FIN11 – Trading and Market Microstructure

Merger Arbitrage

Unlocking Possibilities for Excess Returns in Cash Deals

NHH – Norwegian School of Economics



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1. Introduction

1.1 Motivation and Purpose

A merger or acquisition represents one of the most important strategic decisions made by managers as well as shareholders of the engaged firms (Bino, Krishnaswami, & Mukherjee, 2007). The complexity of these transactions arises from a multitude of factors, each capable of influencing the final outcome of a merger and acquisition (M&A) deal. Furthermore, the stock prices of both the acquiring and the target company are subject to fluctuations based on these factors, as well as the ultimate resolution of the deal.

On January 18, 2022, Microsoft publicly announced its decision to acquire Activision Blizzard, a prominent video game company, in an all-cash transaction valued at $68.7 billion (Microsoft News Center, 2022). The per-share acquisition cost was specified at approximately $95, where later that year, the Federal Trade Commission (FTC) initiated legal proceedings concerning the proposed acquisition (Federal Trade Commission, 2022). The agency aimed to prevent the acquisition, citing concerns that Microsoft would restrict Activision's most popular games from rival consoles or services. However, on October 13, 2023, the lawsuit filed by the FTC reached resolution. The final outcome of the legal matter had a notable impact on Blizzard Entertainment's stock. Post the announcement of the acquisition, the aggregate stock value exhibited a cumulative return exceeding 40%.

Periods characterized by such corporate transactions can present a unique opportunity for investors, also known as *merger arbitrage*. The objective of this strategy is to capture the arbitrage spread – the difference between the acquisition price and the price at which the target's stock trades before the consummation of the merger (Jetley & Ji, 2010). Our analysis seeks to shed light on its dynamics and profit potential. In this paper, we thus find it interesting to look at the profit potential within the period when the acquisition was announced, and when the deal was finalized. Our research question will be as follows:

Can investors generate excess returns through merger arbitrage by investing in target companies of cash deals within the period 2010 to 2022?

Over the years, the strategy of merger arbitrage has gained traction among investors, a trend highlighted by Jetley and Ji (2010). However, a significant decrease in the merger arbitrage spread was seen from 2002 to 2010, amounting to a reduction of over 400 basis points. This decline is mirrored in the declining aggregate returns of merger arbitrage hedge funds, as

reported in the same study by Jetley and Li (2010). Therefore, we have chosen to examine the timeframe from 2010 to 2022 to determine if there still exists good opportunities for excess returns in merger arbitrage.

1.2 Structure

This paper begins by outlining the theoretical foundations of merger arbitrage, followed by the establishment of a theoretical framework for implied odds, as well as theory about risk in merger arbitrage. It then progresses by describing the methodology adopted for constructing the portfolios used in our analysis to evaluate the efficacy of our merger arbitrage strategy. Furthermore, we will present the dataset employed for our research's analysis. Subsequently, the paper elaborates on the theoretical framework employed to assess and quantify the performance of our constructed portfolios, leading up to its practical application and analysis. Finally, we will highlight the identified weaknesses of our merger arbitrage strategy, as well as our constructed portfolio, before the paper concludes with a discussion and presents some possibilities for further research.

2. The Concept of Merger Arbitrage

2.1 Defining Merger Arbitrage

Merger arbitrage, also known as risk arbitrage, is an investment strategy that involves buying the shares of the company being acquired (Jetley & Ji, 2010). As outlined in the introduction, the objective is to capture the spread that typically arises between the offer price and the target company's share price following the announcement of the transaction. Defined by Dybvig & Ross (1989), an arbitrage opportunity is an investment strategy ensuring a positive payoff in some contingency with no possibility of a negative payoff with no net investment. In merger arbitrage, however, the profit depends solely on whether the M&A transaction is a success or failure. It is therefore, in difference from arbitrage, important to underscore that there is a risk of financial loss associated with merger arbitrage.

After the acquisition is announced, the target company's stock will typically trade at a discount to the bid price. This discount is determined by the probability of the bid's success (Maheswaran & Yeoh, 2005). In the case of a successful bid, the share price will reach the bid price, and the arbitrageur will gain a return corresponding the discount. If the bid is unsuccessful, the price of the target share price will fall and the arbitrageur faces selling shares for a lower price. An example of a positive spread from merger arbitrage can be illustrated in Figure 1 below where the investor buys the stock at $20.5 and sells at $21.5 when the deal closes.

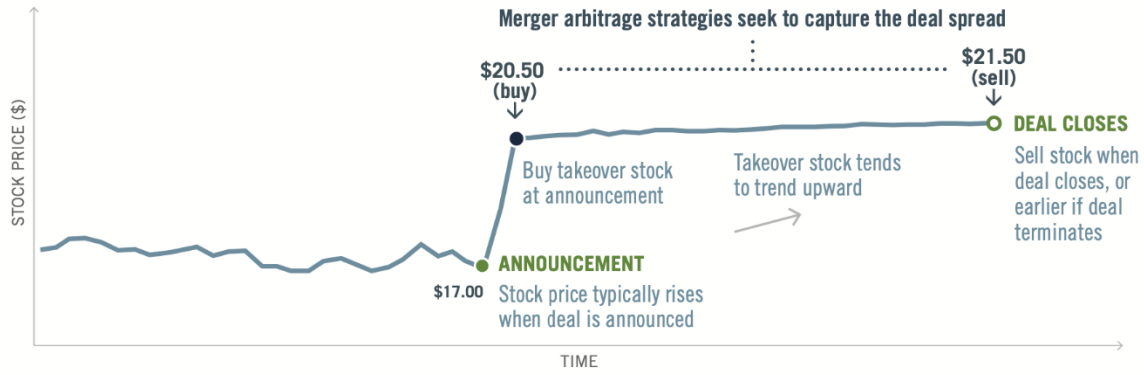


Figure 1 - Merger arbitrage visualized

Dodd and Ruback (1977) finds that merger success announcement is greeted by positive market reaction, while merger cancellation announcement is perceived as bad news (Bino, Krishnaswami, & Mukherjee, 2007). The crucial inquiry centers on the speed and accuracy with which stock price movements reflect all available public information, signifying the market efficiency. According to Xie (2022), today's market is efficient and semi-strong, thus implying that stock prices adjust rapidly to the release of all new information. In Figure 1, the investor therefore takes advantage of the spread that arises after the price change, as a trader, realistically, will not have access to insider-like information.

Finally, there are three principal categories of mergers: stock-for-stock, cash, and mixed consideration (Virtus Investment Partners, 2021). Stock-for-stock merger refers shares of the acquiring company being exchanged for shares in the acquirer, while a cash merger involves the acquirer purchasing the shares of the acquiring company for cash at a certain point. In a mixed consideration, the target company's shareholders receive a mix of cash and stock from the acquiring company in exchange for their existing shares of the target company (Virtus Investment Partners, 2021). Existing literature suggests that stock-for-stock deals typically yield higher returns than cash deals. However, they can also be more exposed to market risk and are less predictable (Branch & Yang, 2006). The cash merger, on the other hand, is a more predictable deal type as the bid price is not exposed to the target company's stock price during the period between the merger announcement and its outcome. The cash merger is therefore the most predictable deal type as the bid price is not exposed to the target company's stock price during the period between the merger announcement and its outcome.

2.2 Implied Odds for a Successful Merger

In order to evaluate the discount to the bid price, we can assess the market's perceived probability that a merger deal will be successfully completed through the formula below.

$$Implied\ odds = \frac{T - D}{O - D}$$

$$T = Trading\ price, O = offer\ price, D = Downside\ price\ of\ the\ stock$$

The implied odds ratio is based on the current trading price of the stock (T), the proposed deal close price (O), and the anticipated downside price if the deal fails (D). The formula takes the difference between the current stock price and the downside price and divides it by the difference between the deal close price and the downside price. This ratio translates into the implied probability of the deal's success.

If the estimated probability of the deal's success remains unchanged, yet the downside price decreases, the formula dictates that the current trading price of the stock must also decrease. Conversely, if the downside price is reduced while the trading price stays the same, the implied probability of the deal's success increases. Furthermore, the wider the spread between the trading price and the offer price, the lower the implied odds. The implication is that when a limited number of investors believe the deal going through, the stock price decreases, thus increasing the spread, and conversely, when investors believe in the deal going through, the stock price increases, thereby reducing the spread.

We could look at the Microsoft & Blizzard Entertainment case as an example. The “deal close” price was $95. On the 3rd of January 2023 the stock traded at $76.88. Before the acquisition was announced, the Blizzard stock had been trading at $65. Even though the downside price was uncertain, we could presume to use the trading price before the announcement, as the company independently was profitable. We can then make the following calculation.

$$Implied\ odds = \frac{76.88 - 65}{95 - 65} = 26.7\%$$

It is important to understand that the offer price (O) in an acquisition scenario might exhibit variability depending on whether the acquiring company opts for a cash or stock-to-stock transaction. In instances where the acquisition is structured with the issuance of stock, the variable O becomes susceptible to fluctuations. Specifically, if the value of the acquiring company’s stock drops, the offer price will correspondingly decrease. Consequently, the inherent risk associated with a stock-based acquisition is higher in comparison to a cash transaction, as the value of cash remains unaffected by fluctuations in the acquiring company’s stock price.

2.4 Risk in Merger Arbitrage

Risk management is divided into two broad categories: systematic and unsystematic risk (Segal, 2023). In merger arbitrage, we must take both into consideration as they play an important role in whether the deal goes through or not.

2.4.1 Systematic Risk

Systematic risk is that part of the total risk that is caused by factors beyond the control of a specific company or individual (CFI Team, n.d.). This type of risk is also known as an undiversifiable risk, as it affects the entire market at once. Consequently, a portfolio exposed to systematic risk exhibits correlated returns with the market. Furthermore, merger arbitrage has traditionally been regarded as a market neutral strategy due to its inherent long-short approach. In essence, it entails taking a long position in the target company's stock while simultaneously taking a short position in the acquirer's stock. As a result, the trader's overall market exposure remains relatively limited compared to alternative strategies (TraderHQ Staff, 2022). In this paper, as outlined in our research question, we will only go long in the target company. This raises the possibility that our strategy may not be market neutral.

2.4.2 Unsystematic Risk

A merger can encounter various challenges leading to its failure, a phenomenon commonly referred to as unsystematic risk. Unsystematic risk is also known as idiosyncratic risk and "… refers to the inherent factors that can negatively impact individual securities or very specific group of assets" (Chen, 2022).

One of the main risk factors influencing the outcome is the regulatory approval from the Federal Trade Commission or Department of Justice (DOJ). Among the key provisions in the U.S. antitrust law is one designed to prevent anticompetitive mergers or acquisitions (Federal Trade Commission, n.d.). The period between 2010 and 2020 has marked a notable shift in M&A enforcement, where the average number of complaints has increased. In the period from 2001 to 2010 the average number was 1466, whilst in the period from 2011 to 2020 the average number was 1687, as found in the study by Billman and Salop (2022).

Another important risk factor is the acceptance of shareholders, often referred to as "shareholder dissent". When a company, investor, or group of investors make a tender offer to purchase the shares of another company at a premium above the current market value, the board of directors may reject the offer (Ganti, 2023). There may be several reasons for a rejection, including considerations related to the size of the offer, and the target company in question.

Moreover, it is important to consider the risk of a material adverse change (MAC). The period between the announcement of an M&A case and its closure presents a substantial time frame during which various developments can transpire (Lip, u.d.). Specifically, during the due diligence process, there can be found issues that have a material impact on the valuation of the target company. This situation could prompt the acquiring company to seek a reduced purchase price, and in a worst-case scenario, the deal may not proceed as planned. It is worth noting that material adverse events account for 69% of terminated transactions and trigger renegotiations in 80% of cases (Denis & Macias, 2010). This indicates that material adverse changes are a significant risk that has to be taken into account.

3. Portfolio Construction

To assess the potential profitability of merger arbitrage, we have chosen to construct and analyze portfolios to measure whether they can generate excess returns. As previously mentioned, stock deals typically yield a higher return than cash deals. Nonetheless, these transactions may carry greater market risk and lack the definitive value that cash deals offer—qualities that can make cash deals particularly appealing to investors. With cash deals, the return is precisely predictable upon successful completion of the deal. For this reason, we have chosen to only look at cash deals in this paper.

In our study we will employ a merger arbitrage strategy characterized by a buy-and-hold approach, as it represents the best approach when engaging in merger arbitrage within the context of cash deals (Pedersen, 2019). The specifics of when we buy and sell the stocks in our portfolios will be elaborated in subsection 4.1, titled “Event-Time versus Calendar Time”.

In the following, we will introduce two types of portfolios, one equal-weighted portfolio, and one value-weighted portfolio. The inclusion of an equal-weighted portfolio stems from Maheswaran and Yeoh’s (2005) findings, which highlighted its superior performance compared to value-weighted portfolios. Simultaneously, the incorporation of a value-weighted portfolio aims to mitigate the bias an equal-weighted portfolio gives, as noted by Mitchell and Pulvino (2001).

3.1 Equal-Weighted Portfolio (EWP)

An equal-weighted portfolio is an investment strategy in which all assets are allocated an equal proportion of the total investment (Tamplin, Equal-Weighted Portfolio, 2023). The total return of the equally weighted portfolio, at a specific time, can be calculated as given below:

$$R_{EW,t} = \sum_{i=1}^{N_t} W_{it} R_{it}, where\ W_{it} = \frac{1}{N_t}$$

The formula $R_{EW,t}$ calculates the total return of the portfolio at time t. In this formula, W_{it} represents the weight assigned to each stock at time t, which is determined based on N_t, the total number of stocks in the portfolio at that time. The equal weighting implied by the fraction indicates a uniform investment distribution across all stocks. R_{it} denotes the return on each individual stock at time t. Essentially, the formula multiplies a consistent fractional weight by the return of each stock, aggregating these values to yield the overall return of the equally weighted portfolio at the specified time t.

3.2 Value-Weighted Portfolio (VWP)

Value weighted portfolio, also known as market capitalization-weighted portfolio, is an investment strategy where the weight of each security is determined by the market capitalization (Tamplin, Market Capitalization-Weighted Portfolio, 2023). This means that the portfolio will favor larger companies. The total return of the value-weighted portfolio, at a specific time, can be calculated as given below:

$$R_{VW}, t = \sum_{i=1}^{N_t} W_{it} R_{it}, where\ W_{it} = \frac{V_i}{\sum_{i=1}^{N_t} V_i}$$

This formula bears resemblance to the one used for determining return in an equally weighted portfolio, but with a key distinction in the calculation of weighing of each stock. In this context $R_{VW,t}$ represents the total return of the portfolio at time t, while R_{it} denotes the daily return on each stock at the same time. The critical difference lies in the computation of the weight, W_{it}. Here, the weight of each stock is derived by considering its market capitalization, represented by V_i. This is achieved by dividing the market capitalization of each stock by the aggregate market capitalization of the entire portfolio, thereby determining the proportional weight to be assigned to each stock.

3.3 Our Dataset

To assess the profitability of merger arbitrage, we have gathered data on the returns from cash-only mergers from 2010 to 2022.

In the following we will outline the process of data collection and proceed to evaluate the returns by employing the two merger arbitrage portfolios. By diversifying our holdings and

allocating investments across a broad range of assets, we effectively distribute our risk exposure and systematically reduce the influence of unique event risks on our entire investment portfolio.

We began the data collection by identifying all mergers and acquisitions involving North American target companies. By utilizing the Bloomberg Merger and Acquisitions Screener, we collected all deals with announcement dates ranging from January 1st 2010, to December 31st. 2022. To focus on transactions that were publicly disclosed, we included only those classified as "completed", "withdrawn" or "terminated", excluding any that were either "rumored" or "still pending". Furthermore, by using the CUSIP (Committee on Uniform Security Identification Procedures) we were able to combine the data with the pricing information of each stock within the deal period, collected from Compustat.

The initial sample consisted of 2790 companies, with 309 183 observations. In order to only focus on stocks, we excluded all non-common stock types. Secondly, for the merger arbitrage strategy to be viable, the target company must be publicly listed. To make sure of this, and exclude any over-the-counter (OTC) traded companies, we only kept stocks listed on one of the major U.S. stock exchanges. This includes the New York Stock Exchange (NYSE), American Stock Exchange, Nasdaq, and the Philadelphia Exchange. Finally, to avoid illiquid stocks and the inclusion of unreliable data, we excluded stocks with low average trading volume. Table 1 below displays these steps in the data-cleaning process.

	Data Cleaning			
Cleaning Step	**Observations**	**Companies**	**Δ Observation**	**Δ Companies**
Initial Dataset	309 183	2 790	NA	NA
Exclusion of Non-Common Stock Types	280 910	2 658	-28 273	-132
Filter for Stock Listed on Major Exchanges	186 749	1 792	-94 161	-866
Retention of stocks traded on at least 80% of days	166 451	1 730	-20 298	-62

Table 1 - Data cleaning Table

4. Performance Measures

4.1 Event-Time versus Calendar Time

There are two approaches to calculate the return of a merger arbitrage portfolio: the event-time approach and the calendar-time approach (Sudarsanam & Nguyen, 2008). The event-time return calculates the return over the transaction period, extrapolating it into an annual return for each deal, and then averages the annual returns across all deals. This approach encounters

two challenges; (1) annualizing returns may overstate the actual return of the merger arbitrage portfolio by assuming continuous earnings from investments in individual mergers, and (2) the clustering of merger events over time and across industries introduces cross-sectional dependence among returns, potentially leading to inaccurate assessments.

Because of these two problems, this paper will employ the calendar-time approach. This approach incorporates each target company into the portfolio from one day after the merger announcement and holds it until one day after the resolution date, thus providing a more realistic description of the achievable returns over the entire period. Specifically, the portfolio return is considered a weighted average of active investment positions at any given time.

4.2 Trading Days

To prevent an overestimation of returns due to the initial takeover premium, which is not part of the arbitrage spread, we record daily returns starting the day after a deal is publicly announced. This approach also ensures we do not contaminate our findings with insider-like trading activity, as it would be unrealistic to consistently predict which companies were on the verge of an acquisition or merger. For deals that are completed, the closure is marked by the delisting of the target company on Bloomberg. For deals that fail, the closure date is set as the day following the public announcement of the failure of the deal. This measure prevents any potential upward bias in returns that could arise from closing positions before the information becomes publicly available.

It's worth emphasizing that we focus our investments on periods comprising ten or more stocks. This approach ensures a sufficient number of stocks in our portfolios, making for an acceptable diversification, and facilitating analyses with feasible and meaningful results. The restriction has minimal influence on our overall analysis since the sole instance of a period with fewer than ten stocks occur only at the very beginning of our timeline. Consequently, we remain invested throughout the entire duration of the period, from February 10th, 2010, and onward.

4.3 Formulas

In order to measure the performance of the portfolios, we will use the selected performance measures that we find relevant for the analysis. These are namely excess return, Sharpe ratio, return on investment, and beta.

Excess return

When calculating excess returns, a crucial consideration arises in determining the risk-free interest rate. The risk-free rate is the expected return an investor can earn on an investment that carries zero risk. The interest rate on a three-month U.S. Treasury bill (T-bill) is often used as the risk-free rate for U.S.-based investors (Hayes, 2023). Accordingly, we will utilize this as a risk-free rate. Excess return is defined as the returns obtained beyond the risk-free rate, as delineated in the formula below:

$$Excess\ return\ (\alpha) = Actual\ Return - Risk\ Free\ Return$$

Sharpe ratio

Investors typically assess potential investments not only based on the returns but also by considering the associated risks. When evaluating an investment strategy, it is important that the risk involved is not disproportionately high relative to the expected returns. To quantify this relationship, the Sharpe ratio can be employed, which calculates the excess return per unit of risk. The formula is as follows:

$$SR = \frac{R_p - R_f}{\sigma_p}$$

In the formula, R_p represents the average return of the portfolio, R_f represents the risk-free rate, and σ_p represents the volatility of the portfolio. Generally, larger Sharpe ratios indicate a more favorable risk-adjusted return. Sharpe ratios above 1 are normally considered "good", offering excess returns relative to volatility (Fernando, 2023).

Return on investment

Return on investment (ROI) calculates the percentage of profit or loss relative to the initial investment, providing a standardized measure of an investment's efficiency and profitability.

$$ROI = \frac{End\ value\ of\ investment - Initial\ investment}{Initial\ investment}$$

Beta

Beta (β) is a measure of the volatility – or systematic risk – of a security or portfolio compared to the market as a whole (Kenton, 2022). Thus, it may be an important measure in relation to the risk of the strategy. We can formulate the formula below:

$$Beta = \frac{Covariance\ portfolio\ \&\ market}{Variance\ portfolio}$$

Based on the formula, the coefficient can be interpreted as shown in Table 2 below. As a reference point, we have opted to use the S&P 500 as a benchmark, as it tracks the share prices of 500 of the largest public companies in the United States. This means that the S&P 500 will give a beta of 1.

Beta value	Interpretation
β = 1	As volatile as the market
β > 1	More volatile than the market
0 < β < 1	Less volatile than the market
β = 0	Uncorrelated to the market
β < 0	Negatively correlated to the market

Table 2 - Implication of Beta values

5. Performance Analysis

5.1 Portfolio Analysis

In this section, we will evaluate the performance of the equal-weighted portfolio (EWP) versus the value-weighted portfolio (VWP) to ascertain findings about the profitability and risk-return characteristics of our merger arbitrage strategy. Below we find two tables; Table 3, which compares the annual and excess returns of the EWP and VWP against the S&P 500, and Table 4, which provides a comparative presentation of the ROI, beta, arithmetic mean, geometric mean, standard deviation, and Sharpe ratio for the entire period.

	Annual Returns						
year	EWP	excess_return_EWP	VWP	excess_return_VWP	SP_500	excess_return_SP500	rf
2010	15.29	14.94	23.96	23.62	15.08	14.74	0.34
2011	11.18	10.84	7.69	7.36	2.09	1.75	0.34
2012	13.53	13.10	4.47	4.04	15.99	15.56	0.43
2013	17.75	17.49	15.90	15.63	32.37	32.10	0.27
2014	7.91	7.68	8.94	8.70	13.66	13.43	0.23
2015	3.70	3.38	3.10	2.78	1.39	1.08	0.32
2016	24.27	23.52	17.39	16.65	11.94	11.19	0.74
2017	6.08	4.81	6.22	4.96	21.81	20.55	1.26
2018	4.56	2.25	5.94	3.64	-4.38	-6.69	2.31
2019	7.05	4.72	13.19	10.87	31.46	29.14	2.33
2020	12.52	11.87	22.41	21.76	18.40	17.75	0.65
2021	15.15	14.99	18.26	18.10	28.70	28.54	0.16
2022	0.17	-2.24	4.88	2.48	-18.10	-20.51	2.40

Table 3 – Annual returns and excess returns for the portfolios & the S&P 500

Summary						
Portfolio	**ROI**	**Beta**	**Arithmetic_mean**	**Geometric_mean**	**Standard_deviation**	**Sharpe_ratio**
Equal_weighted	2.67	0.24	10.70	8.53	6.62	1.37
SP_500	3.45	-	13.11	10.86	14.74	0.81
Value_weighted	3.12	0.26	11.72	9.95	7.19	1.44

Table 4 – Comparative presentation of performance measures for the portfolios, and the S&P 500 for the entire period.

The Return on Investment (ROI) for the entire period shows that the EWP and VWP yielded 267% and 312%, compared to the S&P500's 345%, as presented in Table 4. Notably, the figure below reveals that, during the period 2010 to 2022, the portfolios did not surpass the performance of the index, except for a short period between 2010 and 2012. However, it is important to underscore that "from 2012 until the beginning of this year, the S&P 500 achieved an incredible 16.6% return a year, or per annum (p/a), one of its best runs when calculated over a decade" (Renevier, n.d.).

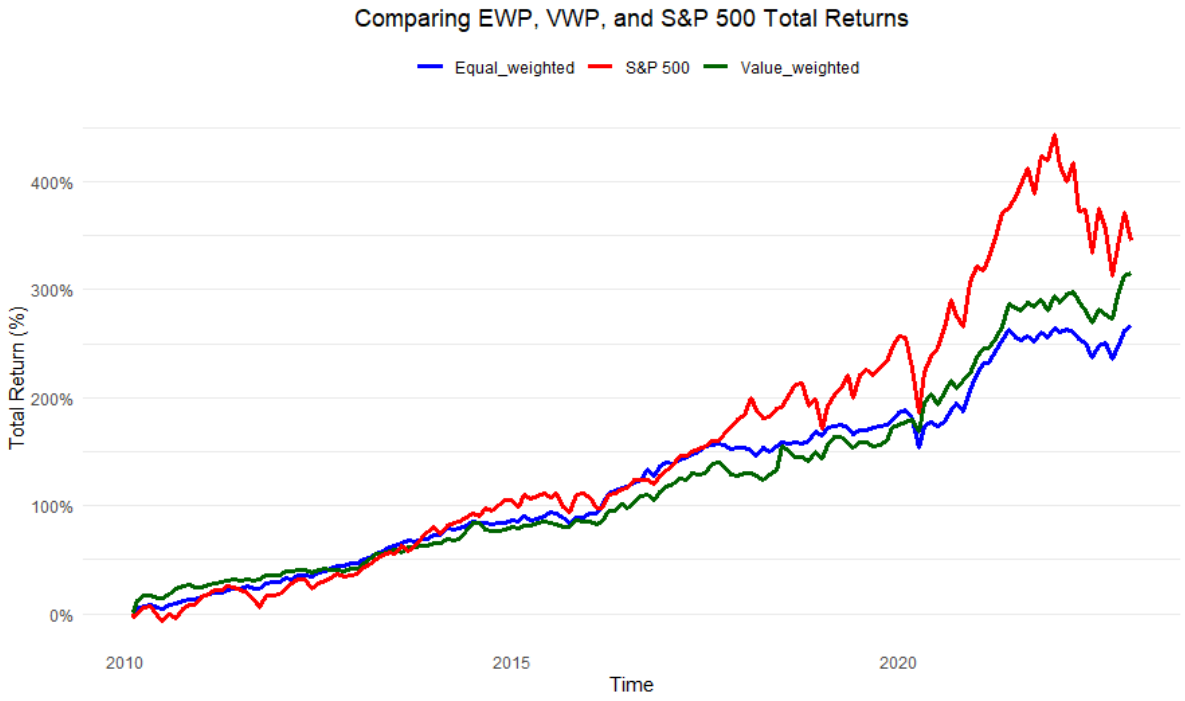


Figure 2 - Total return of portfolios compared to the S&P 500 in the period 2010 to 2022.

In Table 3, it is observed that during the few years in which S&P500 yields negative returns, specifically 2018 and 2022, the EWP and VWP outperformed the index significantly. In 2018, the EWP and VWP surpassed the index by 8.94% and 10.32%, respectively, while in 2022, their outperformance was even more pronounced with the EWP and VWP exceeding the index by 18.27% and 22.98%. This observation suggests that the portfolios may carry unsystematic risk, potentially serving as a hedge against market fluctuations. Moreover, the calculated betas

of the EWP and VWP are 0.24 and 0.26, which, in line with theory, implies that the portfolios are less volatile than the market. This, in turn, reinforces the notion that these portfolios are less correlated with market movements, further supporting their potential as stabilizing elements in an investment strategy.

The geometric mean is most appropriate for series that exhibit serial correlation (Gallant, 2023). This is especially true for investment portfolios (Gallant, 2023). Consequently, our analysis focuses exclusively on this metric. Table 4 reveals a geometric mean of 8.53% and 9.95% for the EWP and VWP compared to the S&P500's 10.86% (per annum). This is not surprising, as both portfolios generally underperform compared to the index. However, despite the underperformance, the EWP and VWP present a more favorable risk-adjusted picture. The S&P500, giving a significantly higher standard deviation, yields a Sharpe ratio of 0.81, whereas the EWP and VWP give Sharpe ratios of 1.37 and 1.44, respectively. This discrepancy underscores that, on a risk-adjusted basis, both EWP and VWP deliver superior excess returns compared to the broader market, thereby enhancing the appeal of these portfolios for investors seeking a more balanced risk-return profile.

5.2 Explanatory factors

5.2.1 Market Capitalization

Comparing the EWP and VWP, it is noteworthy that the VWP yields better risk-adjusted returns over the period. A valuable question is whether there is a positive correlation between the total return and the market capitalization. If we plot the total return compared to the logarithm of the equity value, as found in Figure 3, we find that there is no significant correlation between the equity value for the firm and the total return. Given that there would be a correlation, we would have had an increasing linear line. This means we can not conclude that the VWP yields better returns than the VWP. It suggests that there are other explanatory factors, than the market capitalization, that impact the difference in returns.

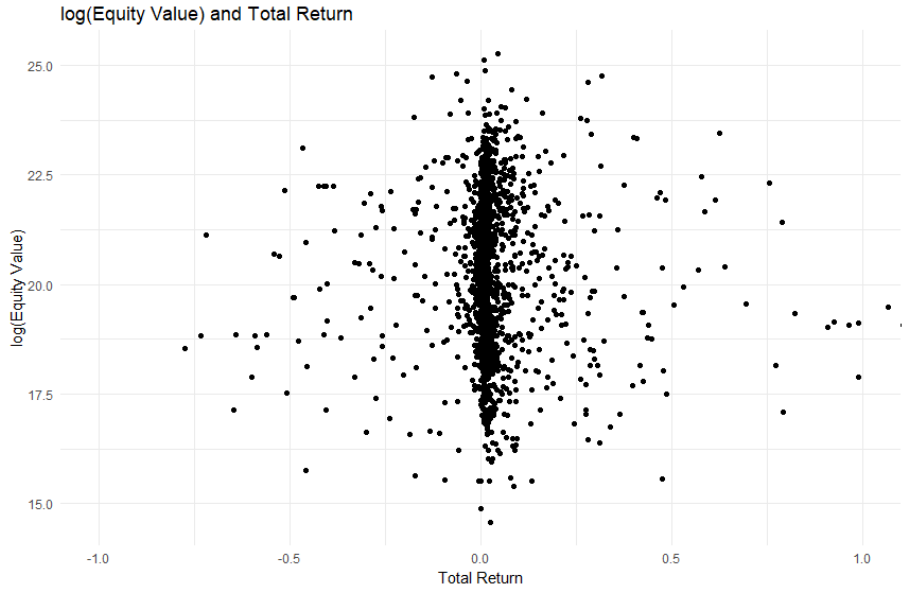


Figure 3 - Scatterplot presenting the correlation between the total return and the log value of equity.

5.2.2 Trading Duration

To further analyze the data, we can study if there is a correlation between number the trading days compared to the total return. Figure 4 presents the duration of each transaction within the designated timeframe. Over the period, it is observed the duration of each deal increases over time. This observation may not be surprising, as outlined in chapter 2.4.2, the number of antitrust enforcement complaints have increased during the period, which can help explain the deal durations trend.

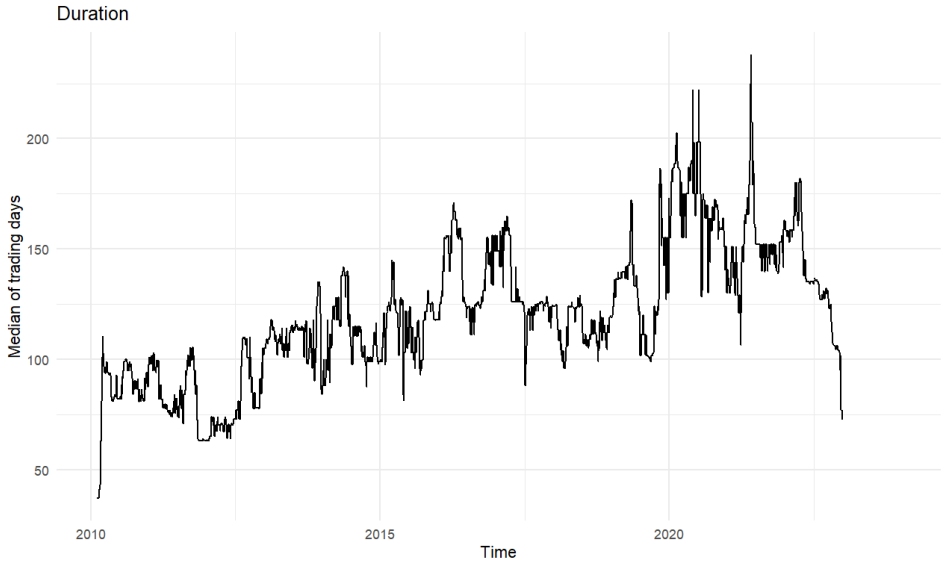


Figure 4 - Median of trading days in the period 2010-2022

In Figure 5, we can plot the relationship between the total return and the number of trading days. We find that the correlation is 0.1, suggesting that there is a small correlation. More specifically, this indicates that there is a positive correlation between the total return and the number of trading days. The implication of this is that there may be no compelling rationale for selling out early.

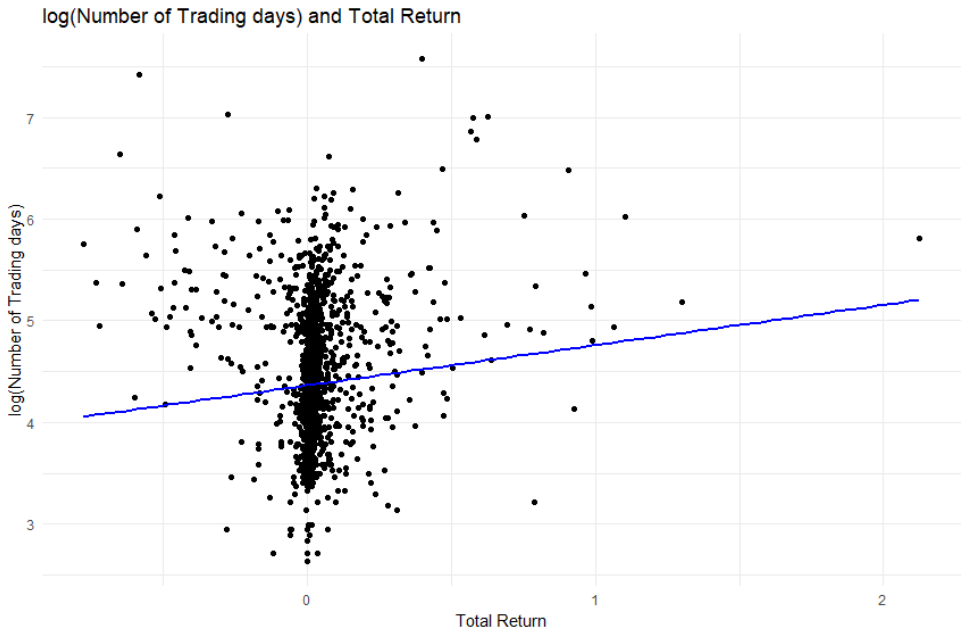


Figure 5 - Scatterplot presenting the correlation between total return and the log value of trading days

5.2.3 Market's Implied Odds

In chapter 2.2, we introduced a formula for the market's implied odds of success. Summarized from the chapter, the formula tells us that the narrower the spread between the target price and the offer price, the higher the market finds the likelihood of a deal's success, and conversely, a wider spread suggests a lower likelihood. Moreover, it is established that if the downside price is reduced while the trading price remains constant, the implied odds increase. In this segment of the analysis, we seek to investigate this formula further to understand if there is a correlation between the implied odds of success and the outcome of the deal.

Before undertaking the analysis, it is important to assess if the outcome is "correctly" related to the return. This means investigating if a completed deal yields a positive return, and a withdrawn or terminated deal yields a negative return. In Table 5 below, the data reveals that there are significantly fewer negative returns in the deals that are completed compared to the

deals that are not completed. This underscores that a completed transaction, most often, yields a positive return, and a transaction that is not completed, often yields negative returns.

	Outcomes		
Deal_Status_Binary	**NegativeCount**	**TotalCount**	**Percentage_Negative_Returns**
Completed	188	1 433	13.12
Not Completed	142	297	47.81

Table 5 – Negative outcomes of deals that are completed and not completed.

Comparing the total returns in Figure 6, we find that completed deals have a narrower distribution of returns, suggesting an upside-weighted variability with lower returns. In contrast, deals that are not completed suggest a more extreme downside-weighted variability, with more extreme returns.

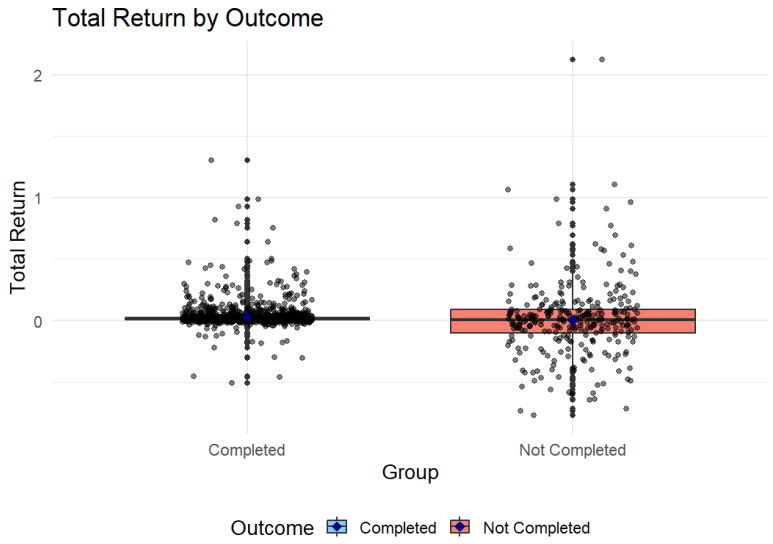


Figure 6 - Boxplot presenting the relation between the outcome and total return

In the process of undertaking the analysis, we employ the trading price (T) of the target company the day after the announcement and define the downside price (D) as the price 10 days preceding the announcement. Following the calculation of the market's implied odds for each target stock on the day following the announcement, we present the results in the form of a histogram, as illustrated in Figure 7 below.

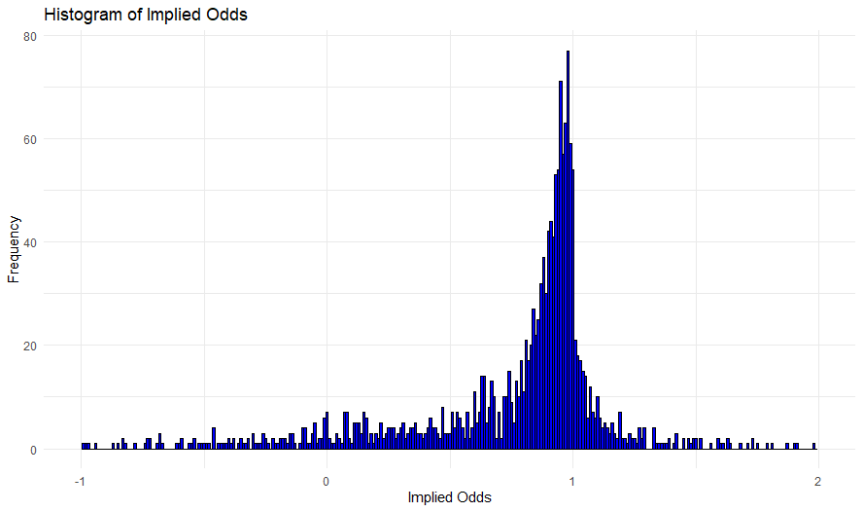


Figure 7 - Histogram of Implied Odds

The interpretation is as follows: if the stock price is higher than the bid, the implied odds will be higher than 100%. Conversely, the interval ranging from 0 and 100% implies that the bid price is higher than the target price, and a negative implied odds means that the stock price has declined to a lower price level than the downside price. These price movements outside the interval 0% to 100% may be a result of idiosyncratic risk such as shareholder dissent. Concentrating solely on the interval from 0% to 100%, we observe that the frequency of occurrences with higher implied odds is significantly higher than the frequency of lower implied odds. Thus, the market implies that most often, the odds for the deal going through are high.

In order to analyze the correlation between the implied odds and the outcome of the deal, we can conduct a regression analysis as presented in Table 6. Within the regression model, the binary outcome variable assumes a value of 1 to denote completed transactions and 0 for those that are not completed. The statistical scrutiny of the regression output reveals a noteworthy significance, as indicated by the p-value corresponding to the implied odds coefficient. The significance implies that there is a correlation between the implied odds and the outcome. Furthermore, the coefficient value is positive, which underscores that a higher implied odds correlates to a higher probability of completion, while a lower implied odds correlates to a lower probability of completion.

However, it is important to note that the model's accuracy is impacted by a skewed outcome distribution, with a preponderance of completed deals. To counteract this, we employed

Random Over-Sampling for balance. Additionally, the 'implied odds' feature shows a broad distribution and numerous outliers, diminishing the model's reliability.

```
Call:
glm(formula = Deal_Status_Binary ~ implied_odds, family = binomial,
    data = balanced_data)

Deviance Residuals:
    Min      1Q  Median      3Q     Max
-1.9242  -1.1634  -0.9546   1.1741   2.8544

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  -0.08651    0.04167  -2.076   0.0379 *
implied_odds  0.10276    0.02573   3.993 6.53e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 3834.2  on 2765  degrees of freedom
Residual deviance: 3808.8  on 2764  degrees of freedom
AIC: 3812.8

Number of Fisher Scoring iterations: 7
```

Table 6 - Regression analysis: correlation between the implied odds and the outcome of the deal

5.3 Weaknesses of our Analysis

Timing of Transactions (t+1) on Close

The timing of transactions, particularly with the (t+1) rule on deal closures, presents a weakness in our merger arbitrage portfolios. This rule implies a one-day lag between the completion of a merger or acquisition deal and its reflection in the portfolio's valuation. Such a delay can lead to deviations in the actual return of the portfolio, versus the reported returns of the portfolio. The mismatch in timing might impact the accuracy of the returns of the portfolio, as it perhaps can miss out on price movements occurring within this window.

Transaction Costs

Given that the Value-Weighted Portfolio and Equal-Weighted Portfolio will adjust daily, the omission of transaction costs is another weakness in our study. In reality, each transaction in a portfolio incurs costs, such as brokerage fees, taxes, and other expenses, which can have an impact on the returns of the portfolio. By not accounting for these costs, the Value-Weighted Portfolio might present an overly optimistic view of its performance.

Qualitative Considerations

The portfolio also falls short in incorporating qualitative considerations, such as management strategies and economic trends. While merger arbitrage is largely quantitative, it is also influenced by qualitative factors. The success of a merger or acquisition can greatly be affected by management strategies because these can have an impact on the certainty and deal timing of deal completions. At the same time, broader economic trends can influence market conditions, regulatory environments, and investor sentiment, all of which play a critical role in the success of mergers and acquisitions. Excluding these qualitative factors could result in artificially inflated returns that do not accurately reflect real-world conditions.

6. Conclusion

6.1 Discussion of our Findings

The primary objective of this study was to examine the potential for investors to achieve excess returns through the application of the merger arbitrage strategy, specifically by investing in target companies involved in cash deals during the period spanning from 2010 to 2022. Our finds suggest that, indeed, investors employing the Equal-Weighted Portfolio (EWP) and Value-Weighted Portfolio (VWP) strategies have realized substantial excess returns during this temporal scope. Furthermore, both portfolios have demonstrated favorable risk-adjusted performance, as evidenced by superior Sharpe ratios.

In the examination of explanatory factors, our investigation of market capitalization and trading duration yielded insightful observations. Notably, the VWP exhibited superior risk-adjusted returns, although no significant correlation emerged between the equity value and total return. The absence of a significant relationship between these variables may suggest that market dynamics and other unexplored factors may be influencing the observed outcome. Additionally, our analysis revealed a small positive correlation between the total return and the number of trading days, indicating that there may be no compelling rationale for early selling.

Moreover, the analysis of the market's implied odds of success highlights a significant correlation with deal outcomes. The positive coefficient in the regression analysis suggests that higher implied odds correspond to a greater probability of deal completion, emphasizing the relevance of market sentiment in predicting merger outcomes. However, limitations in the model, including a skewed outcome distribution and outliers in the implied odds' feature, impact its accuracy.

In the light of these findings, investors should approach merger arbitrage with a nuanced understanding. While our study demonstrates potential for excess returns, careful consideration of timing, transaction costs, and qualitative factors is crucial for a comprehensive evaluation of merger arbitrage.

6.2 Further Research Possibilities

The observed performance of the EWP and VWP, despite their inherent weaknesses, invites further exploration and refinement of merger arbitrage strategies to enhance their efficacy within dynamic market conditions. For the purpose of extending the analytical framework presented in this paper, it is advisable to consider constructing portfolios over timeframes distinct from the 2010-2022 period, characterized predominantly by a robust bull market. Noteworthy from our findings is the significant outperformance of our portfolio during intervals marked by negative returns in the S&P 500. Consequently, an intriguing avenue for further exploration entails assessing the portfolio's performance during more pronounced bear markets, thereby evaluating its efficacy as a potential hedging strategy.

Furthermore, regulative bodies like the Department of Justice and Federal Trade Commission have played an increasingly important role in shaping the outcome throughout the last decades. Recently, the regulative bodies proposed new federal guidelines for mergers and acquisitions, marking the first comprehensive update in over a decade. The proposed guidelines are not necessarily industry-specific but are especially noteworthy for the tech and private equity sector (Brownstein Client Alert, 2023). The tech industry particularly has been targeted due to their significant growth. It may therefore be interesting to rank different industries to evaluate if some industries have a greater advantage than others when it comes to merger deals. Possibly, buying target companies that are challenged which are in the favorable industry or looking at other variables affecting the outcome of the deal.

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