas, 1989; Foster et al., 1984), subsequently affecting SIZE. The expected relationship between the explanatory variables and PEAD can further be seen in Table 1.

Table 5. Descriptive statistics – Sub-Portfolios per Explanatory Variable and Extreme Portfolio

Variable / Sub-portfolio	SHORT					LONG				
	N	Mean	Std.	Min.	Max.	N	Mean	Std.	Min.	Max.
ARBRISK										
Low	988	0.000	0.000	0.000	0.001	947	0.000	0.000	0.000	0.001
High	965	0.001	0.002	0.000	0.023	923	0.001	0.001	0.000	0.007
VOLUME										
Low	1,371	0.001	0.001	0.000	0.005	1,324	0.001	0.001	0.000	0.005
High	1,336	0.837	21.027	0.001	16.613	1,294	1.873	40.388	0.001	1,078.916
INST										
Low	1,519	0.166	0.123	0.000	0.506	1,463	0.210	0.142	0.000	0.506
High	1,489	0.522	0.168	0.047	0.950	1,431	0.561	0.154	0.073	0.969
SIZE										
Low	1,421	456.445	527.714	0.104	4,502	1,367	772.620	820.505	0.102	5,872
High	1,378	28,110	75,247	338.858	726,081	1,338	29,629	73,036	481.671	961,683

This table summarizes the mean value of the explanatory variables per sub-portfolio. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. Based on period 2004-01-01 to 2020-10-01.

In line with Francis et al. (2007) among others, we take positions in the respective extreme portfolios' sub-portfolios. Accordingly, we go long in the high sub-portfolios of the LONG position and short in the high sub-portfolios of the SHORT position. We call this strategy High. Correspondingly, we take long positions in the low sub-portfolios of the LONG position and short positions in the low sub-portfolios of the SHORT position. This long-short strategy we denote Low.

We examine the drift based on the High and Low arbitrage strategies through an event study using BHARs that follows the one described in section 4.1.3. To attain the BHARs of the High (Low) strategies, the BHARs of the high (low) sub-portfolios of the SHORT position are subtracted from the respective high (low) sub-portfolios of the LONG position.

Moreover, we evaluate the explanatory variables' impact on the drift through a regression analysis based on the High and Low limits to arbitrage strategies with a three-month holding period. As in section 4.1.4, we use three regression models employing risk factors from the Fama-French (1993) and Carhart (1997) four-factor model to assess the robustness of the results. The dependent variable in the regressions is the difference between the three-month holding period excess returns of the LONG and SHORT positions' respective high and low sub-portfolios.

5. Empirical results

In this part of the paper, we show and discuss the results from testing our hypotheses. We begin by presenting the post-earnings-announcement drift findings. Thereafter, we show the results related to how limits to arbitrage impact the drift.

5.1. Post-earnings-announcement drift findings

5.1.1. Indicative drift results

Similar to Bernard and Thomas (1989), we begin by displaying the buy-and-hold abnormal returns (BHARs) in a graph distinctive to PEAD studies. Figure 2 shows the average BHARs over the sample period for each portfolio type and holding periods of one to twelve months. The appearance of the average portfolio BHARs in the figure indicates a drift in returns following earnings announcements in Sweden. The results are thus consistent with Setterberg (2011) who also documents signs of a post-earnings-announcement drift in the Swedish stock market using a graphical BHAR analysis. The PEAD strategy on average yields higher BHARs than the other portfolios for holding periods of up to ten months.

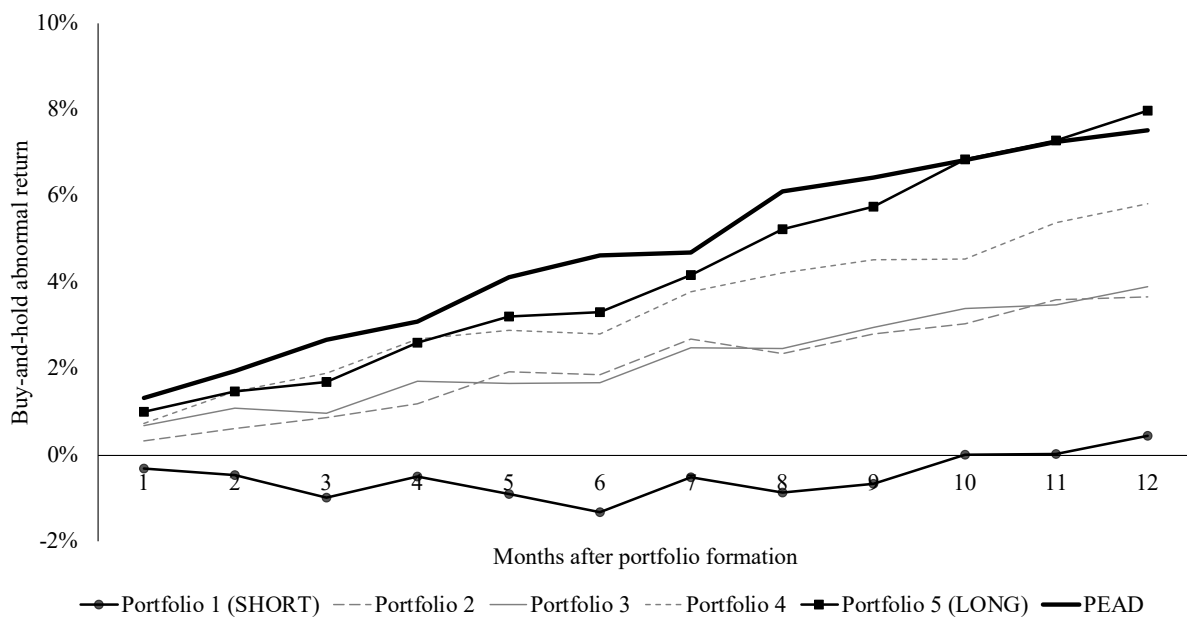


Figure 2. Mean buy-and-hold abnormal returns over one to twelve months after portfolio formation
The figure shows the average buy-and-hold returns for each portfolio type for one to twelve months after portfolio formation. Based on period 2004-01-01 to 2021-10-01.

Overall, the portfolios follow the expected order in which the LONG portfolio yields the highest return and has an upward drift and the SHORT portfolio yields the lowest return and has a downward drift. The PEAD strategy on average yields higher BHARs than the other portfolios for holding periods of up to ten months. However, after that, the LONG position on average generates higher returns. This result

may be due to the limited magnitude and duration of the negative drift of the SHORT portfolio, which generates positive mean returns ten months after the portfolio formation.

Table 6 shows the mean monthly BHAR of the SHORT, LONG and PEAD portfolios for each holding period along with the returns' standard errors and t-values. We find that the average monthly BHARs of the PEAD position are significant at 1% for all holding periods. The PEAD strategy has a mean monthly return of 2.7% for a three-month holding period. In addition, the BHARs of the LONG position are significant for all holding periods with the majority of the returns being significant at 1%. However, the returns of the SHORT portfolio are nonsignificant for all holding periods and can thereby not be distinguished from zero. These findings contradict there being a descending drift after earnings announcements in which companies perform worse than expected. Similar to Setterberg (2011), the return of our PEAD strategy appears to mainly be generated by the LONG portfolio.

Together, Figure 2 and Table 6, demonstrate that most of the return from the drift is generated during the first months after the portfolio formation. Our reported pattern of the drift is aligned with studies from other markets that document the majority of the return from the drift occurring during the first months after the portfolio formation date (e.g., Bernard and Thomas, 1989; Forner and Sanabria, 2010; Sadka, 2006). In addition, this result is consistent with the standard errors of the three portfolios in Table 6 increasing for longer holding periods. That is, the noisiness of the return estimates increases making them less precise when the portfolios are held for longer periods.

Table 6. Mean Buy-and-Hold Abnormal Returns per Holding Period

τ	SHORT			LONG			PEAD		
	Return	SE	t-value	Return	SE	t-value	Return	SE	t-value
1	-0.003	0.004	-0.781	0.010***	0.004	2.838	0.013***	0.004	3.531
2	-0.005	0.006	-0.770	0.015**	0.005	3.099	0.019***	0.005	3.562
3	-0.010	0.007	-1.329	0.017**	0.007	2.584	0.027***	0.006	4.146
4	-0.005	0.008	-0.609	0.026***	0.007	3.836	0.031***	0.007	4.272
5	-0.009	0.009	-1.027	0.032***	0.008	3.866	0.041***	0.009	4.756
6	-0.013	0.010	-1.359	0.033***	0.010	3.244	0.046***	0.010	4.743
7	-0.005	0.010	-0.516	0.042***	0.010	4.394	0.047***	0.011	4.269
8	-0.009	0.011	-0.781	0.052***	0.011	4.855	0.061***	0.013	4.845
9	-0.007	0.013	-0.537	0.058***	0.011	5.077	0.064***	0.013	4.984
10	0.000	0.013	0.006	0.068***	0.012	5.714	0.068***	0.015	4.708
11	0.000	0.015	0.022	0.073***	0.013	5.661	0.072***	0.016	4.547
12	0.004	0.015	0.296	0.080***	0.014	5.872	0.075***	0.016	4.571

This table presents mean monthly buy-and-hold returns. SHORT is the portfolio with the lowest EARs and LONG is the portfolio with the highest EARs. PEAD is the LONG minus SHORT portfolio. τ is the holding period. Based on period 2004-01-01 to 2021-10-01.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Our hitherto reported results of significant positive BHARs of the LONG and PEAD positions lend support for our first hypothesis, that there is a post-earnings-announcement drift in the Swedish stock market. In addition, our results indicate that prices drift particularly after positive earnings surprises. Hence, we go on to further investigate how our long-short PEAD strategy performs and ensure that the returns do not represent reward for bearing risk.

5.1.2. PEAD strategy findings

Table 7 shows our regression results for the mean BHARs over a three-month holding period. The standard errors in the regressions are tested and adjusted for potential issues with heteroskedasticity and autocorrelation using the Newey-West estimator. Model 1 regresses returns on the market factor, Model 2 includes the market, size and value factors and Model 3 contains a momentum factor in addition to the three aforementioned risk factors.

Table 7. Regression Results for PEAD Strategy, Three-Month Holding Period

Variable	SHORT			LONG			PEAD		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	-0.012* (-1.73)	-0.014* (-1.86)	-0.013* (-1.71)	0.014** (2.36)	0.014** (2.19)	0.013** (2.08)	0.027*** (4.43)	0.027*** (4.36)	0.026*** (4.15)
<i>MRP</i>	1.123*** (14.05)	1.126*** (11.61)	1.095*** (10.71)	1.220*** (18.22)	1.194*** (14.85)	1.208*** (14.19)	0.096 (1.44)	0.067 (0.81)	0.112 (1.32)
<i>SMB</i>		0.084 (0.44)	0.048 (0.25)		0.185 (1.15)	0.201 (1.23)		0.104 (0.64)	0.157 (0.96)
<i>HML</i>		-0.154 (-1.25)	-0.187 (-1.46)		-0.151 (-1.48)	-0.136 (-1.27)		0.005 (0.05)	0.054 (0.51)
<i>MOM</i>			-1.103 (-1.96)			0.048 (0.53)			0.153* (1.72)
N	66	66	66	66	66	66	66	66	66
Adj. R2	0.751	0.750	0.750	0.836	0.838	0.837	0.016	-0.008	0.022

This table reports the regression results for excess buy-and-hold returns. SHORT is the portfolio with the lowest EARs and LONG is the portfolio with the highest EARs. PEAD is equal to LONG minus SHORT. MRP is the market risk factor, calculated as the OMXSPI return minus the risk-free rate proxied by the 1-month Swedish Treasury Bill. SMB, HML and MOM are the size, value and momentum factors from the U.S. Returns and the respective risk factors are compounded over the holding periods. Double-sided t-statistics are reported in parentheses. Based on period 2004-01-01 to 2021-01-01.

* p<0.1; ** p<0.05; *** p<0.01.

The PEAD strategy in Model 1 generates an alpha of 2.7% which is statistically significant at 1%. The returns of our trading strategy are further robust to the risk factors from the Fama-French (1993) and Carhart (1997) four-factor model. As seen in Model 2 and 3, the market, size, value and momentum factors fail to explain the returns of the PEAD strategy as all of them are insignificant. The fact that the momentum factor is insignificant suggests that the post-earnings-announcement drift exists independently of a momentum effect. This finding is consistent with prior studies that are unable to find a momentum effect on the Swedish stock market (Doukas and McKnight, 2005; Griffin et al., 2003, Novak, 2008) as well as with research advocating that the drift is not subsumed by other anomalies such as the momentum effect (Bohl et al., 2016; Chen et al., 2014; Leippold and Lohre, 2012). After accounting for the risk factors, the return of the PEAD position corresponds to a mean annual return of about 11% based on a three-month holding period.

The regression analysis verifies the previously indicated results of the return of the trading strategy being produced by the position in the LONG portfolio. The intercept of the LONG portfolio is significant for all three models and has a coefficient of 1.3% after adjusting for the risk factors. The average BHARs of the SHORT portfolio remain insignificant in all regression models, as expected from prior significance tests shown in Table 6. In line with Setterberg (2011), the LONG and SHORT portfolios have market risk factors that are significant at 1% in all regression models. Consequently, the returns of the positions can be explained by the market. Additionally, the coefficients for the market risk factor in the LONG and SHORT portfolio regressions are both above one, indicating that the portfolios on average are more volatile than the overall market. As a result, the market risk exposure is neutralized in the trading strategy seeing that the market beta is shown to be insignificant.

Table 8. Regression Results for PEAD Strategy, One to Three-Month Holding Periods

τ	SHORT			LONG			PEAD		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
1	-0.004	-0.001	-0.003	0.010***	0.011***	0.010***	0.014***	0.012***	0.013***
2	-0.009	-0.009	-0.009	0.013***	0.012**	0.012**	0.021***	0.021***	0.021***
3	-0.012*	-0.014*	-0.013*	0.014**	0.014**	0.013**	0.027***	0.027***	0.026***

This table reports the regression results for excess buy-and-hold returns. SHORT is the portfolio with the lowest EARs and LONG is the portfolio with the highest EARs. PEAD is equal to LONG minus SHORT. τ denotes the holding period. Based on period 2004-01-01 to 2021-01-01.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Since a lot of the drift occurs during the first months after the earnings announcements, we compare the regression results for one to three-month holding periods. Table 8 shows the coefficients of the intercepts of the SHORT, LONG and PEAD strategy for one to three-month holding periods across the regression models. The results of the positions for shorter holding periods are in line with the three-month holding period findings in Table 7. The returns of the PEAD position are produced by the long leg of our strategy since the LONG position is significant and the SHORT position remains insignificant. Yet, we can see that the significance of the LONG portfolio begins to decline as the length of the holding period increases, which might be due to the increased uncertainty of the returns as our previous findings

indicate in Table 6. Additionally, the alpha of our hedge strategy is consistently higher relative to the LONG portfolio.

To summarize, the regression analysis provides robust evidence of there still being a post-earnings-announcement drift in the Swedish stock market after positive earnings surprises. Apart from being statistically significant, our results are economically significant. We show that mean excess BHAR of about 11% can be earned annually from exploiting the drift using a long-short trading strategy with a three-month holding period. These results are consistent with the level of returns obtained in previous studies. In Europe, trading strategies exploiting the drift has been shown to yield yearly returns of 11% in Sweden (Setterberg, 2011), 10.8% in the UK (Liu et al., 2003), 7.3% in Spain (Forner et al., 2009) and 6.6% based on a six-month holding period in Germany (Dische, 2002).

A finding that stands out among our results is the asymmetrical element of the detected drift. The appearance of our drift is aligned with the prior paper by Setterberg (2011) who covers the drift in Sweden as well as studies based on other countries (e.g., Dische, 2002; Forner et al., 2009). Hence, this finding is not unique to our study's sample. The reason behind the absence of a drift for negative earnings surprises can be related to behavioral factors. Investors may react differently to good versus bad earnings announcements. From the cognitive bias called the negativity bias it follows that negative information is more salient than positive information (Rozin and Royzman, 2001). The negativity bias is further linked to investor behavior and affects, for example, investors' attention (Reyes, 2019). Increased weight on bad news in relation to earnings announcements is found by Conrad et al. (2002). They argue that investors react more strongly to negative earnings surprises compared to positive in up markets. In addition, research by Williams (2015) finds that investors respond faster to negative earnings news than positive earnings news in times of greater macroeconomic uncertainty. Consequently, the asymmetrical drift might be a result of investors reacting faster to negative earnings surprises than positive ones.

Nevertheless, the SHORT portfolio may be insignificant due to an unaccounted for risk factor. Francis et al. (2007) propose that the anomaly is caused by information uncertainty. They claim that information uncertainty is associated with risk and that the stocks in the extreme earnings surprise portfolios comprise higher information risk. As a result, stocks with large earnings surprise shocks are rewarded with higher returns which counteracts the downward drift. However, this effect does not oppose the drift's direction for stocks with positive earnings surprises since they drift upwards. This risk effect could thereby be a possible source of our results.

The asymmetric nature the drift has implications for our study's perspective on arbitrage. The results suggest that there is only an opportunity left for arbitrage after positive earnings surprises. As noted, the return from our long-short trading strategy is consequently driven by the long position. Accordingly, the short leg of the strategy mainly contributes to reducing the strategy's exposure to market risk and to financing the long position. The lack of returns to the SHORT portfolio further entails that the position could be replaced by a short position in another group of stocks to still attain a self-financed trading

strategy. Another alternative would be to only go long in the stocks with the most positive earnings surprises.

Moreover, unlike studies documenting stock prices drifting more following bad news than good news (Chan, 2003), our findings do not indicate that short-sale constraints impede arbitrageurs from exploiting the downward drift. Instead, it seems that positive earnings surprises are arbitrated away to a lower extent than negative surprises since the mispricings are concentrated in the stocks with the extreme positive earnings surprises. Consequently, the lack of a downward drift suggests that our proxies of limits to arbitrage will not reflect difficulties related to short-selling. Rather, the explanatory variables may capture if other limits to arbitrage inhibit arbitrageurs from exploiting mispricings in stocks included in the LONG portfolio.

According to Bernard et al. (1994), a strategy can be evaluated by examining how often the strategy triumphs versus fails. Considering the previously shown evidence of our returns being robust to all of the tested risk factors, we in line with Setterberg (2011) examine the PEAD strategy's BHARs. Figure 3 displays the market-adjusted buy-and-hold returns of the PEAD strategy based on a three-month holding period per formation date.

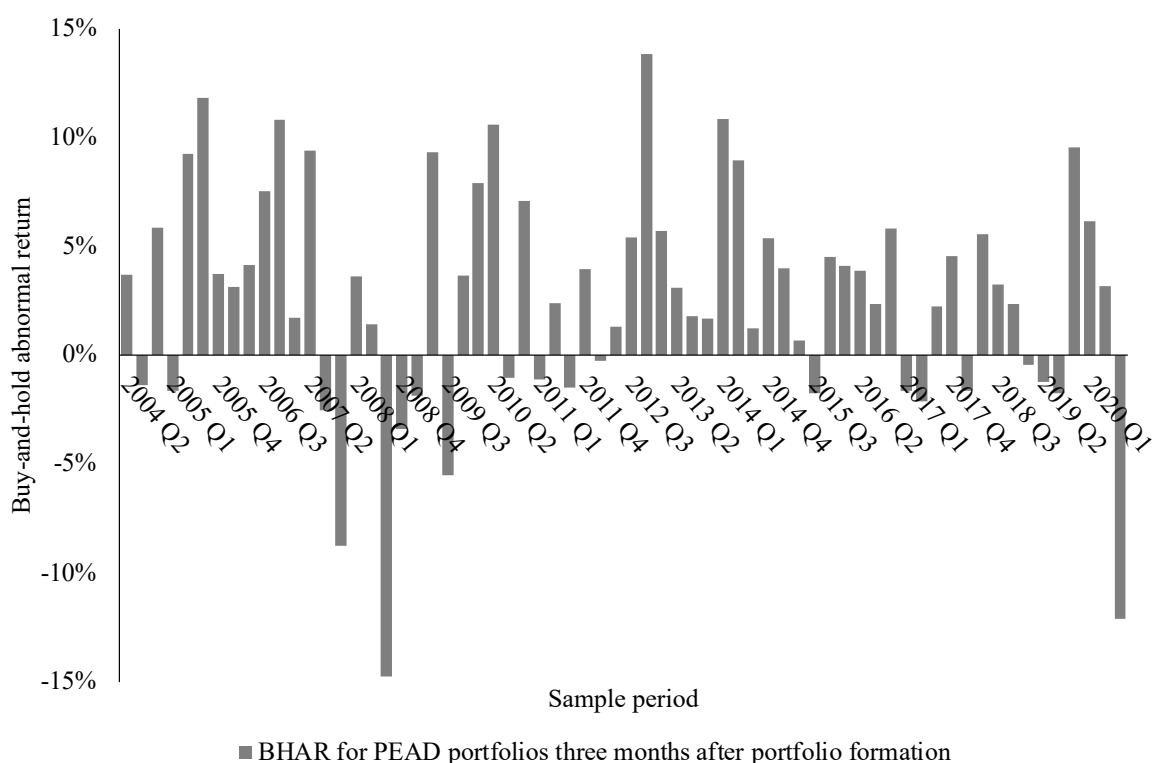


Figure 3. Buy-and-hold abnormal returns of the PEAD strategy three months after portfolio formation
The figure illustrates how often the trading strategy succeeds and generates positive abnormal returns. Based on period 2004-01-01 to 2021-01-01.

Our PEAD strategy yields positive returns a majority of the time. Specifically, 46 out of 66 periods or 70% of the PEAD strategies produce above zero returns. This result is similar to Setterberg (2011), whose long-short strategy on the drift in Sweden succeeds 60% of the time during 1997-2004. As

depicted, substantial BHARs can be earned from the strategy over a relatively short period and the highest return is for the PEAD position taken during the fourth quarter of 2012 which is about 15%.

Our trading strategy in total fails 20 times. Nonetheless, most of the losses are relatively small and do not exceed -2%. Several of the negative returns occur for portfolios formed between 2007-2009 and during this period is when the single most negative return of the trading strategy occurs which is close to -15%. The BHARs for this period coincide with the global financial crisis of 2007-2008 which can explain the predominantly negative returns of the PEAD positions during that time. Other reasons for why the strategy yields negative returns at for example the beginning of 2019 may relate to an economic slowdown during 2018 in which the central bank in Sweden increased the repo rate in December 2018 for the first time since 2015 (Riksbanken, 2024). Moreover, at the end of the same month, the Federal Reserve increased the federal funds rate for the fourth time in 2018 (Federal Reserve Economic Data, 2024). The second largest drop in returns occurs during 2020 and can be attributed to the Covid-19 pandemic which caused the Swedish stock market to decline (Nasdaq, 2024).

Under the assumption that the PEAD strategy returns are binomially distributed with an equal chance of each outcome and that each trial is independent, we conduct a statistical test to evaluate the probability of observing more than 45 positive portfolio returns out of 66 possible quarters. The test reveals that the probability of this occurring is approximately 0.093%, which underscores the unlikelihood of our result being attributed to chance.

5.1.3. Additional robustness test

Sub-period results

To further investigate the robustness of our findings, we split our sample of 66 quarters into two sub-sample periods and run the same regressions. The first sub-sample period runs between 2004 to 2012 and the second from 2012 to 2020. As seen in Table 11 in the Appendix, for the first half of the sample we find that the PEAD strategy generates a return of approximately the same magnitude as the full sample but at a lower significance level. This result seems to be due to both the returns of the SHORT and LONG portfolios being insignificant. Hence, we are unable to detect an upward or downward drift for this period. For the latter half of the sample period, illustrated in Table 12 in the Appendix, the results align more with our full sample findings. The LONG position is significant while the SHORT position is insignificant. The PEAD strategy is again significant at 1% and yields returns that are slightly higher than the returns for our entire study period.

These results suggest that the drift is stronger during the second half of our study. This finding might be due to the first half of our sample period coinciding with the global financial crisis of 2007-2008. Hence, the first period constitutes a time encompassing unusually high volatility and uncertainty with low stock market performance in general (Adebambo et al., 2015). Figure 3 further confirms that our trading strategy does not generate positive returns during this period. The overall sentiment of the market may thus have dominated quarterly announcements of company-specific information which might explain the weaker results for this period.

Extreme observations

We remove outliers to ascertain that our PEAD results cannot be attributed to a limited number of extreme returns. In line with previous PEAD studies (e.g., Mendenhall, 2004; Truong, 2010), we exclude 0.5% of the lowest returns from the SHORT portfolio and 0.5% of the highest returns from the LONG portfolio. As seen in Table 13 in the Appendix, our results remain unchanged with this adjustment. The significance levels of the SHORT, LONG and PEAD positions are unaltered and the magnitude of the positions' returns are in line with the previously documented results.

5.2. Limits to arbitrage findings

5.2.1. Indicative arbitrage results

Since the explanatory variables are based on data of varying lengths back in time, the first observation per proxy is attained at different points in time. Hence, the first portfolio formation date for the explanatory variables differs. The first portfolio based on ARBRISK is formed on 2008-01-01, the first VOLUME portfolio formation date occurs 2004-10-01, the first INST portfolio is computed on 2004-07-01 and the first SIZE based portfolio is produced on 2004-10-01. All results presented in this section are thus based on the respective variables' first formation dates whilst they have the same last formation date which is 2020-07-01.

Figure 4 displays the mean buy-and-hold abnormal returns (BHARs) over one to twelve months after portfolio formation for the High and Low strategies per explanatory variable. Note that the BHARs are calculated based on different periods depending on when the first formation date occurs, yet the trading strategies within each graph correspond to the same period.

The arbitrage risk BHAR graph in Figure 4 does not have the expected appearance. The High arbitrage risk position generates higher average returns than the Low position. However, the High arbitrage risk position only yields higher average BHARs than the original trading strategy for one and two-month holding periods. Nevertheless, as seen in Table 14 in the Appendix, the mean High returns are significant for one and two-month holding periods but the significance then declines and disappears for numerous holding periods. The mean BHARs of the Low arbitrage risk position are not significant for any holding period and thus do not indicate a drift.

We find that arbitrage risk only seems to impact the size of the drift for shorter holding periods. This result is aligned with several prior papers that document weak relationships between the drift and idiosyncratic volatility. Unlike Mendenhall (2004), Chordia et al. (2009) find that idiosyncratic volatility does not impact the magnitude of the drift. Similar results have further been found in studies outside of the U.S. Forner et al. (2009) study the anomaly in the Spanish stock market and do not find evidence of idiosyncratic volatility driving the drift. Additionally, the asymmetrical aspect of our documented drift may have implications for how the arbitrage risk proxy reflects limits to arbitrage. Considering that we do not find a drift for negative earnings surprises, the obstacles that are left for arbitrageurs to overcome

in exploiting the upward drift may not be related to idiosyncratic volatility. Thereby, the effect of arbitrage risk on drift may be limited, especially for longer holding periods.

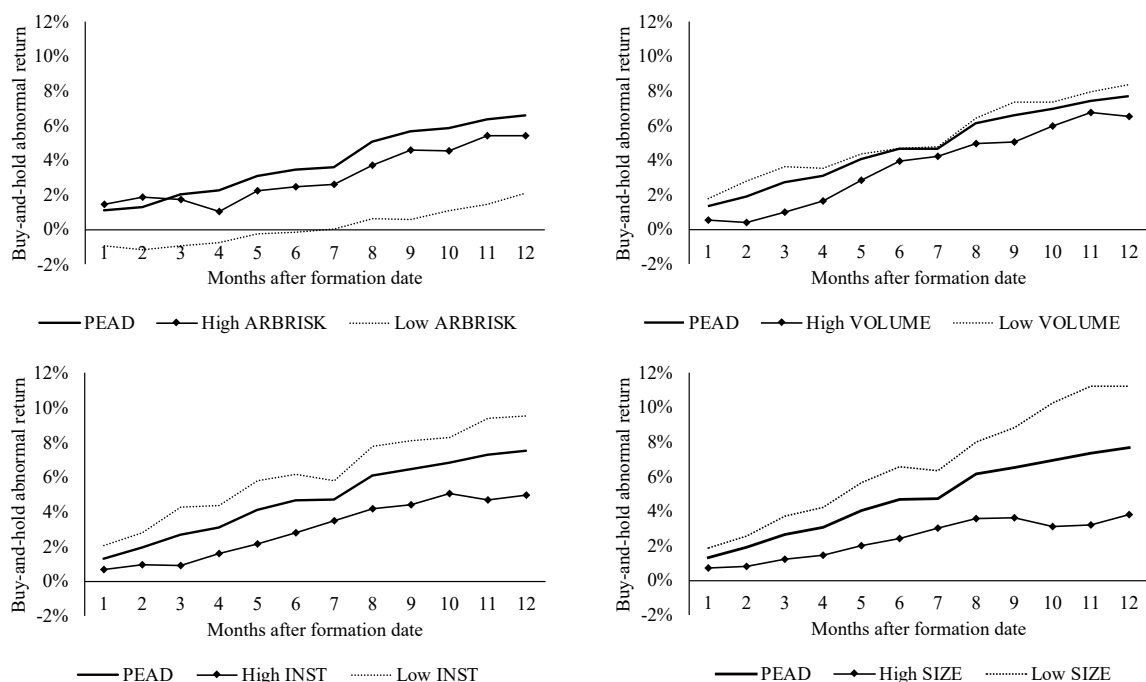


Figure 4. Mean buy-and-hold abnormal returns for the limits to arbitrage sub-portfolios

The figure shows the average buy-and-hold returns for long-short positions based on the limits to arbitrage proxies. The High (Low) position is long in the LONG sub-portfolio with high (low) scores and short in SHORT positions sub-portfolio with high (low) scores for the respective arbitrage proxies. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. Based on period 2004-01-01 to 2021-10-01.

The graph displaying long-short strategies based on trading volume shows the Low position yielding slightly higher average BHARs than the original PEAD strategy. The mean BHARs of the Low position are significant at 1% for all holding periods (Table 14 Appendix). The High position on average yields lower returns than the PEAD strategy yet the returns are mostly insignificant (Table 14 Appendix). For the seven-month holding period, the BHARs of the High and Low positions are close to converging with the PEAD strategy.

The BHAR graph sorted on institutional ownership shows the predicted relationship between the drift and investor sophistication. The Low institutional ownership position on average exhibits higher mean BHARs relative to the original trading strategy. Meanwhile, the mean BHARs of the High institutional ownership position are lower than the PEAD strategy. The BHARs of the Low trading strategy are statistically significant at 1% for all holding periods (Table 14 Appendix). A three-month holding period for the Low institutional ownership position returns a mean BHAR of 4.3% which corresponds to a 1.6% higher average BHAR than the original PEAD strategy. The results thereby point towards the size of the drift being larger for stocks with lower investor sophistication. The High position yields

significant BHARs for some holding periods (Table 14 Appendix). Hence, our results indicate that high institutional stocks drift but to a lower extent compared to low institutional holding firms.

The graph based on firm size suggests that a hedge position based on small firms earns higher mean BHARs than the PEAD strategy. The mean BHARs of the Low position are significant at 1% for all holding periods (Appendix Table 14). For a three-month holding period, the Low position earns a mean BHAR of 3.7% which is about 1% higher than the mean return of the original PEAD strategy for the same holding period. For a majority of the holding periods, the BHARs of the High position lack significance and hence do not suggest that returns of larger firms drift.

The proxies of transaction costs, investor sophistication and firm size show the expected relationship to drift. Our results thus align with previous literature stating that the drift is larger for stocks with higher transaction costs (Bhushan, 1994; Ng et al., 2008; Mendenhall, 2004), lower institutional holding (Clement et al., 2019; Doyle et al., 2006; Hung et al., 2015) and of smaller companies (Bernard and Thomas, 1989; Foster et al., 1984). Overall, our event study findings provide indicative results of limits to arbitrage impacting the magnitude of the post-earnings-announcement drift in Sweden and we thus find support for our second hypothesis. We proceed to examine whether the returns may constitute compensation for risk and determine the robustness of our results.

5.2.2. Regression results for arbitrage strategies

Table 9 presents the regression results for the three-month holding period returns of the High and Low arbitrage strategies for each regression model. Again, the standard errors are tested and adjusted for heteroscedasticity and autocorrelation using the Newey-West estimator. We find that the alphas of Model 1 for the High arbitrage risk strategy and Low positions based on trading volume, institutional ownership and firm size exceed the alpha of the PEAD strategy. The returns of the mentioned strategies are all significant at 1%. The results confirm the BHARs previously documented in the event study in which these positions generate higher returns than the original strategy. Moreover, the excess buy-and-hold returns of the strategies based on higher limits to arbitrage are robust to the risk factors included in Model 2 and 3 since the market, size, value and momentum effects are unable to explain the returns (Table 18 Appendix). After including the risk factors, the mean excess buy-and-hold returns of the strategies range from 3.5% to 4.2%, which verifies the results reported in Figure 4. On an annual basis, the results correspond to returns of approximately 15% to 18%.

Table 9. Regression Results for Arbitrage Based Strategies, Three-Month Holding Period

Model	PEAD	ARBRISK		VOLUME		INST		SIZE	
		Low	High	Low	High	Low	High	Low	High
1	0.027***	-0.002	0.038***	0.035***	0.006	0.042***	0.009	0.040***	0.010
2	0.027***	-0.003	0.040***	0.037***	0.006	0.043***	0.010	0.041***	0.010
3	0.026***	-0.003	0.040***	0.035***	0.003	0.042***	0.008	0.042***	0.007

This table presents the results from the excess buy-and-hold return regressions based on the limits to arbitrage strategies. The High (Low) position is long in the LONG sub-portfolio with high (low) scores and short in SHORT positions sub-portfolio with high (low) scores for the respective arbitrage proxies. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. Based on period 2004-01-01 to 2021-01-01.

* p<0.1; ** p<0.05; *** p<0.01

In contrast, the buy-and-hold returns of the Low arbitrage risk and High trading volume, institutional ownership and size strategies are insignificant in all three regression models and hence cannot be distinguished from zero (Table 18 Appendix). Thereby, the regression results do not show a drift for the strategies based on lower limits to arbitrage. Again, this finding is in line with the event study results in which the mean BHARs of these positions are insignificant for a three-month holding period.

Overall, the long-short strategies based on high limits to arbitrage seem to perform on an equal level over a three-month holding period since the magnitude of the returns is similar and the significance level is the same. In addition, the low correlations between the variables shown in Table 4 speak to the explanatory variables being independent from each other. It is thus difficult to suggest a specific arbitrage proxy, especially between institutional ownership and size, that is more beneficial to base a trading strategy on when implementing a three-month holding period. However, the arbitrage risk BHAR graph in Figure 4 suggests that arbitrage risk does not make for a favorable trading strategy for longer holding periods. In addition, trading volume generates the lowest mean buy-and-hold return out of the variables.

As seen in Table 15 in the Appendix, the results from the regressions generally remain consistent when comparing them over holding periods ranging from one to three months. The strategies are still significant and continue to be robust to our employed risk factors. The only deviation in the results relates to the High arbitrage risk strategy which is insignificant for the one-month holding period. The largest difference in returns between the PEAD strategy and the arbitrage-based hedge positions is for the three-month holding period.

In general, our findings support the documented notion of investors trading the stocks that are easiest to arbitrage (Ng et al., 2008; Milian, 2015). For a three-month holding period we, in accordance with previous literature (e.g., Gerard, 2012; Ng et al., 2008; Mendenhall, 2004; Pontiff, 2006; Wurgler and Zhuravskaya, 2002), find that arbitrage risk impedes arbitrageurs from trading on the anomaly as the

returns of the drift are higher for stocks with higher arbitrage risk. Additionally, our trading volume results align with arbitrageurs being more prone to align stock prices with their fundamental value for stocks that are less costly to trade (Bhushan, 1994; Ng et al., 2008; Mendenhall, 2004). Consistent with for instance Bartov et al. (2000), Ke and Ramalingegowda (2005), Ayers et al. (2011) and Clement et al. (2019), we recognize that the drift is negatively related to investor sophistication. In the paper by Ke and Ramalingegowda (2005), institutional investors with a short investment horizon can earn 5.1% in return from trading on the drift using a long-short logic and a three-month holding period. Their level of return is similar to the 4.2% mean excess buy-and-hold return in our study that is left to be arbitrated away in stocks with low institutional holding. Moreover, we observe that the magnitude of the drift is inversely related to firm size which aligns with the papers by Foster et al. (1984) and Bernard and Thomas (1989). Our regression results confirm the event study indication of larger firms not drifting. This finding is further consistent with the paper by (Martineau, 2021) who is unable to find a post-earnings-announcement drift in the U.S. market for large liquid stocks.

The regression results of the High and Low strategies based on a three-month holding period for the limits to arbitrage proxies show the expected relationship to PEAD. More difficult to arbitrage stocks, that is stocks with higher arbitrage risk, higher transaction costs, lower investor sophistication and small firms, have higher mean excess buy-and-hold returns than the original long-short strategy not sorted on arbitrage. The hedge positions in stocks expected to have low limits to arbitrage on the contrary do not indicate a drift. The regression results thus support our second hypothesis that the presence of limits to arbitrage drives the magnitude of the post-earnings-announcement drift in the Swedish stock market.

On a broader level, we find that our proxies of transaction costs, investor sophistication and size have the biggest impact on the drift. The asymmetrical nature of the drift in Sweden indicates that short-sale constraints do not constitute a source of limits to arbitrage that drives the drift. Short-sale restrictions are mainly captured by the VOLUME, INST and SIZE variables. However, since our results still show that these variables impact the magnitude of the drift, other aspects of arbitrage that the variables reflect seem to affect the anomaly. Given the results for institutional ownership and firm size, an irrationality story may be at play. Sophisticated investors are argued not to underreact to earnings news (Bartov et al., 2000). Firm size is related to investor sophistication as smaller stocks tend to have a lower share of sophisticated investors (Clement et al., 2019; Collins et al., 2003; Truong, 2010). The drift being larger for firms that have lower institutional holding and are smaller can suggest that the investor base with more irrational investors is driving the drift. Nevertheless, market frictions pertaining to the long leg can also constitute a driver of the drift. Our results show that trading volume impacts the size of the PEAD. In addition, firm size also relates to market frictions as small firms tend to be more illiquid (Amihud and Mendelson, 1986). As a result, the VOLUME and SIZE variables may indicate that market frictions specific to stocks with extreme positive earnings surprises are preventing arbitrageurs from exploiting the upward drift.

6. Conclusion

The aim of this study is to investigate whether the post-earnings-announcement drift still exists in the Swedish stock market and if the magnitude of a possible drift can be attributed to limits to arbitrage. This paper thus contributes to an understanding of market efficiency and how it is influenced by market frictions.

We provide evidence of an asymmetric drift after earnings announcements in Sweden. Our results show stock prices drifting after positive earnings surprises. However, we do not find a downward drift in prices following negative earnings surprises. Hence, our findings reveal stock prices reacting differently to good versus bad earnings shocks. By using a regression analysis, we show that the return from a hedge strategy based on the drift is generated by the long position in stocks with the most positive earnings surprises. Specifically, our trading strategy based on a three-month holding period produces a mean return of 11% per year. The results are robust to the market, size, value and momentum effects. Consequently, we find support for our first hypothesis of the drift being present in the Swedish stock market. Our findings thus align with Setterberg (2011) who only detects a drift upwards following earnings announcements and shows that trading on the anomaly yields 11% in yearly return.

The lack of a downward drift in prices after negative earnings surprises indicates that short-sale constraints do not inhibit arbitrageurs from exploiting the drift in Sweden. Instead, our proxies of limits to arbitrage attempt to capture the source of the mispricing that is left in the long position of our trading strategy. In line with our second hypothesis of limits to arbitrage impacting the magnitude of the drift, we find that more difficult to arbitrage stocks yield higher mean returns than a trading strategy sorted exclusively on earnings surprises. Our results particularly show that proxies of transaction costs, investor sophistication and size affect the magnitude of the drift. On average, 7% more per year can be earned from sorting the strategy on low institutional ownership and firm size in addition to earnings surprises. Furthermore, our regression analysis shows no evidence of returns drifting for stocks that based on our explanatory variables should be easier for arbitrageurs to trade. These findings are further robust to the risk factors from the Fama-French (1993) and Carhart (1997) four-factor model. Accordingly, our results confirm the notion of arbitrageurs aligning prices with their fundamental value for securities that have lower barriers to arbitrage (Bhushan, 1994; Gerard, 2012; Jeffrey et al., 2008; Mendenhall, 2004; Zhang et al., 2013).

One of the limitations of our study is that the returns of our trading strategies do not include transaction costs. Costs to trading would affect the profitability of our trading strategies and hence the lucrativeness of our returns may be exaggerated. However, considering the magnitude of the returns and that we only form new portfolios quarterly, it is reasonable to assume that our strategies still would generate positive returns net of transaction costs. Additionally, the returns of the trading strategies constitute average returns earned over our sample period. Thus, the returns do not represent what an investor would earn in real-time from trying to leverage the drift. Thereby, there is reason to be cautious when analyzing the strategies profitability.

The drift in prices contradict the semi-strong form of the efficient market hypothesis. Our proxies of limits to arbitrage open for discussions surrounding irrationality and market frictions causing this inefficiency. Hence, as a suggestion for future research, we propose to further investigate the asymmetrical nature of the drift. Prior research regarding what causes the different responses to negative and positive earnings surprises is relatively scarce within the PEAD sphere. More knowledge about market efficiency and how it is affected by arbitrage would be of interest to researchers, portfolio managers and investors.

References

- Adebambo, B., Brockman, P., and Yan, X. (2015). Anticipating the 2007-2008 Financial Crisis: Who Knew What and When Did They Know It? *The Journal of Financial and Quantitative Analysis*, 50(4).
- Akbas, F., Armstrong, W. J., Sorescu, S., and Subrahmanyam, A. (2016). Capital Market Efficiency and Arbitrage Efficacy. *The Journal of Financial and Quantitative Analysis*, 51(2).
- Ali, A., Hwang, L. S., and Trombley, M. A. (2003). Arbitrage risk and the book-to-market anomaly. *Journal of Financial Economics*, 69(2), 355–373.
- Amihud, Y. (2002). Illiquidity and stock returns: cross-section and time-series effects. *Journal of Financial Markets*, 5.
- Anginer, D., Ray, S., Seyhun, H. N., and Xu, L. (2024). Expensive anomalies. *Journal of Empirical Finance*, 75.
- Ariff, M., Loh, A. L. C., and Chew, P. M. K. (1997). The impact of accounting earnings disclosures on stock prices in Singapore. *Asia Pacific Journal Of Management*, 14.
- Amihud, Y., and Mendelson, H. (1986). Asset Pricing And The Bid-Ask Spread*. *Journal of Financial Economics*, 17, 223-249
- Ayers, B. C., Li, O. Z., and Yeung, P. E. (2011). Investor trading and the post-earnings-announcement drift. *Accounting Review*, 86(2), 385–416.
- Ball, R., and Brown, P. (1968). An Empirical Evaluation of Accounting Income Numbers. *Journal of Accounting Research*, 6(2).
- Barberis, N., Thaler, R., Brunnermeier, M., Constantinides, G., Daniel, K., Harris, M., Huang, M., Lamont, O., Ritter, J., Shleifer, A., Stein, J., and Vuolteenaho, T. (2002). *NBER Working Paper Series A Survey Of Behavioral Finance*.
- Bartov, E., Radhakrishnan, S., and Krinsky, I. (2000). Investor Sophistication and Patterns in Stock Returns after Earnings Announcements. *The Accounting Review*, 75(1).
- Battalio, R. H., and Mendenhall, R. R. (2005). Earnings expectations, investor trade size, and anomalous returns around earnings announcements. *Journal of Financial Economics*, 77(2), 289–319.
- Battalio, R. H., and Mendenhall, R. R. (2011). Post-Earnings Announcement Drift: Bounds on Profitability for the Marginal Investor. *The Financial Review*, 46.
- Bernard, V. L., and Thomas, J. K. (1989). Post-Earnings-Announcement Drift: Delayed Price Response or Risk Premium? *Current Studies on The Information Content of Accounting Earnings*, 27.
- Bernard, V. L., and Thomas, J. K. (1990). Evidence that stock prices do not fully reflect the implications of current earnings for future earnings*. *Journal of Accounting and Economics*, 13.
- Bernard, V., Thomas, J., and Wahlen, J. (1997). Accounting-Based Stock Price Anomalies: Separating Market Inefficiencies from Risk*. *Contemporary Accounting Research*, 14(2), 89-136
- Bhushan, R. (1994). An informational efficiency perspective on the post-earnings announcement drift. *Journal Of Accounting and Economics*, 18.
- Bohl, M. T., Czaja, M. G., and Kaufmann, P. (2016). Momentum profits, market cycles, and rebounds: Evidence from Germany. *Quarterly Review of Economics and Finance* 61, 139–159.

- Brandt, W., Kishore, R., Santa-Clara, P., and Venkatachalam, M. (2008). Earnings Announcements are Full of Surprises. *Anderson School of Business, UCLA, and NBER*, (310).
- Carhart, M. M. (1997). On Persistence in Mutual Fund Performance. *The Journal of Finance*, 52.
- Chan, L. K. C., Jegadeesh, N., and Lakonishok, J. (1996). Momentum Strategies. *The Journal of Finance*, 51.
- Chan, W. C. (2003). Stock price reaction to news and no-news: Drift and reversal after headlines. *Journal of Financial Economics*, 70(2), 223–260.
- Chen, H. Y., Chen, S. S., Hsin, C. W., and Lee, C. F. (2014). Does revenue momentum drive or ride earnings or price momentum? *Journal of Banking and Finance*, 38(1), 166–185.
- Chordia, T., and Shivakumar, L. (2005). Inflation illusion and post-earnings-announcement drift. *Journal of Accounting Research*, 43(4), 521–556.
- Chordia, T., and Shivakumar, L. (2006). Earnings and price momentum. *Journal of Financial Economics*, 80(3), 627–656.
- Chordia, T., Goyal, A., Sadka, G., Sadka, R., and Shivakumar, L. (2009). Liquidity and the Post-Earnings-Announcement Drift. *Analysts Journal*, 65.
- Chudek, M., Truong, C., and Veeraraghavan, M. (2011). Is trading on earnings surprises a profitable strategy? Canadian evidence. *Journal of International Financial Markets, Institutions and Money*, 21(5), 832–850.
- Clement, M., Lee, J., and Yong, K. O. (2019). A new perspective on post-earnings-announcement-drift: Using a relative drift measure. *Journal of Business Finance and Accounting*, 46(9–10), 1123–1143.
- Collins, D. W., Gong, G., and Hribar, P. (2003). Sophistication and the Mispricing of Accruals. *Review of Accounting Studies*, 8, 251–276.
- Conrad, J., Cornell, B., and Landsman, W. R. (2002). When Is Bad News Really Bad News? *The Journal of Finance*, 57.
- Dische, A. (2002). Dispersion in Analyst Forecasts and the Profitability of Earnings Momentum Strategies. *European Financial Management*, 8, 211–228.
- Doukas, J. A., and McKnight, P. J. (2005). European momentum strategies, information diffusion, and investor conservatism. *European Financial Management*, 11(3), 313–338.
- Doyle, J. T., Lundholm, R. J., and Soliman, M. T. (2006). The extreme future stock returns following I/B/E/S earnings surprises. *Journal of Accounting Research*, 44, 849–887.
- Epley, N. (2004). A tale of tuned decks? Anchoring as accessibility and anchoring as adjustment. In D. J. Koehler and N. Harvey (Eds.), *Blackwell Handbook of Judgment and Decision Making* (pp. 240–256). Oxford: Blackwell.
- Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, 25.
- Fama, E. F., and French, K. R. (1993). Common risk factors in the returns on stocks and bonds*. *Journal of Financial Economics*, 33.
- Fama, E. F. (1998). Market efficiency, long-term returns, and behavioral finance. *Journal of Financial Economics*, 49.
- Fama, E. F., and French, K. R. (2008). Dissecting Anomalies. *The Journal of Finance*, 63.

- Federal Reserve Economic of Saint Louis. (2024). *Federal Funds Effective Rate*. Federal Reserve Economic of Saint Louis. <https://fred.stlouisfed.org/series/FEDFUNDS>
- Forbes, W., and Giannopoulos, G. (2015). Post-Earnings Announcement Drift in Greece. *Review of Pacific Basin Financial Markets and Policies*, 18(3).
- Forner, C., and Sanabria, S. (2010). Post-earnings announcement drift in Spain and behavioural finance models. *European Accounting Review*, 19(4), 775–815.
- Forner, C., Sanabria, S., and Marhuenda, J. (2009). Post-earnings announcement drift: Spanish evidence. *Spanish Economic Review*, 11(3), 207–241.
- Foster, G. (1977). Quarterly Accounting Data: Time-Series Properties and Predictive-Ability Results. *The Accounting Review*, 52(1).
- Foster, G., Olsen, C., and Shevlin, T. (1984). Earnings Releases, Anomalies, and the Behavior of Security Returns. *The Accounting Review*, 59(4).
- Francis, J., Lafond, R., Olsson, P., and Schipper, K. (2007). Information uncertainty and post-earnings-announcement-drift. *Journal of Business Finance and Accounting*, 34(3–4), 403–433.
- Frazzini, A. (2006). The Disposition Effect and Underreaction to News. *The Journal of Finance*, 61(4).
- Geoffrey Booth, G., Kallunki, J. P., Sahlström, P., and Tyynelä, J. (2011). Foreign vs domestic investors and the post-announcement drift. *International Journal of Managerial Finance*, 7(3), 220–237.
- Gerard, X. (2012). Information Uncertainty and the Post-Earnings Announcement Drift in Europe. *Financial Analysts Journal*, 68(2).
- Goh, J., and Jeon, B. H. (2017). Post-earnings-announcement-drift and 52-week high: Evidence from Korea. *Pacific Basin Finance Journal* 44, 150–159.
- Griffin, J. M., Ji, X., and Martin, J. S. (2003). Momentum Investing and Business Cycle Risk: Evidence from Pole to Pole. *The Journal of Finance* 58(6).
- Griffin, J. M., Kelly, P. J., and Nardari, F. (2010). Do Market Efficiency Measures Yield Correct Inferences? A Comparison of Developed and Emerging Markets. *The Review of Financial Studies*, 23(8), 3225–3277.
- Harshita, Singh, S., and Yadav, S. S. (2018). Post-Earnings-Announcement Drift Anomaly in India: A Test of Market Efficiency. *Theoretical Economics Letters*, 08(14), 3178–3195.
- Hew, D., Skerratt, L., Strong, N., and Walker, M. (1996). Post-earnings-announcement Drift: Some Preliminary Evidence for UK. *Accounting and Business Research*, 22(4), 283–293.
- Hirshleifer, D., Lim, S. S., and Teoh, H. (2009). Driven to Distraction: Extraneous Events and Underreaction to Earnings News. *The Journal of Finance*, 64(5).
- Huang, S., Liu, X., and Yin, C. (2019). Investor target prices. *Journal of Empirical Finance*, 54, 39–57.
- Huang, X., Nekrasov, A., and Teoh, S. H. (2018). Headline salience, managerial opportunism, and over-and underreactions to earnings. *Accounting Review*, 93(6), 231–255.
- Hung, M., Li, X., and Wang, S. (2015). Post-earnings-announcement drift in global markets: Evidence from an information shock. *Review of Financial Studies*, 28(4), 1242–1283.
- Israel, R., and Moskowitz, T. J. (2013). The role of shorting, firm size, and time on market anomalies. *Journal of Financial Economics*, 108(2), 275–301.

- Jeffrey, N. G., Rusticus, T. O., and Verdi, R. S. (2008). Implications of Transaction Costs for the Post-Earnings Announcement Drift. *Journal of Accounting Research*, 46(3).
- Jegadeesh, N., and Livnat, J. (2006). Post-Earnings-Announcement Drift: The Role of Revenue Surprises. *Financial Analysts Journal*, 62(2), 22-34.
- Jiang, G., Lee, C. M. C., and Zhang, Y. (2005). Information Uncertainty and Expected Returns. *Review of Accounting Studies*, 10, 185-221.
- Ke, B., and Ramalingegowda, S. (2005). Do institutional investors exploit the post-earnings announcement drift? *Journal of Accounting and Economics*, 39(1), 25–53.
- Kempf, E., Manconi, A., and Spalt, O. (2017). Distracted Shareholders and Corporate Actions. *Review of Financial Studies*, 30(5), 1660–1695.
- Kim, D., and Kim, M. (2003). A Multifactor Explanation of Post-Earnings Announcement Drift. *The Journal of Financial and Quantitative Analysis*, 38(2).
- Lakonishok, J., Shleifer, A., and Vishny, R. W. (1994). Contrarian Investment, Extrapolation, and Risk. *The Journal of Finance*, 49(5), 1541–1578.
- Leippold, M., and Lohre, H. (2012). International price and earnings momentum. *European Journal of Finance*, 18(6), 535–573.
- Li, J. (2016). Slow Price Adjustment to Public News in After-Hours Trading. *The Journal of Trading Summer 2016*, 11(3), 16-31.
- Liang, L. (2003). Post-Earnings Announcement Drift and Market Participants' Information Processing Biases. *Review of Accounting Studies*, 8, 321-345.
- Liu, W., Strong, N., and Xu, X. (2003). Post-earnings-announcement Drift in the UK. *European Financial Management*, 9(1), 89-116.
- Livnat, J., and Mendenhall, R. R. (2006). Comparing the post-earnings announcement drift for surprises calculated from analyst and time series forecasts. *Journal of Accounting Research*, 44(1), 177–205.
- Martineau, C. (2021). Rest in Peace Post-Earnings Announcement Drift. *Critical Financial Review*.
- McLean, R. D., and Pontiff, J. (2016). Does Academic Research Destroy Stock Return Predictability? *The Journal of Finance*, 71(1).
- Mendenhall, R. R. (2004). Arbitrage risk and post-earnings-announcement drift. *Journal of Business*, 77(4), 875–894.
- Milian, J. A. (2015). Unsophisticated arbitrageurs and market efficiency: Overreacting to a history of underreaction? *Journal of Accounting Research*, 53(1), 175–220.
- Nasdaq. (2024). *OMXS30, OMX STOCKHOLM 30 INDEX, (SE0000337842)*. Nasdaq.
https://www.nasdaqomxnordic.com/indexes/historical_prices?Instrument=SE0000337842
- Novak, J. (2008). On the importance of accounting information for stock market efficiency. *PhD dissertation, Uppsala University*.
- Novy-Marx, R., and Velikov, M. (2016). A Taxonomy of Anomalies and Their Trading Costs. *The Review of Financial Studies*, 29(1).
- Pontiff, J. (1996). Costly Arbitrage: Evidence from Closed-End Funds. *The Quarterly Journal of Economics*, 111(4).
- Pontiff, J. (2006). Costly arbitrage and the myth of idiosyncratic risk. *Journal of Accounting and Economics*, 42(1–2), 35–52.

- Reyes, T. (2019). Negativity Bias in Attention Allocation: Retail Investors' Reaction to Stock Returns. *International Review of Finance*, 19(1), 155–189.
- Rozin, P., and Royzman, E. B. (2001). Negativity Bias, Negativity Dominance, and Contagion. *Personality and Social Psychology Review*, 5(4), 296–320.
- Sadka, R. (2006). Momentum and post-earnings-announcement drift anomalies: The role of liquidity risk. *Journal of Financial Economics*, 80(2), 309–349.
- Setterberg, H. (2011). *The Pricing of Earnings Essays on the Post-Earnings Announcement Drift and Earnings Quality Risk*.
- Shleifer, A., and Vishny, R. W. (1997). The Limits of Arbitrage. *Journal of Finance*, 52, 35–55.
- S&P Global. (2024). *S&P 500*. S&P Dow Jones Indices.
<https://www.spglobal.com/spdji/en/indices/equity/sp-500/#overview>
- Sveriges Riksbank. (2018). *Repo rate raised to -0.25 per cent*. Sveriges Riksbank.
<https://www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/press-releases/2018/reporantan-hojs-till-025-procent/>
- Truong, C. (2010). Post earnings announcement drift and the roles of drift-enhanced factors in New Zealand. *Pacific Basin Finance Journal*, 18(2), 139–157.
- Truong, C. (2011). Post-earnings announcement abnormal return in the Chinese equity market. *Journal of International Financial Markets, Institutions and Money*, 21(5), 637–661.
- Wang, S. F., Lee, K. H., and Woo, M. C. (2017). Do individual short-sellers make money? Evidence from Korea. *Journal of Banking and Finance*, 79, 159–172.
- Wang, X. W., Yan, Z., Zhang, Q., and Gao, X. (2018). Investor attention and stock market under-reaction to earnings announcements: Evidence from the options market. *Journal of Futures Markets*, 38(4), 478–492.
- Schwert, G., (2003), Anomalies and market efficiency, ch. 15, p. 939-974 in Constantinides, G.M., Harris, M. and Stulz, R. M. eds., *Handbook of the Economics of Finance*.
- Williams, C. D. (2015). Asymmetric responses to earnings news: A case for ambiguity. *Accounting Review*, 90(2), 785–817.
- Wurgler, J., and Zhuravskaya, E. (2002). Does Arbitrage Flatten Demand Curves for Stocks? *Journal of Business*, 75(4), 583–608.
- Yılmaz, M. K., Aksoy, M., and Çelik, T. T. (2020). Market reaction to regulatory policy changes in financial statements filings: evidence from Turkey. *Euroasian Economic Review*, 10(4), 567–605.
- Zhang, Q., Cai, C. X., and Keasey, K. (2013). Market reaction to earnings news: A unified test of information risk and transaction costs. *Journal of Accounting and Economics*, 56(2–3), 251–266.
- Zhang, S., and Gregoriou, A. (2020). Post earnings announcement drift, liquidity and zero leverage firms: Evidence from the UK stock market. *Journal of Business Research*, 116, 13–26.

Appendix

Table 10. Portfolio Formation Overview

Intitial portfolios	N	Firms	Final portfolios	N	Firms
1	1,579	346	1	3,122	410
2	1,543	376	2	3,083	427
3	1,539	372	3	3,113	416
4	1,544	364	4	3,010	408
5	1,567	369	5	3,036	407
6	1,546	367			
7	1,505	363			
8	1,505	370			
9	1,505	364			
10	1,531	360			

This table illustrates the portfolio formation and reports the number of earnings surprises and firms per portfolio. Portfolio 1 contains the stocks with the most negative earnings surprises per quarter and Portfolio 10 includes the stocks with the most positive earnings surprises per quarter. N represents the number of earnings surprises. Based on period 2004-01-01 to 2020-10-01.

Table 11. Regression Results for PEAD Strategy 2004-2012, Three-Month Holding Period

Variable	SHORT			LONG			PEAD		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	-0.022* (-1.76)	-0.021 (1.66)	-0.020 (-1.51)	0.003 (0.33)	0.003 (0.33)	0.000 (0.03)	0.024** (2.39)	0.024** (2.27)	0.020* (1.97)
<i>MRP</i>	1.141*** (8.73)	1.133*** (6.59)	1.094*** (5.75)	1.220*** (14.48)	1.211*** (10.90)	1.284*** (10.85)	0.079 (0.74)	0.075 (0.53)	0.187 (1.27)
<i>SMB</i>		0.037 (0.08)	0.046 (0.10)		0.053 (0.19)	0.037 (0.14)		0.024 (0.07)	-0.000 (-0.00)
<i>HML</i>		-0.003 (-0.01)	-0.027 (-0.11)		-0.013 (-0.8)	0.032 (0.21)		-0.006 (-0.03)	0.063 (0.34)
<i>MOM</i>			-0.086 (0.51)			0.161 (2.54)			0.248* (1.91)
N	33	33	33	33	33	33	33	33	33
Adj. R2	0.701	0.681	0.673	0.867	0.858	0.864	-0.015	-0.084	0.006

This table reports the regression results for excess buy-and-hold returns. SHORT is the portfolio with the lowest EARs and LONG is the portfolio with the highest EARs. PEAD is equal to LONG minus SHORT. MRP is the market risk factor, calculated as the OMXSPI return minus the risk-free rate proxied by the 1-month Swedish Treasury Bill. SMB, HML and MOM are the size, value and momentum factors from the U.S. Returns and the respective risk factors are compounded over the holding periods. Double-sided t-statistics are reported in parentheses. Based on period 2004-01-01 to 2012-07-01.

* p<0.1; ** p<0.05; *** p<0.01.

Table 12. Regression Results for PEAD Strategy 2012-2020, Three-Month Holding Period

Variable	SHORT			LONG			PEAD		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	-0.000 (-0.39)	-0.001 (-0.82)	-0.001 (-0.14)	0.027*** (2.94)	0.025** (2.74)	0.025*** (2.79)	0.025*** (4.28)	0.027*** (4.25)	0.026*** (4.18)
<i>MRP</i>	1.094*** (12.54)	1.079*** (10.98)	1.056*** (10.49)	1.210*** (11.72)	1.148*** (0.12)	1.122*** (9.19)	0.116 (1.47)	0.068 (0.72)	0.066 (0.66)
<i>SMB</i>		0.128 (0.79)	0.049 (0.27)		0.260 (1.33)	0.171 (0.78)		0.133 (0.84)	0.124 (0.70)
<i>HML</i>		-0.269 (-2.32)	-0.317 (-2.53)		-0.238 (-1.70)	-0.294* (-1.93)		-0.132 (0.27)	-0.134 (0.20)
<i>MOM</i>			-0.138 (-1.02)			-0.156 (-0.96)			-0.007 (-0.11)
N	33	33	33	33	33	33	33	33	33
Adj. R2	0.830	0.848	0.848	0.810	0.822	0.821	0.035	-0.002	-0.037

This table reports the regression results for excess buy-and-hold returns. SHORT is the portfolio with the lowest EARs and LONG is the portfolio with the highest EARs. PEAD is equal to LONG minus SHORT. MRP is the market risk factor, calculated as the OMXSPI return minus the risk-free rate proxied by the 1-month Swedish Treasury Bill. SMB, HML and MOM are the size, value and momentum factors from the U.S. Returns and the respective risk factors are compounded over the holding periods. Double-sided t-statistics are reported in parentheses. Based on period 2012-07-01 to 2021-01-01.

* p<0.1; ** p<0.05; *** p<0.01.

Table 13. Regression Results for PEAD Strategy 2012-2020 with Outliers of EAR Trimmed by 0.5%, Three-Month Holding Period

	SHORT			LONG			PEAD		
Variable	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	-0.011 (-1.50)	-0.012 (-1.65)	-0.011 (-1.49)	0.014** (2.37)	0.013** (2.19)	0.025*** (2.07)	0.025*** (4.20)	0.026*** (4.15)	0.024*** (3.93)
<i>MRP</i>	1.119*** (13.88)	1.121*** (11.47)	1.187*** (10.57)	1.198*** (18.08)	1.175*** (14.75)	1.192*** (14.14)	0.079 (1.20)	0.052 (0.65)	0.104 (1.25)
<i>SMB</i>		0.092 (0.48)	0.053 (0.27)		0.175 (1.10)	0.195 (1.20)		0.086 (0.53)	0.147 (0.91)
<i>HML</i>		-0.163 (-1.31)	-0.199 (-1.55)		-0.148 (-1.46)	-0.130 (-1.23)		0.017 (0.17)	0.072 (0.69)
<i>MOM</i>			-0.133 (-1.05)			-0.057 (0.65)			0.173* (1.98)
N	66	66	66	66	66	66	66	66	66
Adj. R2	0.747	0.746	0.746	0.834	0.836	0.835	0.007	-0.020	-0.026

This table reports the regression results for excess buy-and-hold returns. SHORT is the portfolio with the lowest EARs and LONG is the portfolio with the highest EARs. PEAD is equal to LONG minus SHORT. MRP is the market risk factor, calculated as the OMXSPI return minus the risk-free rate proxied by the 1-month Swedish Treasury Bill. SMB, HML and MOM are the size, value and momentum factors from the U.S. Returns and the respective risk factors are compounded over the holding periods. Double-sided t-statistics are reported in parentheses. Based on period 2004-01-01 to 2021-01-01.

* p<0.1; ** p<0.05; *** p<0.01.

Table 14. Mean Monthly Buy-and-Hold Abnormal Returns for Arbitrage Strategies

τ	ARBRISK				VOLUME			
	Low		High		Low		High	
	Return	SE	Return	SE	Return	SE	Return	SE
1	-0.009	0.006	0.014**	0.006	0.019***	0.005	0.007	0.005
2	-0.012	0.008	0.019**	0.008	0.026***	0.007	0.008	0.007
3	-0.009	0.010	0.017*	0.010	0.037***	0.008	0.012	0.008
4	-0.007	0.012	0.010	0.012	0.042***	0.009	0.014	0.009
5	-0.002	0.014	0.022	0.014	0.056***	0.011	0.020*	0.011
6	-0.001	0.014	0.025*	0.014	0.066***	0.012	0.024*	0.012
7	0.000	0.015	0.026*	0.015	0.063***	0.014	0.030**	0.014
8	0.006	0.016	0.037**	0.016	0.080***	0.015	0.036**	0.015
9	0.006	0.017	0.046***	0.017	0.088***	0.014	0.036**	0.014
10	0.011	0.020	0.045**	0.020	0.103***	0.017	0.031*	0.017
11	0.015	0.022	0.054**	0.022	0.112***	0.019	0.032	0.019
12	0.021	0.023	0.054**	0.023	0.112***	0.020	0.038*	0.020

τ	INST				SIZE			
	Low		High		Low		High	
	Return	SE	Return	SE	Return	SE	Return	SE
1	0.021***	0.005	0.007	0.005	0.019***	0.005	0.007	0.005
2	0.028***	0.007	0.010	0.007	0.026***	0.007	0.008	0.007
3	0.043***	0.008	0.009	0.008	0.037***	0.008	0.012	0.008
4	0.044***	0.010	0.016	0.010	0.042***	0.009	0.014	0.009
5	0.058***	0.011	0.021*	0.011	0.056***	0.011	0.020*	0.011
6	0.062***	0.012	0.028**	0.012	0.066***	0.013	0.024*	0.013
7	0.058***	0.014	0.035**	0.014	0.063***	0.014	0.030**	0.014
8	0.078***	0.016	0.042**	0.016	0.080***	0.015	0.036**	0.015
9	0.081***	0.016	0.044***	0.016	0.088***	0.015	0.036**	0.015
10	0.083***	0.018	0.051***	0.018	0.103***	0.017	0.031*	0.017
11	0.094***	0.019	0.047**	0.019	0.112***	0.019	0.032	0.019
12	0.095***	0.020	0.050**	0.020	0.112***	0.020	0.038*	0.020

This table presents the mean return along with the standard errors and significance levels based on the limits to arbitrage strategies. The High (Low) position is long in the LONG sub-portfolio with high (low) scores and short in SHORT positions sub-portfolio with high (low) scores for the respective arbitrage proxies. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. Based on period 2004-01-01 to 2021-10-01.

* p<0.1; ** p<0.05; *** p<0.01

Table 15. Regression Results for Arbitrage Based Strategies, One to Three-Month Holding Periods

τ	ARBRISK									VOLUME					
	PEAD			Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
1	0.014***	0.012***	0.013***	0.001	-0.001	0.005	0.015*	0.013	0.011	0.019***	0.016***	0.017**	0.010	0.008	0.009
2	0.021***	0.021***	0.021***	0.001	-0.003	-0.002	0.022*	0.025**	0.024**	0.029***	0.028***	0.028***	0.008	0.008	0.008
3	0.027***	0.027***	0.026***	-0.002	-0.003	-0.003	0.038***	0.040***	0.040***	0.035***	0.037***	0.035***	0.015	0.015	0.013
τ	INST									SIZE					
	PEAD			Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
1	0.014***	0.012***	0.013***	0.019***	0.018***	0.018***	0.008*	0.007	0.008	0.018***	0.016**	0.016**	0.009*	0.008	0.010
2	0.021***	0.021***	0.021***	0.030***	0.029***	0.029***	0.010	0.011	0.011	0.029***	0.030***	0.029***	0.009	0.008	0.008
3	0.027***	0.027***	0.026***	0.042***	0.043***	0.042***	0.009	0.010	0.008	0.040***	0.041***	0.042***	0.010	0.010	0.007

This table presents the results from the excess buy-and-hold return regressions based on the limits to arbitrage strategies. The High (Low) position is long in the LONG sub-portfolio with high (low) scores and short in SHORT positions sub-portfolio with high (low) scores for the respective arbitrage proxies. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. τ is the holding period. Based on period 2004-01-01 to 2021-01-01.

* p<0.1; ** p<0.05; *** p<0.01

Table 16. Complete Regression Results for Arbitrage Based Strategies, One-Month Holding Period

Variable	ARBRISK						VOLUME					
	Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	0.001 (0.09)	-0.001 (-0.144)	0.005 (0.68)	0.015* (1.94)	0.013 (1.63)	0.011 (1.40)	0.019*** (3.54)	0.016*** (2.96)	0.017** (3.01)	0.010 (1.59)	0.008 (1.31)	0.009 (1.41)
<i>MRP</i>	-0.206* (-1.93)	-0.143 (-1.28)	-0.023 (-0.28)	0.187 (1.27)	0.193 (1.96)	0.158 (0.92)	0.001 (0.01)	0.053 (0.52)	0.077 (0.72)	-0.085 (0.42)	-0.060 (0.62)	-0.022 (0.86)
<i>SMB</i>		-0.221 (-0.68)	0.127 (0.65)		-0.226 (-0.78)	-0.325 (-0.99)		-0.267 (-1.29)	-0.223 (-1.03)		-0.143 (-0.59)	-0.076 (-0.30)
<i>HML</i>		-0.203 (-0.96)	0.263 (0.97)		0.471 (1.75)	0.340 (1.17)		0.070 (0.37)	0.152 (0.69)		0.062 (0.78)	0.187 (0.73)
<i>MOM</i>			0.545*** (3.52)			-0.154 (-0.72)			0.099 (0.74)			0.152 (0.97)
N	52	52	52	52	52	52	64	64	64	64	64	64
Adj. R2	0.052	0.047	0.242	0.019	0.040	0.031	-0.016	-0.021	-0.028	-0.005	-0.032	-0.033

Table 16. Continued

Variable	INST						SIZE					
	Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	0.019*** (3.84)	0.018*** (3.40)	0.018*** (3.31)	0.008* (1.80)	0.007 (1.42)	0.008 (1.65)	0.018*** (3.15)	0.016** (2.69)	0.016** (2.57)	0.009* (1.50)	0.008 (1.20)	0.010 (1.73)
<i>MRP</i>	0.116 (1.38)	0.145 (0.143)	0.144 (1.27)	-0.152* (-2.04)	-0.116 (-1.37)	-0.063 (-0.81)	0.114 (1.03)	0.141 (1.20)	0.117 (0.92)	-0.195 (-1.36)	-0.144 (-1.39)	-0.062 (-0.95)
<i>SMB</i>		-0.181 (-0.86)	-0.184 (-0.88)		-0.167 (-0.87)	-0.071 (-0.38)		-0.231 (-1.06)	-0.274 (-1.20)		-0.141 (-1.45)	0.007 (0.04)
<i>HML</i>		0.119 (1.06)	0.113 (0.79)		0.004 (-0.28)	0.180 (0.59)		0.260 (1.19)	0.180 (0.50)		-0.220 (-0.98)	0.056 (0.29)
<i>MOM</i>			-0.007 (0.81)			0.214* (1.69)			-0.097 (-0.69)			0.334* (1.73)
N	65	65	65	65	65	65	64	64	64	64	64	64
Adj. R2	0.010	-0.005	-0.021	0.032	0.011	0.041	0.003	0.006	-0.005	0.060	0.062	0.155

This table presents the results from the excess buy-and-hold return regressions based on the limits to arbitrage strategies. The High (Low) position is long in the LONG sub-portfolio with high (low) scores and short in SHORT positions sub-portfolio with high (low) scores for the respective arbitrage proxies. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. MRP is the market risk factor calculated as the OMXSPI return minus the risk-free rate proxied by the 1-month Swedish Treasury Bill. SMB and HML are the size and value factors from the U.S. MOM is the momentum factor from the U.S. Returns and the respective risk factors are compounded over the holding periods. Double-sided t-statistics are reported in parentheses. Based on period 2004-01-01 to 2020-11-01.

* p<0.1; ** p<0.05; *** p<0.01

Table 17. Complete Regression Results for Arbitrage Based Strategies, Two-Month Holding Period

Variable	ARBRISK						VOLUME					
	Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	-0.001 (-0.13)	-0.003 (-0.33)	-0.002 (-0.31)	0.022* (1.89)	0.025** (2.05)	0.024** (2.02)	0.029*** (4.95)	0.028** (4.93)	0.028** (4.87)	0.008 (0.69)	0.008 (0.64)	0.008 (0.65)
<i>MRP</i>	-0.127 (1.36)	-0.099 (-0.90)	0.093 (0.80)	0.265* (1.26)	0.213 (1.26)	0.166 (0.83)	-0.022 (-0.29)	0.026 (0.04)	0.072 (0.59)	0.094 (0.71)	0.115 (0.73)	0.189 (1.00)
<i>SMB</i>		-0.022 (-0.09)	0.188 (0.84)		0.083 (0.23)	0.031 (0.08)		-0.113 (-0.52)	-0.06 (-0.22)		-0.125 (-0.35)	-0.049 (-0.16)
<i>HML</i>		-0.141 (-0.92)	0.164 (0.96)		0.204 (0.86)	0.129 (0.45)		0.007 (-0.09)	0.089 (0.58)		0.059 (0.19)	0.193 (0.58)
<i>MOM</i>			0.426*** (3.19)			-0.105 (-0.46)			0.114 (1.24)			0.185 (0.78)
N	52	52	52	52	52	52	64	64	64	64	64	64
Adj. R2	0.016	-0.005	0.156	0.045	0.024	0.008	-0.016	-0.044	-0.043	-0.008	-0.039	-0.041

Table 17. Continued

Variable	INST						SIZE					
	Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	0.030*** (4.23)	0.029*** (3.97)	0.029*** (3.95)	0.010 (1.40)	0.011 (1.37)	0.011 (1.39)	0.029*** (3.31)	0.030*** (3.20)	0.029*** (3.17)	0.009 (0.93)	0.008 (0.76)	0.008 (0.84)
<i>MRP</i>	0.114 (1.25)	0.124 (1.13)	0.155 (1.27)	0.016 (0.17)	0.039 (0.34)	0.105 (0.83)	0.059 (0.51)	0.070 (0.52)	0.021 (0.14)	0.015 (0.13)	0.054 (0.56)	0.215*** (3.35)
<i>SMB</i>		0.003 (0.02)	0.034 (0.14)		-0.164 (-0.68)	-0.099 (-0.40)		-0.109 (-0.38)	-0.160 (-0.53)		-0.109 (-0.55)	0.058 (0.72)
<i>HML</i>		-0.063 (-0.41)	-0.007 (-0.4)		0.110 (0.68)	0.231 (0.23)		0.096 (0.49)	0.006 (0.03)		-0.079 (-0.81)	0.214* (1.68)
<i>MOM</i>			0.078 (0.14)			0.168 (0.24)			-0.125 (-0.73)			0.407** (2.37)
N	65	65	65	65	65	65	64	64	64	64	64	64
Adj. R2	0.009	-0.021	-0.032	-0.015	-0.035	-0.028	-0.012	-0.040	-0.048	-0.016	-0.041	0.079

This table presents the results from the excess buy-and-hold return regressions based on the limits to arbitrage strategies. The High (Low) position is long in the LONG sub-portfolio with high (low) scores and short in SHORT positions sub-portfolio with high (low) scores for the respective arbitrage proxies. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. MRP is the market risk factor calculated as the OMXSPI return minus the risk-free rate proxied by the 1-month Swedish Treasury Bill. SMB and HML are the size and value factors from the U.S. MOM is the momentum factor from the U.S. Returns and the respective risk factors are compounded over the holding periods. Double-sided t-statistics are reported in parentheses. Based on period 2004-01-01 to 2020-12-01.

* p<0.1; ** p<0.05; *** p<0.01

Table 18. Complete Regression Results for Arbitrage Based Strategies, Three-Month Holding Period

Variable	ARBRISK						VOLUME					
	Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	-0.002 (-0.27)	-0.003 (-0.32)	-0.003 (-0.39)	0.038*** (3.20)	0.040*** (3.25)	0.040*** (3.19)	0.035*** (4.56)	0.037*** (4.64)	0.035*** (4.46)	0.015 (1.22)	0.015 (0.84)	0.013 (1.20)
<i>MRP</i>	-0.091 (-0.48)	-0.161 (-1.11)	-0.096 (-0.49)	0.238* (1.53)	0.191 (1.04)	0.227 (1.20)	0.007 (0.09)	-0.089 (-0.88)	-0.049 (-0.46)	0.121 (1.27)	0.132 (0.93)	0.182 (1.24)
<i>SMB</i>		0.305 (1.51)	0.374 (-0.16)		0.091 (0.70)	0.129 (0.85)		0.399* (1.96)	0.446* (2.16)		-0.052 (-0.01)	-0.006 (0.02)
<i>HML</i>		-0.080 (-0.61)	-0.018 (1.81)		0.131 (0.14)	0.165 (0.27)		-0.077 (-0.60)	-0.034 (-0.25)		0.018 (-0.10)	0.072 (0.39)
<i>MOM</i>			0.190 (1.52)			0.106 (0.65)			0.136 (1.22)			0.154 (1.09)
N	52	52	52	52	52	52	64	64	64	64	64	64
Adj. R2	-0.002	-0.004	0.020	0.042	0.014	0.000	-0.016	0.014	0.022	0.002	-0.031	-0.027

Table 18. Continued

Variable	INST						SIZE					
	Low			High			Low			High		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Intercept</i>	0.042*** (4.89)	0.043*** (5.15)	0.042*** (4.74)	0.009 (1.17)	0.010 (1.24)	0.008 (1.04)	0.040*** (3.95)	0.041*** (3.91)	0.042*** (3.90)	0.010 (0.90)	0.010 (0.84)	0.007 (0.58)
<i>MRP</i>	0.178* (1.88)	0.130 (1.22)	0.167 (1.34)	0.032 (0.29)	-0.006 (-0.12)	0.050 (0.36)	0.031 (0.24)	-0.048 (-0.39)	-0.065 (-0.49)	0.124 (1.05)	0.125 (0.93)	0.229* (1.84)
<i>SMB</i>		0.186 (1.02)	0.229 (1.22)		0.127 (0.54)	0.193 (0.84)		0.326 (1.21)	0.306 (1.11)		-0.002 (-0.00)	0.119 (0.42)
<i>HML</i>		-0.021 (-0.144)	0.019 (0.10)		0.015 (0.18)	0.077 (0.58)		-0.064 (-0.38)	-0.083 (-0.47)		-0.001 (-0.01)	0.111 (0.92)
<i>MOM</i>			0.124 (0.11)			0.191 (1.52)			-0.058 (-0.39)			0.349** (2.14)
N	65	65	65	65	65	65	64	64	64	64	64	64
Adj. R2	0.038	0.017	0.016	-0.014	-0.041	-0.020	-0.015	-0.024	-0.038	0.010	-0.023	0.082

This table presents the results from the excess buy-and-hold return regressions based on the limits to arbitrage strategies. The High (Low) position is long in the LONG sub-portfolio with high (low) scores and short in SHORT positions sub-portfolio with high (low) scores for the respective arbitrage proxies. ARBRISK constitutes the residual variance from regressing a stock's daily return on the market over 48 months up until one month before an earnings announcement. VOLUME represents the daily closing price one month before an earnings announcement multiplied by the number of stocks traded per day divided by market capitalization. INST constitutes the proportion of shares that are institutionally owned. SIZE equals market capitalization. MRP is the market risk factor calculated as the OMXSPI return minus the risk-free rate proxied by the 1-month Swedish Treasury Bill. SMB and HML are the size and value factors from the U.S. MOM is the momentum factor from the U.S. Returns and the respective risk factors are compounded over the holding periods. Double-sided t-statistics are reported in parentheses. Based on period 2004-01-01 to 2021-01-01.

* p<0.1; ** p<0.05; *** p<0.01