**LUT School of Business and Management**

Bachelor's thesis, Business Administration

Financial Management

# The Profitability of Merger Arbitrage in the European Markets 2010-2018

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**Abstract**


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Merger arbitrage is an event-driven investing strategy that exploits price differences after M&A announcements. This thesis examines the risk-adjusted profitability of merger arbitrage in Europe on a data sample consisting of 134 M&A bids announced between 2010 and 2018. Four different portfolios are constructed by the deal payment method and practical limitations in risk arbitrage. Merger arbitrage returns are benchmarked against market portfolios derived from European stock data. Returns are risk-adjusted with the linear and non-linear CAPM and Fama & French three and five-factor models.

Based on the results, cash deal portfolios generate statistically significant abnormal excess returns whereas the evidence of stock deal portfolio performance remains indefinite. Cash deal portfolios are neutral to market fluctuations as stock deal portfolios are significantly exposed to market risk and other risk factors. Merger arbitrage returns are substantially limited by practical limitations such as capital access.

**Tiivistelmä**


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Yrityskauppa-arbitraasi on sijoitustrategia, joka hyödyntää hintaeroja yritysostotarjousten jälkeen. Tämä työ tutkii yrityskauppa-arbitraasin riski-korjattua tuottoa Euroopassa. Aineisto koostuu 134:stä yritysostotarjouksesta, jotka julkistettiin vuosien 2010 ja 2018 välisenä aikana. Tutkielmassa muodostetaan neljä portfoliota ostotarjousten maksutavan mukaan.Yrityskauppa-arbitraasin tuottoja verrataan markkinaportfoliohin, jotka on muodostettu eurooppalaisista osakkeista. Riski-korjattuja tuottoja ja niiden merkitsevyyttä testataan erilaisten lineaaristen ja ei-lineaaristen markkina- ja riskimallien avulla.

Tulokset osoittavat, että portfoliot jotka muodostettiin käteisostotarjousten perusteella tuottavat tilastollisesti merkitseviä ylituottoja. Osakevaihtotarjousten perusteella muodostettujen portfolioiden suoriutuminen on pääosin riippuvainen markkinariskistä ja muista riskifaktoreista eikä ylituottojen olemassaoloa voida vahvistaa. Käteisostotarjousten perusteella muodostetut portfoliot eivät osoita tilastollisesti merkitsevää riippuvuutta markkinariskiin, kun taas osakevaihtoportfoliot ovat alttiita markkinariskille. Arbitraasivoittoja pienentää merkittävästi rajoitettu pääoma.

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# 1. Introduction

There has always been one constant in the history of stock markets and money management: a will to seek for excess returns. Most aggressive players are hedge funds that use leverage and different investment strategies trying to beat the market in any condition. This thesis will be looking at a risky investment strategy used by hedge funds called merger arbitrage.

Mergers and acquisitions occur when management considers synergies of two entities to be greater than they were separately or when the company´s market price is under its asset value making the target attractive to aggressive corporate raiders. Merger arbitrage as an investment strategy tries to take advantage of the price differences after merger and acquisition announcements. After the merger & acquisition (M&A) deal is announced, the target company`s share price tends to appreciate but ends up trading below the offer price. The difference between the offer price for the target company`s share and the share price at the stock exchange is called an arbitrage spread. In a case of a successful M&A deal, arbitrageur receives the spread. Merger arbitrage is also called risk arbitrage since it involves a risk that a merger deal is withdrawn. Merger arbitrageurs lay a bet on the outcome of the deal resulting either at the arbitrage spread profit or a loss unknown.

There have been several studies relating to merger or risk arbitrage. Some of these studies have found statistically and economically significant evidence between merger arbitrage and abnormal excess returns, e.g. Cao, Goldie, Liang & Petrasek (2016), Hall, Pinnuck &Thorne (2012), Hutchinson & Kearney (2007), Baker & Savasoglu (2002) and Mitchell & Pulvino (2001). As the US markets remain arguably the most efficient stock market in the world, there still have been studies reporting a link between abnormal excess returns and merger arbitrage during many decades as Mitchell & Pulvino (2001) demonstrated with a data sample covering over 30 years. Jetley & Ji (2010) reported arbitrage spreads declining more than 400 basis points since 2002 and suggested that this decline may be permanent. Regardless of this finding e.g Jiang, Tao & Danqing (2018) still show significant evidence of abnormal excess return with a data sample from 2000 to 2015 in the U.S market. The nature of merger arbitrage doesn't seem to let abnormal returns disappear as long there is risk involved in the merger completion. Although the evidence and literature are mainly from the US context, there are no obvious barriers that

would deter practicing merger arbitrage in the European stock market. Merger arbitrage literature studying the European markets is limited and controversial about the magnitude of merger arbitrage profitability and lacks the evidence from post financial crisis 2008 time. McDermott & Mulcahy (2017) argue that only the equal-weighted merger arbitrage portfolio generates abnormal daily excess returns of 0,2 basis points in Germany during 2003-2007. Sudarsanam & Nguyen (2008) show evidence of abnormal monthly excess returns 87 basis points in the UK context during 1987 and 2007. In light of these results, merger arbitrage has been profitable in Europe, but the post 2008 era remains undiscovered. The evolution of merger arbitrage in the U.S, the divergences in the scientific evidence and the lack of academic literature in the European context give reasons to study merger arbitrage.

## *1.1. Research problem, method, and objectives*

This thesis examines merger arbitrage strategy´s ability to generate abnormal excess returns in the European stock market during 2010 and 2018. The data covers 134 merger and acquisition bids between publicly listed companies in Europe. The main research question is:

*"Has the merger arbitrage strategy generated significant abnormal excess returns during 2010-2018 in the European stock market?"*

To answer this question, four merger arbitrage portfolios are constructed using daily stock data from 2010 to 2018. The methodology for this thesis is mainly adapted from Mitchell & Pulvino (2001) study. This methodology is the calendar-time approach. The event-time method assumes that merger arbitrage portfolios earn event-time returns regularly which is rather an unrealistic approach (Mitchell & Pulvino, 2001). Linear models that were chosen for this study consist of the CAPM, Fama & French (1993) three-factor and Fama & French (2015) five-factor models which are explained later in this study. Models provide possible evidence if merger arbitrage has produced significant abnormal excess return in a given time period. Previous and most notable studies have used different linear models such as the Capital Asset Pricing Model and Fama & French (1993) three-factor model when benchmarking merger arbitrage returns. The market risk premium has not historically been a good explanatory factor in merger arbitrage returns. As an addition to previous studies, merger arbitrage portfolios are benchmarked against

Fama & French (2015) five-factor model. To provide a robust answer to the main research question, the following sub-questions are formed:

1. *What are the characteristics of different deal type portfolios in the matters of risk and return?*

Merger arbitrage portfolios containing cash and stock deals are constructed to evaluate risk and return characteristics between different deal types. Portfolio returns are calculated with fixed transaction costs and capital constraints to provide a more realistic approach to merger arbitrage profitability.

2. *Do merger arbitrage portfolios face more risk in bear markets?*

Mitchell& Pulvino (2001) tested features of merger arbitrage with the non-linear CAPM. They argued that merger arbitrageurs face more risk in economic downturns. The idea behind this statement is that the acquirer is more likely to back off from the deal if the market is plunging. To assess the problem of possible non-linearity, piecewise linear regression is performed to study merger arbitrage characteristics in different market conditions.

This thesis consists of six chapters. The second chapter explains the merger arbitrage strategy, deal types, risk arbitrage theory in efficient market context and previous studies on merger arbitrage profitability. Data gathering and merger arbitrage portfolio statistics are presented in the third chapter. Portfolio construction and portfolio return calculations are explained in the fourth chapter. Returns of the merger arbitrage portfolios, the theory of the linear asset pricing models and the results of linear regressions are presented in chapter five. The sixth and final chapter concludes this thesis.

# 2. Merger Arbitrage

Merger arbitrage as an investment strategy is portrayed as an event-driven strategy. In merger arbitrage, the investor is not usually interested in security`s future cash flows, only the completion of the deal. After the acquirer has estimated a proper valuation for the target company, a tender offer is announced to the public. Tender offer means a public announcement which states conditions for the merger & acquisition deal. To get shareholders to sell their shares, the ac-

quiring company usually has to offer a premium to the current share price. After the announcement has been released to the public, arbitrageur can either buy shares of a target company, simultaneously buy target`s shares and short sell acquirer shares, or if the deal is unlikely to succeed or share is trading above the offer price, short sell the target share. Arbitrageur receives a profit when shares are bought at a discount to offer price and sold later at the offer price when the deal completes. The exact calculation for deal returns is explained later in this paper. Figure 1 illustrates merger arbitrage as target shares are bought after the announcement and sold later at the offer price.

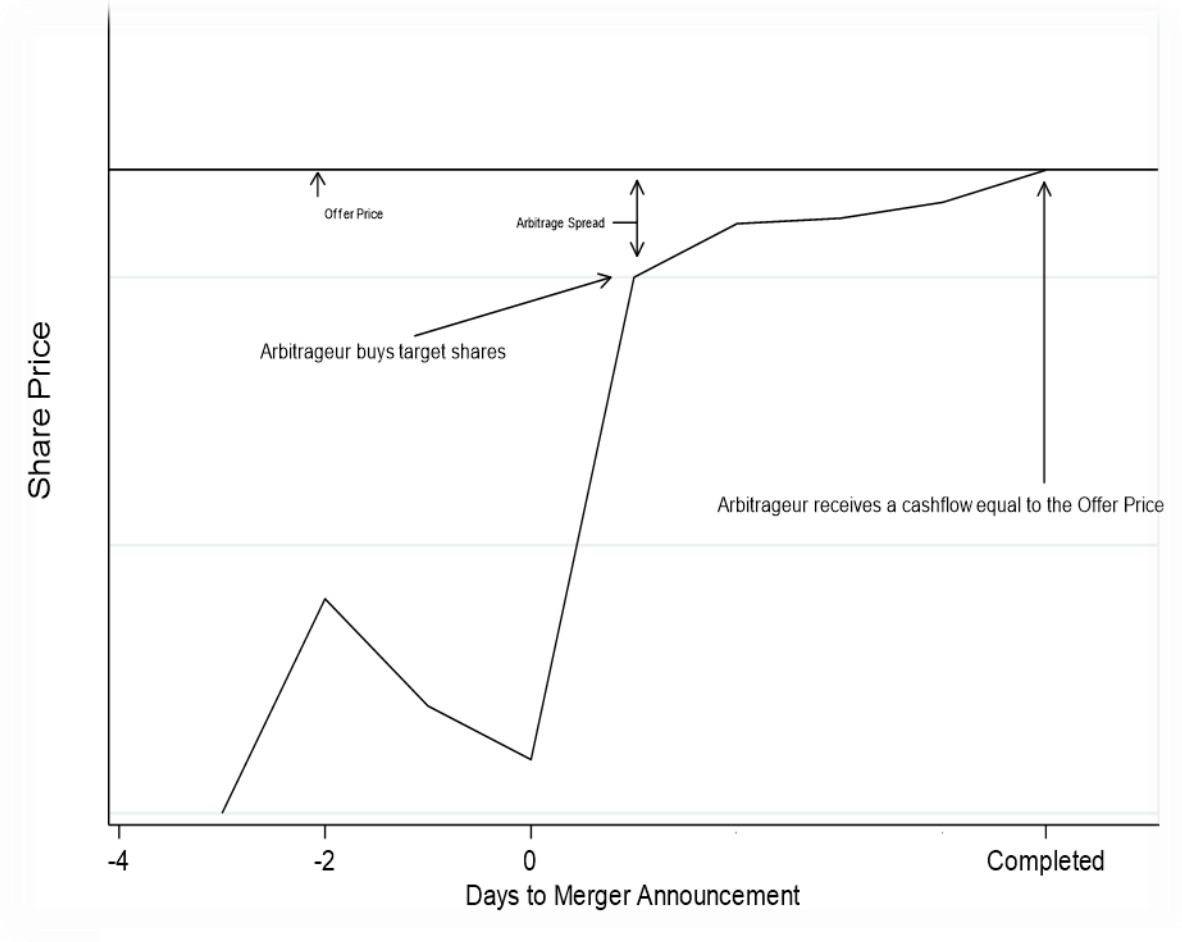


**Figure 1: Merger arbitrage as an event-driven strategy**

## *2.1. Deal types in M&A*

In cash offer deals, the consideration offered is cash. In other words, this means the acquirer paying a fixed amount of cash for each share. If the share trades below the offer price after the announcement, an arbitrageur can exploit price differences and bet on the outcome of the deal. Arbitrageur takes a long position in the target company`s shares and receives a cash flow equal to the offer price if the deal is completed. This thesis uses equation 1 to calculate the arbitrage spread that was mentioned earlier by Jetley & Ji (2010):

(1) $$S_{cash,t} = \frac{P_{Offer} - P_{target,t}}{P_{target,t}}$$

*where*

$S_{cash,\,t}$ = *arbitrage spread on trading day t*

$P_{offer}$ = *price that acquirer has offered to pay for each share*

$P_{target,\,t}$ = *closing price of the target company`s share on trading day t*

On December 7th in 2018 Mascot Bidco Oy and Amer Sports signed an agreement under which Mascot Bidco Oy made a cash tender offer for all issued and outstanding shares of Amer Sports Corporation excluding shares held by Amer Sports. The tender offer was 40,00 EUR per Amer Sports share. The tender offer was subject to a condition of Mascot Bidco Oy gaining more than 90 percent of shares and voting rights. (Amer Sports, 2018). Amer Sports share closed at 38,37 EUR on the announcement day. The arbitrage spread for the deal was 4,24 %. On September 5th of 2019 the deal was announced to be completed and Amer Sports` shares were delisted from Nasdaq Helsinki (Amer Sports, 2019). In this instance arbitrageur would have bought Amer Sports share at 38,37€ and received cash flow equal to 40,00€ when the deal was completed.

Another way to acquire a target company is to offer shares in exchange for the target company`s shares. The proposal includes a conversion ratio that defines how many acquirer`s shares the target company`s shareholders will receive for their shares. Collar transaction means that the actual exchange ratio is defined at the completion date. Merger arbitrageur will take a long position in the target company and short sell the acquirer`s shares equal to the market value of the target share. By short-selling acquirer´s share, the arbitrageur locks in the premium offered

as acquirer share market price on the deal completion date is rather uncertain. The arbitrage spread for stock deals is calculated by using equation 2 (Jetley & Ji, 2010):

(2) $$S_{stock,t} = \frac{(P_{acquirer,t})(ER) \; - \; P_{target,t}}{P_{target,t}}$$

*where*

$S_{stock,\,t}$ = *arbitrage spread on trading day t*

$P_{acquirer,\,t}$ = *closing price of acquirer`s share*

*(ER) = exchange ratio*

$P_{target,\,t}$ = *closing price of the target company`s share on trading day t*

On June 19th 2017 YIT Corporation announced its intentions to merge with Lemminkäinen Corporation. YIT Corporation offered 3,6146 shares as consideration for each Lemminkäinen Corporation share. (YIT, 2017) On the announcement day, YIT´s share traded at 7,90€ and therefore presented a value of 28,55 € offered per Lemminkäinen share where Lemminkäinen share traded at 27,85€. Theoretically, an arbitrageur would have bought Lemminkäinen share and sold short YIT shares equal to the amount of share value of the target company multiplied by exchange ratio. On the completion date 1st of February 2018, short position would have been covered with YIT shares, generating a net cash-flow of 0,70€ representing arbitrage spread of 2,53%. Merger conditions define which strategy is suitable for stock-for-stock deals. If the deal has a disclosed value and exchange ratio floats, short-sell is not necessarily required as cash flow received upon completion is known at least on some level and does not depend on the acquirer´s share price on completion day.

Myers & Majluf (1984) presented the idea of asymmetric information between shareholders and managers. They suggested that managers have an incentive to issue a stock when they think it is overvalued. Based on their theory, management prefers to pay in shares rather in cash when they consider their shares to be overvalued. In the long run, investors learn to consider share-bids as a sign of overvaluation which causes the acquirer`s share price to decline. Liu & Wu (2014) found in their study that short-selling of acquirer shares in share-financed deals increases when merger announcements occur.

Mixed deals method of payment contains both cash and stock deal features. Mixed deal arbitrage spread is mentioned in equation 3, where $S_{mix,t}$ = arbitrage spread on trading day *t* and other variables like mentioned in equations 1 and 2.

(3) $$S_{mix,t} = \frac{P_{Offer,t} + (P_{Acquirer,t})(ER) - P_{Target,t}}{P_{target,t}}$$

## *2.2. Prior studies on merger arbitrage profitability*

Wei et al. (2018) report monthly alphas ranging from 0,51 % to 1,60 %. The study consisted of active and passive risk arbitrage in US markets. All alphas were statistically significant. Active risk arbitrage tries to block M&A deals when seeking for a better bid.

McDermott & Mulcahy (2017) studied merger arbitrage returns in Germany using M&A data from 2003 to 2007. They conclude that only equally weighted portfolio generated statistically significant abnormal excess returns of 0,2 basis points daily. Data consisted of 61 cash or cash and share transactions. They argue that practical limitations such as broker commission and capital constraints reduce arbitrage profits significantly.

Goldie et.al (2016) studied merger arbitrage returns from hedge fund vs. non-hedge fund perspective. Their study reported hedge fund portfolio risk-adjusted returns of 1,18 % monthly. As non-hedge fund merger arbitrage produced monthly risk-adjusted returns of 0,95 %. Both statistically and economically significant.

Hall et al. (2012) studied risks and returns of merger arbitrage in Australian stock markets using stock data sample from 1985 to 2008. They reported statistically significant excess returns of 2,06 percent for long cash deal strategy and 2,46 percent for long-short cash deal strategy. The study reported higher market risk exposure during depreciating markets for both cash and stock deals as stock deals remained riskier.

Sudarsanam & Nguyen (2007) study in the UK shows evidence of significant risk-adjusted returns ranging from 0,88 to 0,93 percent monthly. They use a sample consisting of 975 M&A bids between 1987 and 2006.

Kearney et.al (2007) reported significant risk-adjusted returns in UK stock markets using M&A data from 2001 to 2004. The value-weighted portfolio used in their study generated 20,71 percent compounded rates of returns when an equally weighted portfolio generated total returns of 62,15 percent for a 4year holding period. As contrary to prior research, they did not find evidence of increasing market risk during depreciating markets.

Maheswaran & Yeoh (2005) used a sample of 193 mergers & acquisitions bids from 1991 to 2000 in Australian stock markets. CAPM and Fama & French (1993) Three-factor models pointed out that merger arbitrage created statistically significant excess risk-adjusted returns from 0,84% to 1,20% monthly. When transaction costs were included, excess returns were not statistically significant. They concluded that transaction costs affect significantly merger arbitrage returns.

Baker & Savasoglu (2002) studied merger arbitrage´s profitability in the US markets with a data sample covering 4135 bids between 1981 and 1996. Market and Fama & French (1993) models indicated a statistically significant portfolio alpha that ranged from 0,72 % to 0,86% per month.

Mitchell & Pulvino (2001) studied merger arbitrage opportunities in US stock markets. Merger arbitrage produced a statistically significant value-weighted portfolio alpha of 0,74% monthly. The results didn't include transaction costs and, also assumed the portfolio had unlimited access to capital. After adding transaction costs and constraints of capital, the monthly alpha generated by the merger arbitrage portfolio declined to 0,29%. They argue as well, that transaction costs have a large impact on merger arbitrage returns.

Although the profitability of merger arbitrage has been almost evident, Jetley & Ji (2010) argue that arbitrage spread has been declining over the years. In this instance returns prior to 2002 might not reflect this moment to their full extent. According to Jetley & Ji (2008) fewer hostile deals, lower bid premiums, increased amount of cash deals and trading activity`s increase around the merger announcements are driving the arbitrage spread down. This is not necessarily a sinister moment for merger arbitrageurs as decreased profits mean in turn decreased risk. The next sub-chapters illustrate what is risk arbitrage, what are the idiosyncratic risk and the systematic in merger arbitrage context and why there still might be hope for aggressive players betting on the merger & acquisition outcomes.

## *2.3. Risk Arbitrage*

Arbitrage`s idea is gaining profits while having no risk at stake. Arbitrage means simultaneously buying an underpriced asset from market A and selling the equivalent overpriced asset at market B without any real capital requirements. Arbitrageur (short) sells the overpriced asset and uses it as a collateral to buy the underpriced asset. Arbitrage opportunities, therefore, represent market inefficiencies. As the law of one price states, two equivalent assets with the same economical features should have the same price. Arbitrage opportunities are eliminated as arbitrageurs start buying the underpriced asset and selling the overpriced asset until asset prices have reached the same level. (Sharpe, Alexander, Bailey.1999.283-297).

Although merger arbitrage involves the term “arbitrage”, it is not a pure arbitrage that was portrayed in the preceding paragraph. In order to open a pure arbitrage position, there should not be any risk involved. Merger arbitrage involves a risk that the merger is withdrawn, and it requires capital as both long and short position require an investment. Arbitrage spread which is the profit of successful merger arbitrage also represents the risk involved. The potential loss of merger arbitrage can be much bigger than the arbitrage profit and usually, the idiosyncratic risk of deal completion cannot be hedged. (Baker & Savasoglu, 2002). The study conducted by Shleifer & Vishny (1997) suggests that arbitrageurs cannot always eliminate arbitrage portfolio´s idiosyncratic risk since they don’t always have access to proper diversification.

The magnitude of possible losses in merger arbitrage can be enormous as the estimated loss in General Electric Co. merger with Honeywell International Inc. was almost 3 billion dollars for arbitrageurs. Usually, arbitrageurs control a big portion of the target company´s shares. For example, the percentage of outstanding target shares held by arbitrageurs was 53,36% in General Electric merger. (Officer, 2007)

## 2.4. What factors are related to the idiosyncratic risk in merger arbitrage?

The idiosyncratic risk in merger arbitrage context is the completion risk of a single deal. There have been several studies about factors affecting the success rate of a merger. This plays an important role in merger arbitrage profits since they rely upon completion.

Deal attitude is a key element in the success of mergers and acquisitions deals. E.g. Hoffmeister & Dyl (1981) and Branch & Yang (2003) both argued that hostile bids are reducing the completion probability. In hostile bids, the management does not support the acquisition proposal. Jennings & Mazeo (1993) find high premiums to share prices reducing the likeliness of a withdrawal. High premiums make bidding unattractive for the other possible bidders and reduce the likelihood of resistance.

The form of payment affects deal completion. Cash offers enhance the likelihood of successful takeover when compared to stock-financed deals. As stock offers are sometimes interpreted as the overvaluation of the acquirer´s share price and target shareholders feel more uncertainty about the value of the premium offered, they prefer to receive cash rather than shares. (Branch & Yang, 2003)

Other factors affecting the success probability are termination fees, regulations among the industry and transaction size. Branch & Yang (2003) argued that bigger transaction size deals fail more often. If there are termination fees involved in the merger deal, withdrawal is not a desirable result as the withdrawal leads to monetary losses (Officer, 2003).

## 2.5. Exposure to systematic risk

The previous sub-chapter introduced the idiosyncratic risk in merger arbitrage and key factors determining the idiosyncratic risk. This sub-chapter introduces systematic risk involved in the merger arbitrage portfolio which does not depend on the number of deals in the portfolio i.e. the degree of diversification.

As the very early merger arbitrage literature portrayed merger arbitrage as a market risk-free strategy (e.g. Brown & Raymond, 1986 and Samuelson & Rosenthal, 1986), a study performed

by Mitchell & Pulvino (2001) had contradictory results. They reported increasing exposure to systematic risk during negative market conditions. After running a threshold regression where -4 percent threshold defined positive and negative markets, beta estimates were approximately 0,48 in negative markets as positive market beta stayed close to zero.

Maheswaran & Yeoh, (2005) found no significant difference in exposure to market risk during different market conditions when they evaluated merger arbitrage portfolio formed from 193 cash deals in Australian markets.

Branch & Yang (2006a) studied connections between negative market conditions and performance of risk arbitrage portfolio. The findings of this study concluded that long and long/short portfolios formed from cash-offer deals had higher betas in negative markets than betas derived from the complete sample.

Hall et.al (2013) found in their study that merger arbitrage is not market neutral and is exposed to a greater amount of market risk during declining markets. The paper studied merger arbitrage in Australian markets from 1985 to 2008 with a sample size of 431 deals. Authors pointed out that they benefited from a larger sample size when detecting asymmetric exposure to market risk, as the study by Maheswaran & Yeoh (2005) had a much smaller sample size.

Greater exposure to systematic risk in negative market conditions can be explained e.g. with acquirer considering that it overpays if target share is plunging in the stock market or if the banks are tightening their conditions on financing acquirers. The jurisdiction among takeover attempts plays a role in the possible existence of non-linear market exposure. E.g. in the UK jurisdiction controlling takeovers can prohibit the acquirer withdrawing from the deal even if the market is plunging as in the U.S, the case is different. (Sudarsanam & Nguyen, 2008)

## *2.6. Efficient Market Hypothesis in Merger Arbitrage Context: Why abnormal excess returns have not been arbitraged away?*

According to Fama (1970), there are three types of market efficiencies. Weak-form means that market prices have already been affected by historical public information and no one could get excess returns by analyzing past data on market prices. Semi-strong means that the market is adjusting prices very fast whenever there is new public information available. In that case, one

could earn excess returns only by accessing insider information. Strong market efficiency is considered when one cannot gain an edge compared to other investors, even if they had access to insider information. Strong-form, therefore, means that all public and private information are reflected in the market prices whenever they appear.

In efficient markets (semi-strong) the share price of a target company should theoretically jump straight to the offer price. If the share price would trade at 15,00€ a day before the deal announcement and the offer price would be 30,00€, there should be in theory no sellers at any price level under 30,00€ after the announcement. No rational shareholder would sell his shares at any other price than its fair value or more if there was no possibility of a withdrawal. The offer price would then represent the fair value of the share. However, as the deal completion is uncertain, some shareholders prefer to sell their shares to avoid exposing themselves to the deal completion risk. This selling pressure blocks the market price from rising to the offer price level and creates an opportunity for abnormal returns. Then opportunities for merger arbitrage profits could be explained by selling pressure and completion risk. (Baker & Savasoglu, 2002) When target shareholders start selling their shares, arbitrageurs who have limited access to capital are not able to keep the price on its efficient level. This causes the share price to fall below its efficient level and makes an opportunity for abnormal returns (Shleifer & Vishny, 1997).

Baker & Savasoglu (2002) illustrated the reasoning of merger arbitrage and presented the following equations that describe the merger arbitrage. Equation 4 represents a situation where there is a large amount of small investors who are taking part in the idiosyncratic game and demand no compensation for the risk taken. Their expected profit $P_T$ is probability of success $\pi$ multiplied by shareholder payoff $p$.

(4) $$P_t = 1 + \pi p$$

Equation 5 represents a situation similar to the first equation but investors are facing transaction costs. Therefore, the payoff for the investor is probability $\pi$ multiplied by payoff $p$ minus transaction costs $c$.

(5) $$P_t = 1 + \pi p - c$$

Equation 6 represents a situation with limited amount arbitrage players *A* that maximize mean-variance utility (including absolute risk aversion coefficient) and no transaction costs. First two parts $P_T$ and $(1+\pi)$ are the same as earlier. X is the amount of shares shareholders sell to arbitrageurs *A.*

$$P_t = 1 + \pi p - \frac{X}{A}(1-\pi)p^2 \quad (6)$$

Larcker & Lys (1987) provided another argument to the abnormal return associated with merger arbitrage. According to them, arbitrageurs are better informed about the deal success probability than a regular investor. They proposed that merger arbitrage returns are explained by information costs. Activist merger arbitrage is another theory related to abnormal returns. Activist arbitrageurs enter deals with low premiums and try to affect the outcome of the deal by leveraging a bigger premium (Wei et al. 2018)

Another approach is the transaction cost theory for arbitrage. Mitchell & Pulvino (2001) studied the effect of transaction costs by applying the effect of direct and indirect costs to their portfolios. Direct trading costs are transaction fees paid to the broker whereas indirect trading costs are associated with illiquidity as Mitchell & Pulvino (2001) demonstrated in their study. If the arbitrageur is buying or selling more shares than the market is ready to consume at the current price level, the arbitrageur pays more or receives less for the target shares. Mitchell & Pulvino (2001) argued that transaction costs play a big role in abnormal returns of merger arbitrage.

Arbitrageurs are facing holding costs that are caused by idiosyncratic risk and restrictions in short-selling. As Shleifer & Vishny (1997) mentioned in their study, risk arbitrageurs sometimes lack the possibility of diversification. This leads to a situation where arbitrageurs might avoid entering deals if they feel they are exposed too much to idiosyncratic risk as Baker & Savasoglu (2002) illustrated. By having a lesser amount of arbitrageurs competing for the returns, might leave room for abnormal earnings.

Keown & Pinkerton (1981) noticed in their study that markets start reacting to intended mergers before the public announcement. This is caused by insider activity. They also found support for semi-strong market form since market prices still react to the announcement.

# 3. Deal Data

All the M&A deal data for portfolio construction was extracted from Thomson One M&A Database (2019). All deals gathered from Thomson One were announced and resolved between 2010 and 2018. This thesis includes only deals announced countries inside the European Monetary Union. EMU consists of the following countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain. By having the same currency for each deal simplifies the return measurement as all values are reported in euros.

***Deal requirements:***

- target and acquirer are publicly listed
- the acquirer is seeking to own a majority of target´s equity after the transaction
- acquirer offers cash or stock in exchange for target equity
- the deal value is 50 MIL € or more
- the deal is announced and resolved between 01/2010-12/2018
- deal type is either tender offer or disclosed value M&A deal
- target company´s share value is over 100 cents on the announcement day
- the acquirer offers a positive premium to the target shareholders
- deal status is either completed or withdrawn

Preceding criteria were applied when searching for M&A Deals. Other considerations offered besides cash and stock were excluded. Considerations including e.g. options, convertible bonds do not always enable straightforward pay-off structure making it difficult or impossible to calculate exact merger arbitrage returns. Spinoffs, recapitalizations, self-tenders, minority stake purchases and repurchases were excluded. In order to extract the merger arbitrage profits, the deal must be either completed or withdrawn to determine the date when to close the position. Target companies with a share price trading below 100 cents on the announcement day were excluded. This is to avoid buying shares that are most likely to be either shares of bankrupt

firms or that there is a risk that trading is halted. Every deal included in merger arbitrage portfolios was checked separately. All deals announced with insufficient information regarding deal data or stock quote data were excluded.

## *3.1. Final Deal Data Sample*

After running the data search with parameters defined in the preceding sub-chapter, there were 153 cash-only deals and 72 stock deals. Table 1 lists the number of deal announcements by year and the deal type and the number of deals included in the portfolios. Most active years in announcements for cash-deals were 2012, 2017 and 2018 as in 2016 there were only 9 announcements. Opened positions in target shares were most active in 2011 and 2017. Stock deal announcements spiked during 2015-2016 and 2011 as most inactive years occurred in 2010 and 2018. Stock-deal positions were opened most during 2016 as in 2012 there was only one deal to invest in. Out of 153 cash bids, only 95 (62,09%) were included in the final portfolio. The stock portfolios contain 39 deals.

**Table 1: Number of Deals Announced & Positions Initiated in Target Shares by Year and Deal Type**

| Year | Cash Deal Annoucements | Number of Positions taken | Stock Deal Announcement | Number of Positions taken |
|---|---|---|---|---|
| 2010 | 15 | 12 | 4 | 3 |
| 2011 | 20 | 16 | 11 | 4 |
| 2012 | 21 | 15 | 7 | 1 |
| 2013 | 14 | 10 | 9 | 6 |
| 2014 | 15 | 9 | 6 | 6 |
| 2015 | 9 | 7 | 12 | 6 |
| 2016 | 12 | 3 | 12 | 7 |
| 2017 | 26 | 18 | 7 | 4 |
| 2018 | 21 | 15 | 4 | 2 |
| **Total** | **153** | **95** | **72** | **39** |

Source: Thomson One M&A Database (2019)

Figure 2 illustrates the average number of active deals in portfolios. The average deal running time for cash deals was 134 days, and the average stock deal running time was 190 days. The withdrawal rate for cash deals invested in was 4,21 percent as the stock deal withdrawal rate was 12,82 percent.

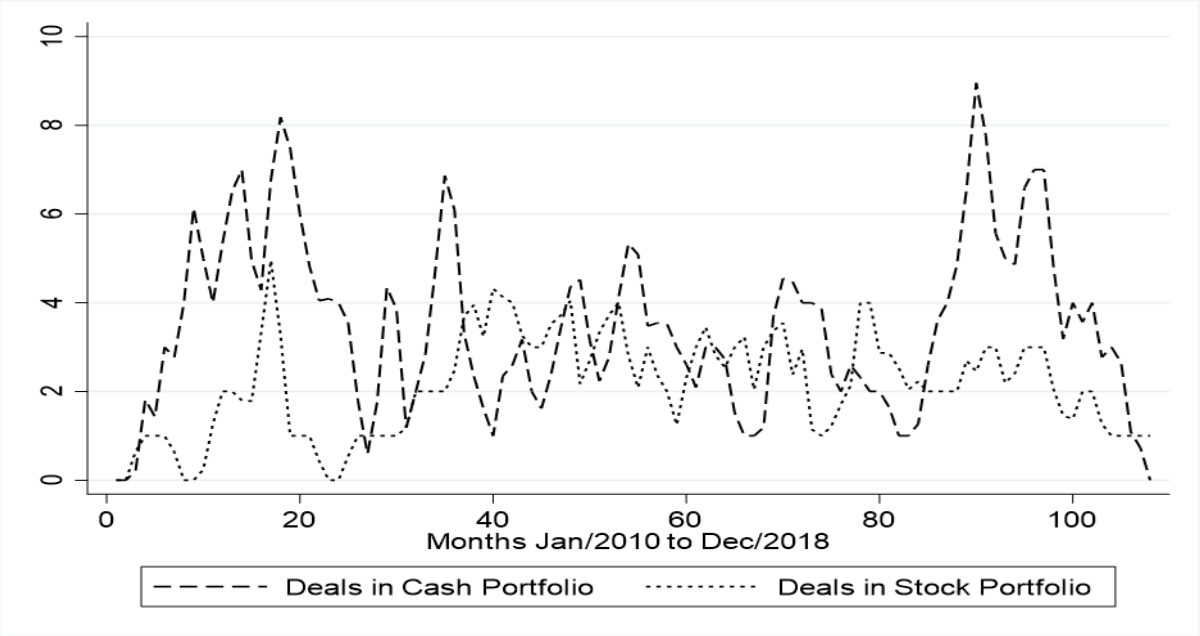


**Figure 2: Average Number of Deals Active in the merger arbitrage portfolios**

# 4. Method

In this chapter, merger arbitrage portfolio construction is explained. The first sub-chapters explain position initiating and closing criteria, and daily deal returns calculation. The following sub-chapters explain portfolio return, weighting methods, and transaction costs. Portfolios are formed out of 95 cash deals and 39 stock deals that were announced and resolved between 2010-2018. By using a sample consisting of 95 cash and 39 stock deals, four different portfolios are constructed. The first two portfolios (later referred to as "long cash/stock portfolio") use the value-weighted method and are fully exposed to merger arbitrage positions. Methods for calculations are presented in the following sub-chapters. The other two portfolios (later referred to as "risk arbitrage fund portfolio") use the same value-weighted method to weight individual

deal returns, but capital constraints and risk management are applied to give a more realistic approach to the magnitude of merger arbitrage profits.

## *4.1. Activating and closing positions*

All daily stock price quotes and possible dividends paid during the stock´s holding period were extracted from Datastream 5.1. Portfolios take long positions in target companies` shares. The position is opened a day after the announcement if the share price is trading below the offer price. If not, the position is not opened. The closing price of the next trading day after the announcement day is the buying price plus transaction fee specified later in this chapter. Target shares remain in the portfolio until the deal has announced to completed or withdrawn. If the deal is completed, the offer price is used as the closing price on deal completion day. Theoretically, the share price on the market and the bid should converge at the deal completion day. However, Maheswaran & Yeoh (2005) found in their study that 36% of successful bids had 5,3% lower value in the share`s market price than the actual bid was on completion day. This is caused by illiquidity. Withdrawn deals are sold at the market price minus transaction fee.

Portfolios containing stock deals use the same method described above. The buying price is the target share price on day t+1 where t is the announcement day. The transaction fee is added to the buying price. On completion day, target shares are converted to cash using the acquirer´s share price and conversion ratio. If the deal has a fixed value, the offer price is used as a closing price. Withdrawn deals are sold at the market price minus transaction fee.

Portfolios constructed in this thesis differ slightly from the method in Mitchell & Pulvino (2001) study. They excluded deals only if data was unreliable or deal structure was too complicated for a straightforward pay-off calculation. Portfolios initiated positions in every M&A deal, not only in those that traded below the offer price on the announcement day +2.

In the US markets, risk arbitrageurs start initiating positions on the announcement day and unwinding them after the deal has been withdrawn. As positions are sometimes very sizable, unwinding can take several days. (Moore, Lai, Oppenheimer, 2006).

## 4.2. Deal Returns

The return for each deal in the portfolio is calculated by using equation 7. It is assumed in this thesis that possible dividends are received at the end of the share`s holding period and added to the cash flows received at the end of the holding period.

(7) $$Rit = \frac{P_{it} + D_{it}}{P_{it-1}} - 1$$

*where*

$R_{it}$ *= return of deal i and trading day t*

$P_{it}$ *= target share price on trading day t*

$D_{it}$ *= dividend received on trading day t*

$P_{it-1}$ *= target share price on trading day t-1*

## 4.3. Portfolio returns and weighting

Portfolio returns are calculated with the value-weighted method. This is to enhance the robustness of the results as the proxy for market returns (Eurostoxx600) is calculated by weighting individual stock returns on their market values. Each target share receives a weight coefficient based on its market value. Weight calculation is provided in equation 8.

(8) $$W_{it} = \frac{V_{it}}{\sum_{i=1}^{Nt} V_{it}}$$

*where*

$W_{it}$ *= the weight of active deal in the portfolio on day t*

$V_{it}$ *= the market value of the target share on day t*

$\sum_{i=1}^{Nt} V_{it}$ *= the total market value of the portfolio on day t*

The daily merger arbitrage portfolio return is the sum of weighted deal returns on day *t*. The calculation for daily portfolio returns is given in equation 9. Daily returns of the merger arbitrage portfolio are then compounded to monthly frequency by using equation 10.

(9) $$R_{MergerArbitrage,t} = \sum_{i=1}^{Nt} WitRit$$

(10) $$R_{MergerArbitrage,j} = \prod_{m=1}^{M}\left(1 + R_{MergerArbitrage,t}\right) - 1$$

*where*

$R_{MergerArbitrage,\,j}$ *= the merger arbitrage portfolio return in month j*

$R_{MergerArbitrage,\,t}$ *=the return of the merger arbitrage portfolio on day t*

For risk arbitrage funds, the return calculation methods are similar. Risk arbitrage fund portfolios receive funds worth 1,000,000 € at the beginning of the time series. Risk management restriction is 10 %. One deal in a portfolio can represent a maximum of 10 percent of the portfolio´s initial value at the time when the investment occurs. The initial value is the fund´s cash reserves plus the market value of shares held. This a simplified version of the Risk Arbitrage Index-method used by Mitchell& Pulvino (2001). By applying a cash investment of 1,000,000 € and a 10 percent restriction, this method is trying to replicate a more realistic situation since full exposure to one deal could lead to a disastrous situation. As a result of actual cash held in risk arbitrage fund portfolios, market risk exposure is likely to be different between risk arbitrage and long cash/stock portfolios. Hall et.al (2012) faced a similar problem when they considered applying capital limitations and risk management rules for merger arbitrage portfolios. Cash held in portfolio clearly underestimates the systematic risk but full exposure to one deal is somewhat unbearable and could, in turn, overestimate the returns. Both portfolio types are examined with linear models to achieve more robust results.

In the US markets, a typical risk arbitrageur maintains a mean portfolio size of 150 million dollars and limits the position size with the 10% rule (Moore, Lai, Oppenheimer, 2006). This

thesis limits the initial investment to 1,000,000 €. This is to avoid being exposed to illiquidity risk at its full extent.

### *4.4. Transaction Costs*

Portfolio returns are calculated with transaction costs. Goldstein et al. (2009) reported a strong decline in transaction costs from 1977 to 2004 for institutional investors. The largest frequencies for NYSE-listed institutional trades were between 5 and 15 basis points. In Europe, commissions are quoted as basis points. Commissions for institutional investors in Europe are estimated to be 15 basis points. (Goldstein et al. 2009). This thesis uses 15 basis points (0,15%) as a commission per trade. The effect of transaction costs is included in portfolio returns by adding 0,15% to buying price and deducting 0,15% from selling price.

## 5. Results

This chapter provides results for merger arbitrage profitability and risk. The first sub-chapter presents descriptive statistics of merger arbitrage. Results for risk-adjusted returns are presented thereafter.

### *5.1 Descriptive Statistics of Merger Arbitrage Returns and Risk*

This sub-chapter provides statistics of merger arbitrage returns and risk. This includes monthly excess returns, standard deviation, cumulative returns, return distribution and Sharpe Ratios. The market return is the Eurostoxx600 Index and the risk-free rate is Euribor 1-month for the Sharpe Ratios and the CAPM. Market index return is calculated with equation 11 and the daily values for Eurostoxx600 are total market return. The total market return includes capital gains and all kinds of cash payments (dividends) that are invested back into the equity index. Sharpe Ratio developed by William Sharpe (1966) measures the relationship between risk(volatility) and return. Sharpe Ratio is calculated using equation 12.

(11) $$R_{EuroStoxx600,t} = \frac{\text{EuroStoxx600}_t}{\text{EuroStoxx600}_{t-1}} - 1$$

*where*

*$R_{Market,\,t}$ = return of the index on day t*

*EuroStoxx600 $_t$ = index value on day t*

*EuroStoxx600 $_{t-1}$ = index value on day t-1*

**(**12) $$S = \frac{R_i - R_f}{\sigma_i}$$

*where*

*S = Sharpe Ratio*

*$R_i$ = monthly return of a portfolio*

*$R_f$ = risk-free rate*

*$\sigma_i$ = portfolio return monthly standard deviation*

Table 2 lists returns for the complete period from 2010-2018. Excess returns are given for merger arbitrage portfolios and Eurostoxx600 Index. All the returns presented in Table 2 are monthly mean of portfolio returns minus the risk-free rate. Euribor 1-month is used as a risk-free rate when it is yielding above zero. If risk-free rate≤0, it is defined as zero. Sharpe ratios are provided for each portfolio. Months active column lists the number of active months. Month is active when there are one or more investments in the portfolio in month *j*.

**Table 2: Monthly Excess Returns, Volatility, and Sharpe Ratios: Complete Sample**

| Portfolio | Ri-Rf | Standard Deviation | Sharpe Ratio | Months Active |
|---|---|---|---|---|
| | *Mean* | | | |
| Long Cash | 0,96% | 2,91% | 0,33 | 105 |
| Long Stock | 0,75% | 6,16% | 0,12 | 102 |
| Risk Arbitrage Fund Cash | 0,57% | 1,63% | 0,35 | 105 |
| Risk Arbitrage Fund Stock | 0,28% | 1,31% | 0,15 | 102 |

| **Market Proxy** | *Mean* | Standard Deviation | Sharpe Ratio | Months Active |
|---|---|---|---|---|
| **EUROSTOXX600 Total Return Index** | 0,59% | 3,48% | 0,16 | 108 |
| **Risk-Free Rate** Euribor 1-month | 0,02% | 0,03% | - | 108 |

Portfolios without capital constraints yielded monthly excess returns ranging from 0,96 percent to 0,75 percent on average. Risk arbitrage portfolios yielded monthly returns ranging from 0,28 to 0,57 percent. Long stock portfolio possesses high risk as a monthly standard deviation is 6,16 percent as risk arbitrage portfolio´s monthly standard deviation is 1,3 percent. As stock deal portfolios go only long in target shares, positions are subject to higher risk as the positions are not balanced with short positions.

Cumulative returns for merger arbitrage and market portfolios are presented in Figure 3. Cumulative return is calculated by compounding daily returns for the complete holding period from 2010 to 2018. Returns are not risk-adjusted. Long cash portfolio yields 227 percent for the 9-year holding period. Previous academic literature has reported somewhat high yields for merger arbitrage. E.g Maheswaran & Yeoh (2005) report a $ 1 investment in cash deals obtaining a value of $ 5,8 at the end of the 112 months holding period yielding therefore ~480 percent. Similar results are presented also by Mitchell & Pulvino (2001) as they report mean rates of return of 16,05 percent annually for a study consisting of 36 years sample including 4750 deals. Long stock portfolio yields 117% for the complete holding period as market return stays at 86%. Risk arbitrage portfolios yield 83 percent for cash and 34 percent for stock deals.

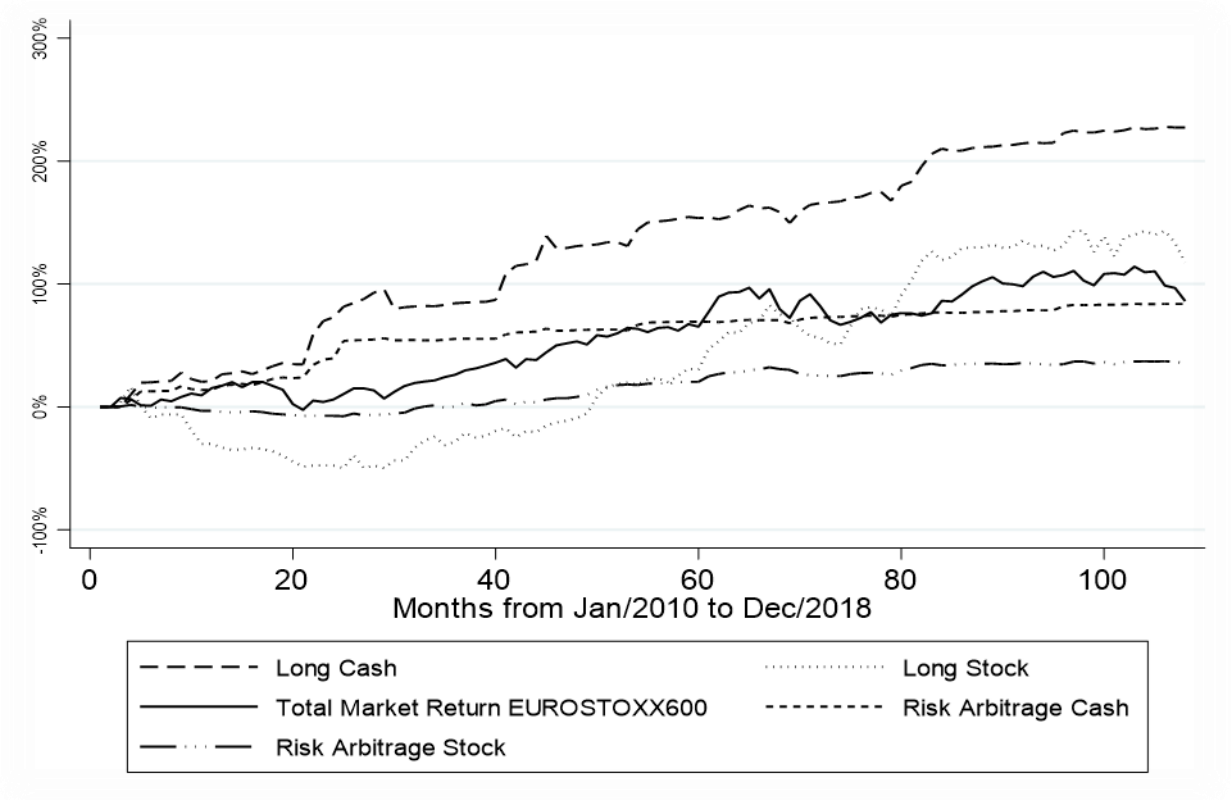


**Figure 3: Cumulative Returns**

Table 3 illustrates the different features of portfolios. Both cash portfolios show relatively strong positive skewness as the monthly returns are positive and skewed on the right side of the mean. This means that volatility measures given earlier portray cash portfolio´s total risk negatively as positively skewed return distribution is not probably unsatisfactory risk for investors. Stock portfolios have skewness values that come close to zero. Kurtosis statistics illustrate the presence of extreme values in all portfolios. Extreme values are present for cash portfolios during 2010 and 2012 as stock portfolios show extreme values during 2013 and 2015. Following sub-chapters consist of merger arbitrage returns benchmarked against linear and non-linear models.

**Table 3: Return Distribution (monthly)**

| **Portfolio** | Mean | Max | Min | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Long Cash – Rf | *0,0096* | 0,1815 | -0,0808 | 0,0008 | 2,44 | 15,90 |
| Long Stock - Rf | *0,0075* | 0,1868 | -0,1728 | 0,0003 | -0,1475 | 3,77 |
| Risk Arbitrage Fund Cash- Rf | 0,0057 | 0,1010 | -0,0241 | 0,0002 | 3,48 | 17,37 |
| Risk Arbitrage Fund Stock- Rf | 0,0028 | 0,0387 | -0,0364 | 0,0001 | 0,2504 | 3,77 |
| **EuroStoxx600 - Rf** | ***0,0059*** | **0,0809** | **-0,1037** | **0,0012** | **-0,3658** | **3,23** |

## *5.2. The Capital Asset Pricing Model*

The Capital Asset Pricing Model (CAPM) is a linear model that is used to predict the expected return for a risk asset and estimate the cost of capital. The model assumes that in a well-diversified portfolio, there is no unsystematic risk. The CAPM was developed by Sharpe (1964), Lintner (1965) and Mossin (1966). The CAPM is presented in equation 13 and the beta coefficient in equation 14.

(13) $$R_i = R_f + \beta_i(R_m - R_f)$$

*where*

$R_i$ *= the return of a risk asset*

$R_f$ *= the risk free rate of return*

$\beta_i$ *= measure of sensitivity to systematic risk (beta)*

$R_m - R_f$ *= market risk premium*

(14) $$B_i = \frac{\sigma_m \sigma_i \rho}{\sigma^2{}_m}$$

*where*

$\sigma_m$ = *standard deviation of market return*

$\sigma_i$ = *standard deviation of the risk asset*

$\rho$ = *correlation of the returns between the market and the risk asset*

$\sigma^2{}_m$ = *variance of the market return*

If the CAPM is valid, the expected return of a risk asset is then expressed as a linear function where the independent variable is the systematic risk. To test the performance of a certain portfolio in the past, the Market Model is constructed. The Market Model is an empirical version of the CAPM and allows a non-zero intercept(alpha). (Jensen, 1968). The Market Model is mentioned in equation 15.

(15) $$R_i - R_f = \alpha_i + \beta_i\left(R_m - R_f\right) + \varepsilon_i$$

*where*

$\alpha_i$ = *abnormal excess return (alpha)*

$\varepsilon_i$ = *error term (idiosyncratic risk)*

*all other variables as mentioned in equation 13 and 14*

Fama (1991,1998) criticized the CAPM and the systematic included in the model and argued that abnormal return could be just a result of the miss-specified risk-return model. Hedge funds are portrayed somewhat in a market-neutral context meaning that they are only a little or not at all exposed to market risk (Bali, Brown & Caglayan, 2012). As merger arbitrage is a hedge fund strategy, it is suitable to consider what are the possible outcomes of explaining returns with the CAPM where all the idiosyncratic has been allegedly diversified away. Idiosyncratic risk is seen from the R2-value of the regression. If the model fails to capture return variances, R2-values score low indicating of the presence of idiosyncratic risk. Titman & Tiu (2011) argue that in fact, those hedge funds with low R2-values are market neutral and as well possess relatively high Sharpe ratios meaning that they are beating other funds whether returns were risk-adjusted with systematic or total risk. Bali et.al (2012) argue that although hedge funds expose

themselves to idiosyncratic risk, the systematic risk plays the main role in explaining hedge fund returns. When merger arbitrage returns are benchmarked against common risk factors, it is reasonable to compare results with Sharpe ratios that risk-adjust returns to total risk. The next chapter provides results for the CAPM estimation.

### *5.2.1. Benchmarking Merger Arbitrage Returns with the CAPM*

The risk-free rate for the CAPM benchmarking is Euribor 1-month when yielding above zero. The market return is the Eurostoxx600 total market return. Table 4 presents the results for the CAPM benchmarking. Rows include a complete sample (105 months and 102 months). Columns include the number of observations (N), adjusted R-square (Adj.R2), the abnormal excess return of merger arbitrage portfolio (α) and beta coefficient (β). Significant p-values are marked with * and interpretation for them is mentioned under the table. Robust standard errors are in the parenthesis.

**Table 4: The CAPM Linear Regression Results**

| **Portfolio** | **Adjusted R2** | **α** | **β** | **Obs.** |
|---|---|---|---|---|
| Long Cash | 0,0077 | 0,0084*** | 0,1070 | 105 |
| | | (0,0023) | (0,1) | |
| Long Stock | 0,1338 | 0,003 | 0,6807*** | 102 |
| | | (0,005) | (0,14) | |
| Risk Arbitrage Fund Cash | -0,0036 | 0,005*** | 0,0359 | 105 |
| | | (0,001) | (0,05) | |
| Risk Arbitrage Fund Stock | 0,1060 | 0,002* | 0,1236*** | 102 |
| | | (0,001) | (0,037) | |

*****statistically significant 99 %**
****statistically significant 95%**
***statistically significant 90%**

Monthly risk-adjusted excess return is 0,84 percent for the long cash portfolio. Stock portfolio´s monthly 0,3 percent excess return is not significant at any confidence level. Risk arbitrage portfolio for cash deals yields an abnormal excess return of 0,5 percent where stock deal portfolio yields returns of 0,2percent. As explained earlier, cash reserves in risk arbitrage portfolios corrupt the market beta estimates as cash has a beta of zero. The stock deal portfolio itself has provided an excess return of 0,2 percent at a 90 percent confidence level since its risk-return ratio has improved due to lower exposure to market risk. When comparing stock deal portfolios, it seems that returns are mainly explained by market returns as the beta coefficient remains statistically significant at the highest confidence level. These findings follow the same pattern as e.g. Hall et al (2013) noticed in the Australian market. Their study suggests that a portfolio containing cash deals is subject to considerably smaller systematic risk than a stock deal portfolio when only long positions are allowed. Stock swap deals with simultaneous buying and short-selling, allow arbitrageurs to use similar pay-off structure as cash deals where the amount of payment is certain whether the acquirer's stock is plunging or not. In this instance, it is not possible as none of the portfolios sells short. The cash portfolios seem to be subject to idiosyncratic risk rather than systematic risk as they show almost zero sensitivity to the market movements. As prior studies have pointed out that CAPM may not be the best model in explaining merger arbitrage profits. In their study Hall et.al (2013) benchmarked merger arbitrage portfolios against market return and found adjusted R-square values (including all samples) that ranged from 0,115 to -0,039. When the Sharpe ratios are compared with the CAPM results, there is some support to the connection between low R2 and the high Sharpe ratio pattern mentioned earlier by Titman & Tiu (2011). The systematic risk included in the CAPM fails to explain cash portfolio return and alphas are significant both economically and statistically. At the same time, cash portfolios´ Sharpe ratios show a better risk-return ratio compared with stock deal or the market portfolio.

To evaluate and test the linear model´s robustness, the sample is divided into three sub-samples. Sub-sample results are provided in the appendices. Results indicate that time span from 2010 to 2012 long cash portfolio´s alpha is over 100 basis points. This could be an aftermath of the financial crisis 2008. Compared with other sub-samples or Sudarsanam & Nguyen (2008) studies in the UK markets that indicated abnormal excess returns ranging from 0,86 to 0,93 monthly, it is preferable to draw any conclusions about merger arbitrage´s risk-adjusted profitability from

2013 onwards. Time-series from 2013 onwards shows statistically significant monthly abnormal return that ranges from 0,88 to 0,58 percent for long cash portfolio and 0,26 to 0,17 percent for risk arbitrage portfolio. This is consisted with findings by Mitchell & Pulvino (2001) as their capital-constrained portfolio yields 0,29 percent monthly on a risk-adjusted basis. Subsample 2013-2015 shows significant positive excess returns of 148 basis points for the long stock portfolio. The next chapter examines the possible asymmetric exposure to market risk.

### *5.2.2. Non-linear adjustments for the CAPM*

Mitchell & Pulvino (2001) mentioned risk arbitrage containing very little systematic risk but during strongly bearish markets, risk arbitrage returns could be linked more with market returns. As explained earlier, deals are more likely to fail in economic downturns. Although merger arbitrage portfolios in this thesis contain a limited amount of deals compared to academic literature to test market risk features in "realistic" conditions, market neutrality is examined and tested by running a piecewise linear regression. Equation 16 presents the non-linear CAPM model as equation 17 presents the restriction that is given to keep the model continuous. The threshold is set to $R_{Market}$-$R_{Risk\text{-}free}$ = 0.

(16) $$Ri - Rf = (1 - \delta)[\alpha_{Mlow} + \beta_{Mlow}(Rm - Rf)] + \delta\left[\alpha_{Mhigh} + \beta_{Mhigh}(Rm - Rf)\right] + \varepsilon$$

(17) $$\alpha_{Mlow} + \beta_{Mlow}(Threshold) = \alpha_{Mhigh} + \beta_{Mhigh}(Threshold)$$

*where*

$R_i$-$R_f$ = *risk arbitrage portfolio return minus risk-free rate*

$\delta$ = *dummy variable (equals 0 when* $R_m$-$R_f \leq 0$ *and 1 when* $R_m$-$R_f \geq 0$*)*

$\alpha$ = *abnormal excess return for market conditions over and under the threshold level*

$\beta$ = *beta coefficient for market conditions over or under the threshold level*

$R_m$-$R_f$ = *market risk premium*

$\varepsilon$ = *error term*

Results for piecewise linear regression are presented in Table 5. 0 percent yielded the best adjusted R-squared and was therefore used as the threshold level for piecewise linear regression. The first column presented the portfolio on which the non-linear model was estimated as other columns provide alphas, beta coefficients for up and down markets and adjusted R-square values. Robust standard errors are in the parenthesis.

**Table 5: Piecewise linear regression results for the CAPM**

| **Portfolio** | $\alpha_{MktHigh}$ | $\beta_{MktLow}$ | $\beta_{MktHigh}$ | **Adj.R2** | **Obs.** |
|---|---|---|---|---|---|
| Long Cash | *0,0092*** | 0,1339 | 0,0803 | -0,0018 | 105 |
| | *(0,004)* | (0,09) | (0,26) | | |
| Long Stock | *0,0078* | 0,8284*** | 0,5274 | 0,1277 | 102 |
| | *(0,01)* | (0,24) | (0,34) | | |
| Risk Arbitrage Fund Cash | 0,0039* | -0,0169 | 0,0929 | -0,0081 | 105 |
| | (0,002) | (0,07) | (0,13) | | |
| Risk Arbitrage Fund Stock | 0,0037* | 0,1765*** | 0,0704 | 0,1055 | 102 |
| | (0,002) | (0,05) | (0,09) | | |

*****statistically significant 99%**
****statistically significant 95%**
***statistically significant 90%**

Long cash portfolio yields 0,92 percent monthly risk-adjusted return and shows no evident difference in beta slopes. Whereas the regression for stock portfolios yields higher beta estimates for down markets. This is in line with prior studies. Sudarsaman & Nguyen (2008) studied a sample of 975 deals in the UK. They reported value-weighted stock deal portfolio beta rising from -0,1063 to 1,15 when down markets occurred. Mitchell & Pulvino (2001) reported stock deal portfolio beta rising from -0,07 to 0,15 when the market was below the given threshold level. Both cash portfolios in this thesis seem to be generating positive abnormal excess returns in any market condition as both the CAPM and the non-linear CAPM results show statistically significant alphas.

The Wald-test is run to examine whether betas for down and up markets are statistically different. Table 6 presents Wald-test results. P-value indicates if the market risk sensitivity differs significantly between market conditions when the threshold is set to 0 %.

**Table 6: Wald-test results**

| Portfolio | F-statistic | P-value |
|---|---|---|
| Long Cash | *0,02* | 0,8778 |
| Long Stock | *0,33* | 0,5666 |
| Risk Arbitrage Fund Cash | 0,37 | 0,5425 |
| Risk Arbitrage Fund Stock | 0,67 | 0,4161 |

**where :** ***Threshold Rm-Rf is 0%***
***H0 is*** $\beta_{MktLow} = \beta_{MktHigh}$
***H1 is*** $\beta_{MktLow} \neq \beta_{MktHigh}$

Results for Wald-test do not support the of non-linearity as none of the values is statistically significant. Other conclusion, supporting this finding can be drawn from the adjusted R2 values. The CAPM shows higher values and therefore explains the returns relatively better than the non-linear CAPM. Branch & Yang (2006) study suggested that unhedged risk arbitrage portfolios containing stock offer deals have higher betas in down markets. Their unhedged portfolio beta for cash, stock and collar offers in target shares was 0,854 as beta for downmarket was 1,3. Both betas were statistically significant. They argued that non-linear pattern is present when negative and positive market conditions are studied separately. Although results for beta comparison do not support the non-linearity, threshold regression shows that betas in down markets are modestly higher than they are in up markets. Due to the relatively low time period (9 years) and lack of extremely bear market conditions, any definitive conclusions cannot be presented if the non-linearity exists in the European markets. Like mentioned earlier Maheswaran & Yeoh (2005) had smaller sample size than Hall et.al (2013) in the Australian merger arbitrage studies. The divergences of these two studies regarding to the existence of asymmetric pattern indicates that asymmetric risk needs a large sample from two or three decades to evaluate it reliably. In the next chapters, merger arbitrage returns are studied with Fama & French (1993,2015) three-and five-factor models.

## *5.3. Fama & French (1993, 2015) three and five-factor model*

Fama & French (1993) three-factor model is a modification of the arbitrage pricing model (APT) .The model has two additional explanatory factors compared to the single-factor market model. The model has its roots in their earlier studies where they noticed shares with small market cap and shares with high book-to-market-ratio outperformed the proxy market. SMB (size factor) is calculated as the return of small-cap firms minus the return of large-cap firms.

HML (value factor) is calculated as the return of high B/M ratio firms minus the return of the low B/M ratio firms. Fama & French (1993) found the firm size and B/M ratio as a proxy for sensitivity to common factors of risk. Size and value captured common variation in returns, as three factors included in the model had good explanatory power on the cross-sectional average returns. Three-factor regression formula (18) is given below:

(18) $$Ri - Rf = \alpha i + \beta i(Rm - Rf) + \beta_{SMB} SMB + \beta_{HML} HML + \epsilon i$$

*where*

$R_i$ = *return of a risk asset*

$R_f$ = *risk free rate of return*

$R_m$-$R_f$ = *market risk premium*

*SMB= size premium*

*HML= value premium*

$\alpha i$ = *regression intercept (risk asset´s alpha)*

$\beta$ = *measure of sensitivity to given risk factor*

$\epsilon i$ = *residual*

Later Fama and French (2015) introduced their five-factor model as an answer to evidence presented by Novy-Marx (2013) and Titman, Wei & Xie (2004) who argued that the three-factor model was incomplete. Fama and French added two more factors to the three-factor model. New factors include *RMW*, which presents the spread between returns of weak and robust profitability. Profitability is measured by operating profit. *CMA* stands for the spread between conservative and aggressive stock returns. Firms are divided into two categories by their investment style measured by lagged total asset growth. Formula (19) for five-factor regression is presented below:

(19) $$Ri - Rf = \alpha i + \beta i(Rm - Rf) + \beta_{SMB} SMB + \beta_{HML} HML + \beta_{RMW} RMW + \beta_{CMA} CMA + \epsilon i$$

*where*

*all other variables equal to equation 18 except for,*

*RMW = profitability premium*

*CMA = investment premium*

The market risk premium used in Fama & French (1993, 2015) three and five-factor model linear regressions in this thesis is the monthly value-weighted all-share portfolio return from Europe minus the 1-month T-bill rate. All factor data is obtained from the Kenneth French Data Library (2019). Risk factors (including market as mentioned earlier) are formed using stock data from Europe. Table 7 presents the descriptive statistics of risk factors obtained from the Kenneth French Data Library.

**Table 7: Descriptive Statistics of Risk Factors from Kenneth French Data Library**

| **Explanatory factors Fama & French** | Mean | Max | Min | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Mkt-rf | *0,004* | 0,1188 | -0,1231 | 0,0023 | -0,1660 | 3,2313 |
| SMB | *0,0017* | 0,0467 | -0,0467 | 0,00002 | 0,0928 | 3,1210 |
| HML | -0,0017 | 0,0641 | -0,0472 | 0,0005 | 0,3682 | 2,7930 |
| RMW | 0,0037 | 0,0356 | -0,0383 | 0,0002 | -0,2220 | 2,5116 |
| CMA | 0,000003 | 0,0312 | -0,0291 | 0,0001 | 0,1795 | 2,9710 |
| (1-Month T-Bill) | 0,0003 | 0,0019 | 0,00 | - | - | - |

| CROSS CORR | *MKT-rf* | SMB | HML | RMW | CMA |
|---|---|---|---|---|---|
| MKT | 1,0000 | | | | |
| SMB | -0,1400 | 1,000 | | | |
| HML | 0,4968 | -0,1300 | 1,0000 | | |
| RMW | -0,4541 | -0,0307 | -0,8361 | 1,0000 | |
| CMA | 0,0259 | -0,1219 | 0,5396 | -0,4382 | 1,0000 |

All the skewness values are between 1 and -1 which indicates of distribution is quite symmetrical. Distribution is rather peaked as all kurtosis values exceed two. All the correlations among risk-factors are modest except for RMW and HML. Strong negative correlation among profitability and value factor is probably explained by investors preferring to pay a premium for profitable firms over non-profitable firms and if the case is this, value stocks are usually non-profitable and have no bright future in the eyes of the investors. Due to the relatively high

correlation among these two factors, problems with multicollinearity arise. As there is a significant relationship between HML and RMW & CMA factors, merger arbitrage portfolio performance measurement and evaluation are conducted by relying on the results of other linear models which are the CAPM and Fama & French (1993) three-factor model.

### *5.3.1. Fama & French (1993) Three-Factor Benchmarking*

The market risk premium obtained from Kenneth French Data Library uses 1-month T-bill as a proxy for risk-free return. The market risk premium is the value-weighted all-share portfolio return from Europe minus the risk-free rate. All factors including the market risk premium use stock data from Europe. Table 8 shows the results for the linear regression. Robust standard errors are in the parenthesis.

**Table 8: Fama & French (1993) Three-Factor regression results**

| Portfolio | Adjusted R2 | α | Marketβ | SMB | HML | Obs. |
|---|---|---|---|---|---|---|
| Long Cash | -0,009 | 0,0084*** | 0,0919 | -0,0735 | -0,089 | 105 |
| | | (0,002) | (0,10) | (0,28) | (0,19) | |
| Long Stock | 0,1993 | 0,005 | 0,4294*** | 0,1812 | 0,6487** | 102 |
| | | (0,005) | (0,13) | (0,34) | (0,28) | |
| Risk Arbitrage Fund Cash | -0,0178 | 0,0051*** | 0,037 | 0,0294 | -0,0687 | 105 |
| | | (0,001) | (0,037) | (0,15) | (0,082) | |
| Risk Arbitrage Fund Stock | 0,1519 | 0,002** | 0,0625** | 0,0230 | 0,1474** | 102 |
| | | (0,001) | (0,025) | (0,07) | (0,06) | |

*****statistically significant 99 %**
****statistically significant 95%**
***statistically significant 90%**

Cash deal portfolios´ monthly alphas remain in line with the CAPM results as they yield 0,84 and 0,5 percent. Cash portfolios show no sensitivity to the new factors at any confidence level. Both stock portfolios show positive sensitivity to the market and value factor. For long stock portfolio estimated market beta is 0,42 and value factor yields 0,64 as both remain statistically

significant at 99 and 95 percent confidence levels. If acquirers seek and bid for undervalued companies with low P/B ratio i.e value stocks offering their supposedly overvalued stocks(growth) as a consideration, a long position in target shares reminds more or less of an investment in value stocks. In that case, stock deal portfolio returns could be partly explained by cheap stocks. Oddly, none of the portfolios show no significant sensitivity to the size factor, as the targets remain usually smaller than the acquirer.

Adjusted R-values range from -0,0178 to 0,1993 in Fama & French (1993) three-factor model. The explanatory power of the model did not improve in the cash deal portfolios when adding two more factors. Nevertheless the three-factor model seems to work better in capturing stock deal returns as they now show significant sensitivity to value factor and add explanatory power to the model. Baker & Savasoglu (2002) used Fama & French (1993) three-factor model alongside the CAPM in their study. The CAPM regression results point at the statistically significant intercept of 0,78 percent whereas three-factor regression indicated abnormal returns of 0,59 percent monthly. Adding two factors improved their model and positive factor (value & size) loadings reduced the alpha (intercept). They find a statistically significant positive correlation between merger arbitrage returns and value stocks as the estimated coefficient is 0,32. Contradictory, Mitchell & Pulvino (2001) experienced increasing intercepts although adding Fama & French (1993) factors improved the model.

### *5.3.2. Fama & French (2015) Five-Factor Benchmarking*

The market risk premium obtained from Kenneth French Data Library uses 1-month T-bill as a proxy for risk-free return. The market risk premium is the value-weighted all-share portfolio return from Europe minus the risk-free rate. All factors including the market risk premium use stock data from Europe. Table 9 shows the results for the five-factor linear regression. Robust standard errors are in the parenthesis.

**Table 9: Fama & French (2015) Five-factor regression results**

| Portfolio | Adjusted R2 | α | Marketβ | SMB | HML | RMW | CMA | Obs. |
|---|---|---|---|---|---|---|---|---|
| Long Cash | 0,0429 | 0,0095*** | -0,1157 | -0,1157 | -0,1262 | -0,2187 | -0,2508 | 105 |
| | | (0,002) | (0,09) | (0,28) | (0,24) | (0,23) | (0,46) | |
| Long Stock | 0,1866 | 0,005 | 0,4673*** | 0,1975 | 0,4100 | -0,1561 | 0,4211 | 102 |
| | | (0,006) | (0,16) | (0,37) | (0,65) | (0,79) | (0,78) | |
| Risk Arbitrage Fund Cash | 0,0457 | 0,0064*** | -0,004 | -0,0391 | -0,0560 | -0,2568 | -0,4504 | 105 |
| | | (0,002) | (0,05) | (0,14) | (0,15) | (0,25) | (0,27) | |
| Risk Arbitrage Fund Stock | 0,1581 | 0,002** | 0,0760** | 0,017 | 0,002 | -0,1515 | 0,1670 | 102 |
| | | (0,001) | (0,03) | (0,08) | (0,1) | (0,13) | (0,13) | |

*****statistically significant 99 %**
****statistically significant 95%**
***statistically significant 90%**

Five-factor regression adjusted R2 values range from 0,0429 to 0,1866. Adding two factors to the three-factor model causes the explanatory power to enhance for cash portfolios. Investment style and profitability factors modestly lift the intercepts compared to the CAPM and Fama & French (1993) three-factor model as alphas range from 0,64 to 0,95 percent. Although cash portfolios show no significant sensitivity to the investment style and profitability factors, coefficients remain negative. Stock portfolio monthly abnormal excess returns range from 0,5 to 0,2 percent. Stock portfolios express market risk exposure of 0,07 and 0,46 at 95 and 99 confidence levels. The strong correlation between value factor and profitability or investment style factor causes lowered adjusted R-square values and statistically insignificant value factor coefficients in stock deal portfolio regressions. Intercepts remain somewhat in line with three-factor regression estimation. The correlation among risk factors is disrupting regression coefficients and deters making definitive conclusions about fundamental drivers in merger arbitrage profits when using the five-factor model. As mentioned earlier, due to this problem, all conclusions are drawn from the results of the CAPM and the three-factor model.

# 6. Conclusion

This thesis examines the risk-adjusted profitability of merger arbitrage in the European stock markets. Using a sample consisting of 95 cash deal and 39 stock deal bids, four merger arbitrage are constructed. Benchmarking the portfolios against the CAPM, Fama & French (1993) three-factor and Fama & French (2015) five-factor model show statistically significant evidence of abnormal excess returns in cash deal merger arbitrage. The cash portfolio generates excess risk-adjusted monthly returns between 88 and 58 basis points. However, there is statistically significant evidence that merger arbitrage profits are constrained by limitations in capital access and hedge fund´s tolerance for risk. Risk arbitrage fund facing capital constraints generates excess risk-adjusted returns between 17 and 26 basis points. These findings are consistent with other studies in other markets as the cash deal merger arbitrage is market neutral and profitable. There is a lack of evidence in the stock deal portfolios´ risk-adjusted profitability although its risk-adjusted performance of 148 and 40 basis points monthly between 2013 and 2015 is rather robust. Stock deal portfolios are significantly correlated with common risk factors in the market. Benchmarking against linear models show no strong evidence of the existence of abnormal excess returns in stock-financed deals. The results of stock portfolios' profitability and risk features should be interpreted carefully as on the contrary, these findings are not strongly supported by prior research. Limited time frame, number of deals and withholding from short-selling may affect these results.

Cash deal portfolios are subject to lower risk in both systematic and total measures. Stock deal systematic and total risk between two portfolios differs as the capital-constrained portfolio is not fully exposed to merger arbitrage. Capital constrained stock deal portfolio obtains lower systematic and total risk than the unrestricted portfolio. Both deal type portfolios show modestly greater sensitivity to market return during negative market conditions but fails to reject the null hypothesis of linearity. This is not a definitive conclusion as prior studies point out that verifying the presence of asymmetric market risk needs a longer time period.

Based on this evidence, I conclude that cash deal merger arbitrage generates statistically and economically significant risk-adjusted returns in the European stock markets.

As the real risk arbitrage funds have only a limited amount of capital at their disposal, it would be interesting to study how leverage affects the merger arbitrage returns. Other interesting topics cover the weighting methods of each investment in the portfolio and how the remaining funds not invested in risk arbitrage are allocated. As the risk-free rates have been close to zero or negative in Europe, buying government bonds is not at least in this moment a profitable way to store excess cash.

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***Electronic Resources***

Datastream 5.1

Thomson One M&A Database (2019)

Kenneth French Data Library (2019) Available at : http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

# Appendices:

## Table 10: Sub-sample CAPM Results

| Portfolio | Adjusted R2 | α | β | Obs. |
|---|---|---|---|---|
| Long Cash | | | | |
| 2010-2012 | -0,0173 | 0,0107* | 0,1276 | 34 |
| | | (0,005) | (0,24) | |
| 2013-2015 | -0,0027 | 0,0088** | 0,1232 | 36 |
| | | (0,004) | (0,11) | |
| 2016-2018 | -0,0270 | 0,0058** | 0,0259 | 35 |
| | | (0,002) | (0,05) | |
| Long Stock | | | | |
| 2010-2012 | 0,1252 | -0,0172 | 0,8869*** | 30 |
| | | (0,15) | (0,24) | |
| 2013-2015 | 0,2186 | 0,0148** | 0,6566** | 36 |
| | | (0,006) | (0,25) | |
| 2016-2018 | 0,0388 | 0,008 | 0,3738* | 36 |
| | | (0,007) | (0,21) | |
| Risk Arbitrage Fund Cash | | | | |
| 2010-2012 | -0,0005 | 0,006** | 0,0605 | 34 |
| | | (0,002) | (0,13) | |
| 2013-2015 | -0,0158 | 0,0026* | 0,0254 | 36 |
| | | (0,001) | (0,03) | |
| 2016-2018 | -0,0219 | 0,0017*** | 0,0116 | 35 |
| | | (0,0006) | (0,012) | |
| Risk Arbitrage Fund Stock | | | | |
| 2010-2012 | 0,0870 | -0,001 | 0,1066*** | 30 |
| | | (0,002) | (0,03) | |
| 2013-2015 | 0,1660 | 0,004* | 0,1917** | 36 |
| | | (0,002) | (0,09) | |
| 2016-2018 | -0,0097 | 0,002 | 0,0416 | 36 |
| | | (0,001) | (0,04) | |

*****statistically significant 99 %**
****statistically significant 95%**
***statistically significant 90%**
**Heteroskedasticy Robust Standard Errors Are in the parenthesis**

**Figure 4: Piecewise Linear Regression Long Cash Portfolio**

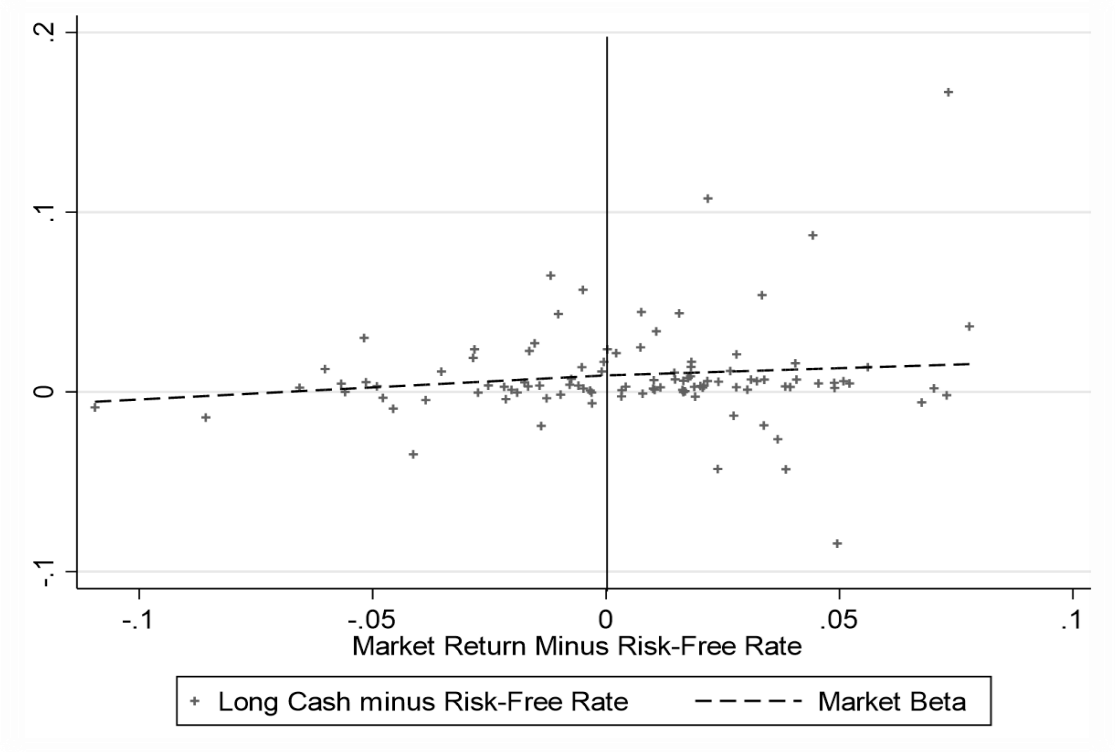


**Figure 5: Piecewise Linear Regression Long Stock Portfolio**

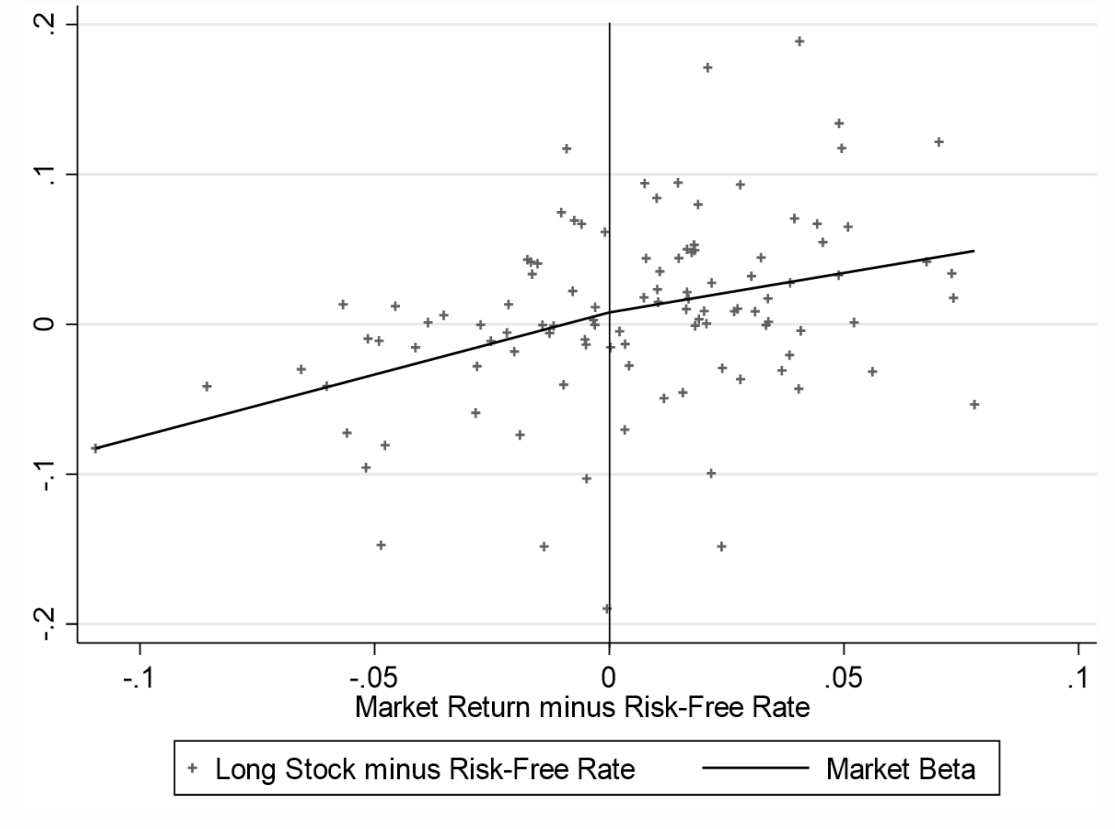

**Figure 6: Piecewise Linear Regression Risk Arbitrage Cash**

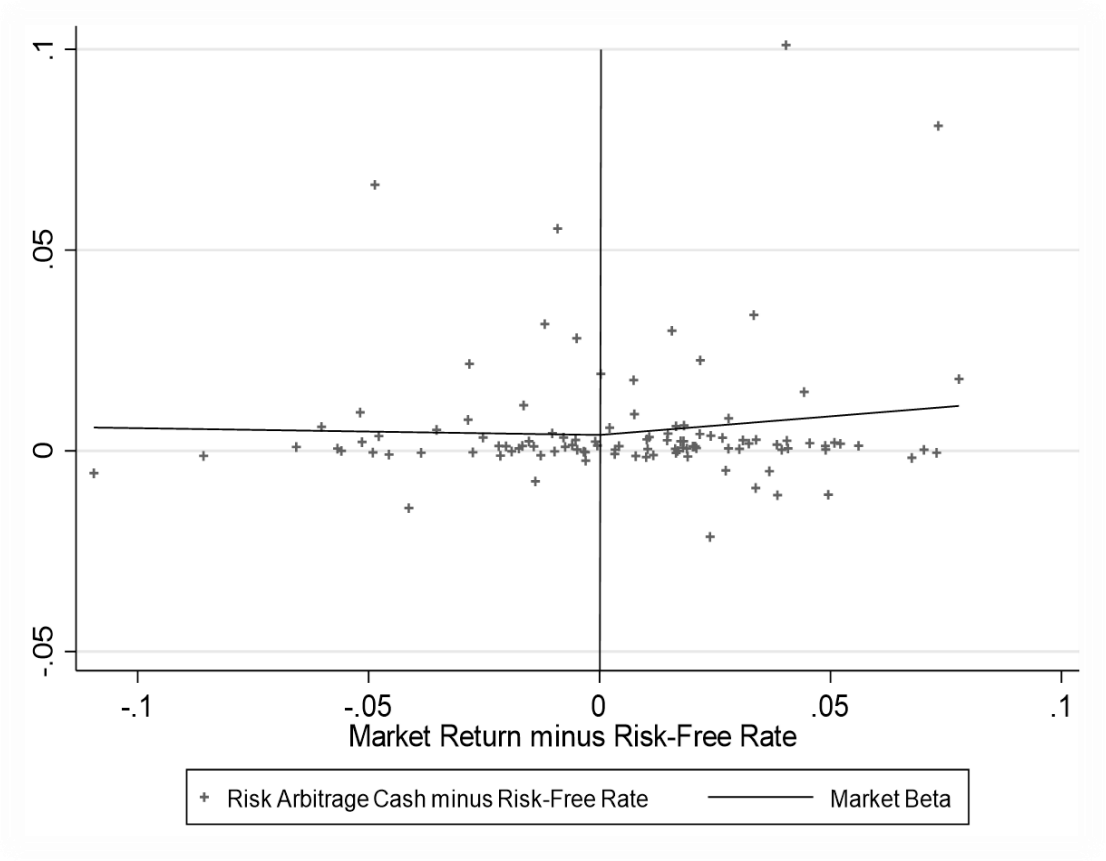


**Figure 7: Piecewise Linear Regression Risk Arbitrage Stock**