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Analysis of U.S. Merger Arbitrage Spreads during the 2008 Financial Crisis and the COVID-19 Market Recovery

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ABSTRACT

Arbitrage trading strategies have been long prevalent as risk-free trading strategies that traders can take advantage of in times of market uncertainty. M&A transactions, due to the nature of valuations, can present arbitrage opportunities between times of close and open. We completed a regression analysis of M&A gross spreads returns and various recessionary economic indicators to determine if times of market uncertainty present better M&A arbitrage opportunities. We analyzed this topic to determine if there are opportunities for large-scale structural equity returns during market downturns. We concluded that there may be slightly higher returns during times of economic recession due to liquidity constraints decreasing the ability of arbitrageurs to revert arbitrage means back to zero. Due to lack of normalizing index returns during M&A transactions being announced and closed, further analysis by regressing index returns during the M&A transaction and gross spread returns may yield clearer results.

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I would like to thank Dr. Woolridge for guidance on this final thesis as well as all the help he has provided me throughout my time at Penn State.

To Dr. Davis, thank you for being such a help in the thesis process and as an instructor I've had at Penn State.

To my family and friends, thank you for all your support no matter what I decided to pursue.

Introduction

Arbitrage transactions and trading strategies have been present as long as there has been inefficiencies between asset classes or markets. Arbitrage activity in the United States has contributed to market efficiency while also acting as intermediaries by providing capital in and outflows between different markets. With increased arbitrage trading opportunities due to technology, and knowledge it is seen that abnormal returns from high yield stocks or transactions can be held closer to pricing efficiency in financial markets (Kadapakkam, 2002). Furthermore, the restriction of capital movement in financial markets hinder transaction volumes that can affect the pricing of assets across restricted markets. Day-to-day market efficiency is directly impacted by liquidity which stimulates arbitrage activity (Choridia et al., 2008). Additionally, liquidity plays a crucial role in determining returns from market mispricing. Specifically, liquidity affects the ability for arbitrageurs to take advantage of differences in the bidding and market prices of M&A transactions.

Liquidity and Arbitrage During Recessions

Establishing the idea that liquidity levels affect the intraday arbitrage levels is important to understand what financial situations affect the ability for arbitrageurs to make a return. If liquidity and arbitrage activities bring assets closest to their fair value, then situations of illiquid and inactive markets might present the best opportunity for larger discrepancies between market

price and fair value. Furthermore, risk arbitrage strategies during times of large price discrepancies could provide the highest possible arbitrage returns.

In general, empirical studies show that stock market illiquidity is linked to the business cycle, but also yields predictive power for future recessionary periods (Ellington, 2018). Furthermore, Ellington explains that illiquidity both increases the probability of pushing the economy into a recession and the economy remaining in a recession (Ellington, 2018). With the framework that recessions cause illiquid market conditions due to capital reallocation, interest rate fluctuations and poor investor sentiment, arbitrage profits and trading strategies have the potential to generate the highest return. Deville and Riva (2007) find that liquidity-linked variables, such as derivative trading volume, imbalance between contract trading volumes, and trading volume of underlying assets are critical for the speed of reversion of arbitrage profits (Deville and Riva, 2007). Although, this refers to certain strategies that can provide riskless returns, the framework that liquidity influences market mispricing is crucial to understanding how illiquidity and recessions can affect the mispricing of M&A transactions. Variations between offer price and company trading patterns can be exacerbated if there is not enough liquidity and volume to readjust prices back to fair value.

M&A Arbitrage Process

Throughout the experiment a fundamental understanding of M&A deal progression is examined. Once an M&A deal has been announced with an offer price, the target's stock price will slowly close in on the per share offer price to coincide with the acquiror's purchase price. Institutions and retail investors tend to sell off the target's shares as it closes, but arbitrageurs can hold those shares until the merger completes. This depends on numerous factors such as type of deal, and probability of the deal passing.

There are three types of transactions that M&A arbitrageurs can potentially take advantage of: cash deals, all share deals, and cash-share deals. The choice of payment for the transactions presewnts a crucial decision about the thought process behind the arbitrage opportunity (Melka and Shabi, 2012). The simplest case is an all-cash M&A transaction. The buyer generally offers to buy all shares of the target company for a control premium. The arbitrageurs aim is to invest in shares of target companies in transactions that have a high likelihood to succeed. The difficulty of capitalizing on all cash merger arbitrage opportunities is the ability to assess the risk of a specific transaction. Additionally, arbitrageurs will calculate gross return of finalized deals as *Gross return = (Offer price / Sharer purchase price) – 1* (Melka and Shabi, 2012).

All-share transactions are more complex in terms of the transactions necessary to capitalize on the arbitrage opportunity. In this specific case, the arbitrageur's strategy consists of acquiring shares in the target company and simultaneously short selling the buyer's shares,

whilst respecting the exchange ratio of the offer (Melka and Shabi, 2012). Upon closure of the transaction, the shares in the target company are exchanged for shares in the buyer which are then used to cover the original short position. The relative appreciation of the target stock compared to the acquiror will allow you to cover the initial short position while also profiting the spread between the entry and exit price of the long position.

For mixed transactions, the arbitrage position is similar as the arbitrageur creates a long position on the target company and a short position on the acquiror according to the exchange ratio set out. Some mixed transactions include clauses which allow choices between different methods of payment. However, this can significantly impact the results of arbitrage transactions as the market exchange ratio for the stock could change drastically which could change contract sizing necessary to accurately complete the arbitrage transaction. Since the variability of share volume and exchange ratios change, tweaks to offer agreements such as collars help fix the exchange ratio at announcement despite a mixed deal.

Although, these transactions present theoretical riskless returns, a contingency in all of these strategies is the transactions success probability. Melka and Shabi (2012) breakdown the potential risks of publicly announced M&A transactions through internal and external risks. Internal risks include management reluctance due to the transaction no longer being economically feasible. This can create issues with potential arbitrage opportunities with extreme gross spreads. Additionally, the external risks include limited financing capabilities on the completion date, or lack of clearance from administrative bodies such as the SEC or DOJ (Melka and Shabi, 2012). Furthermore, with risks of failure, although uncommon, it is important for arbitrageurs to properly calculate the estimated probability of failure and losses to understand the potential opportunity. However, the experiment discussed throughout this thesis only focuses on

completed transactions. It is also important to note that during recessions the likelihood of M&A transactions to fail can be higher due to illiquid financing resources, and worsening market conditions that affect ability to purchase external assets.

Chapter 2

Historical Explanation of Merger Arbitrage Activity

There has been a vast amount of academic research that presents theories regarding the pursuit, reasoning, and timing of M&A transactions. The theoretical analysis of M&A transactions can be divided into the behavioral theories that encompass management, and irrational valuations regarding M&A transactions and the neoclassical approach that focuses on value creation, and rational drivers for M&A transactions. The neoclassical theories of mergers, as stated by Gugler et al. (2012), are based on three assumptions, namely, mergers have a positive synergy effect, managers focus on maximizing the wealth of shareholders, and market efficiency hold. Harford (2005) furthers that analysis of mergers between 1981 and 2000 finds that merger waves occur when large-scale reallocation of resources is required (i.e., recessionary periods). Resource reallocation is generally caused by economic, technological, or regulatory shocks (Gort, 1969; Mitchell and Mulherin, 1996). Harford (2005) continues that shocks result in reallocation only if they are accompanied by lower transaction costs and higher liquidity. During merger waves, the operating performance of merged entities is comparable to the unmerged entities in worst cases and improves on average.

Eisfeldt and Rampini (2003) show that variation in capital liquidity strongly impacts the degree of total (industrial, household, and labor) capital reallocation in the economy and further that the degree of capital liquidity is cyclical. While the study does not explicitly analyze market valuations, Harford (2005) argues that because higher market valuations relax financial constraints, market valuations are an important component of liquidity. Shleifer and Vishny make a similar argument in a study of asset liquidity, showing that for transactions to occur buyers who intend to employ the asset in its best use must be financially unconstrained. Shleifer

and Vishny hypothesize that the reason merger waves always occur in booms is because increases in cash flow simultaneously increase fundamental values and relax financial constraints. Harford (2005) summarizes neoclassical merger theory as once a technological, regulatory, or economic shock to industry occurs, the reaction is the reallocation of assets through M&A activity. Companies within industries cluster over time and compete for the best allocation of assets efficiently driving shareholder value and maximizing merger valuations.

Tobin's Q ratio has allowed for further reasoning behind M&A transactions by comparing bidding and target firms. The Q-theory of investment states a firm's investment rate should rise with its Q (the ratio of market value to the replacement cost of capital) (Jovanic and Rousseau, 2002, 198). Furthermore, both Lang et al. (1989) and Servaes (1991) find that Tobin's bidder and target q ratios largely determine the merger's gain. Where higher q is used as a proxy for managerial performance if bidders with higher q ratio acquire lower q ratio targets the result is a financial gain from the merger. Jovanic and Rousseau (2002) use the theory to explain merger waves by analyzing technological capacity as the main factor behind higher q rations and conclude that when there is a bull market higher q companies will buy bundled capital assets. However, the q theory of mergers suffers from a few sub-optimality.

Jovanic and Rousseau (2002) state that the q theory of merger can explain all merger waves until the 1990s' except for the conglomerate merger wave of the 1960s. Horizontal mergers account for less than 50% of total mergers post-2000s' (Gugler et al., 2012). The theory further fails to recognize that acquirers could buy new capital assets which could be more optimal given the current market conditions. The Q theory forms a big assumption about M&A transactions that focuses solely on asset value creation, rather than the plethora of other factors that can influence management's decision to transact. Finally, Q theory assumes that when there

is excessive free cash flow, managers can go for suboptimal takeovers. This creates an agency problem as it deviates from the fundamental assumption that managers will always maximize shareholder wealth.

The behavioral theories on M&A transactions suggest mis-valuation of companies within a market is a driver of merger waves (Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004). This fundamental idea of behavioral theories suggests that when irregularities occur in equity markets there could be significant mispricing in valuations leading to exacerbated spreads. Shleifer and Vishny (2003) discuss market mis-valuations of merging firms. Their theory suggests that when firms are valued incorrectly, rational managers can take advantage of the inefficient market as an arbitrage opportunity. This can be extrapolated to rational investors that can identify similar mispricing and take advantage in the arbitrage markets. When a company's shares are overvalued, this will position them to acquire an undervalued company, and use the assets gained to prevent shareholder equity loss once valuations readjust. This contributes to merger waves when a market has many overvalued and undervalued companies as undervalued companies become targets for overvalued companies to level out to mispricing. However, Rhodes-Kropf and Viswanathan (2004) also recognize that there may be other reasons why merger waves occur. They present a rational theory based on correlated misinformation. In the "RKV" world, errors in valuing potential takeover synergies are correlated with overall valuation errors. Furthermore, they develop a decomposition that breaks the market-to-book ratio into three components: the firm-specific pricing deviation from short-run pricing, short-run deviations from firms' long-run pricing, and long-run book pricing. They conclude that findings show that management over-optimism of merger synergies and

misevaluation drive mergers. This allows there to be more irregularities within equity markets creating a situation where arbitrageurs can capitalize.

If we assume that there is some percentage of the M&A market that fundamentally relies on behavioral theories such as inaccurate valuations, or synergy inflation then it is important to understand if merger arbitrage opportunities arise when valuation irregularity and information asymmetry are at their highest. Officer (2007) finds relatively little evidence of pricing responses to liquidity events in the merger arbitrage market. Merger spreads are not correlated across deals on average, suggesting a lack of systematic components in merger spreads. Neither merger arbitrage black swan events nor substantial changes in deal flow relative to available capital are associated with detectable pricing effects. Recessionary environments with theoretically less deal flow may show signs of stable merger arbitrage spreads relative to capital restraints. Liu and Wu (2014) discuss Shleifer and Vishny's (2003) hypothesis from a merger arbitrage explanation. The merger arbitrage price pressure explanation relaxes the assumption that states excess demand curves for equities are perfectly elastic and reflect perfect information scenarios. Mitchell et al. (2004) provide some evidence that merger arbitrage short selling can explain nearly half of the negative announcement returns for stock acquirers. Liu and Wu (2014) perform a unique data analysis that focuses on the use of daily short-selling flow data that more precisely quantifies the magnitude and timing of short-selling activity in stock mergers at different stages in the deal processes. Properly defining the timing and reasoning behind the value destruction that M&A transactions can cause could provide powerful insight into the strategies behind merger arbitrageurs. In situations where M&A transactions are seen as a widespread negative, the increase in short-selling pressures can create more opportunities for mispricing and misvaluations in the market dramatically increasing merger arbitrage spreads. Kryzanowski and

Nie (2019) further find strong evidence that arbitrage short selling plays an important role in explaining the equity price effects for acquirers for M&A announcements.

Chapter 3

Differences in Arbitrage Spreads during Different Time Periods

The purpose of this paper is to identify factors that contribute to increased gross spread returns in M&A arbitrage transactions, as well as a comparative analysis of these factors across bull markets and recessionary markets. Factors are specifically chosen based upon their fluctuations between different business cycle conditions. Once each factor is defined, the experiment tests their correlation to the gross spread returns from M&A transactions during the time period. This will help gain insight into when major indicators show illiquid indicators during recessions, does this directly cause greater risk arbitrage returns comparatively to bull market conditions. This could give arbitrageurs insight into how liquidity and market efficiency contribute to the potential of risk arbitrage returns.

The hypothesis of the experiment is to determine whether certain economic factors that indicate liquidity have more of an impact on gross spread returns during recessions vs. during bull markets. Based upon prior research and liquidity constraints amongst arbitrage trading, it seems that gross spread returns should be higher during recessions as there is not enough activity in markets to accurately arbitrage out large deviations from the offer price. Therefore, during recessions arbitrageurs should theoretically be able to make a larger profit if they have access to the capital to take advantage of these arbitrage opportunities. Cordia et al. (2008) explains that daily liquidity of market transactions greatly impact the ability for arbitrage profits to revert back to market neutral. Hence, if there is a lack of liquidity and market activity to correct large deviations in fair value pricing then there theoretically be larger opportunities for arbitrage especially for risk arbitrage trading. The experiment is not testing whether entities can capitalize

on the larger spreads, however, only if there is the opportunity for greater returns through asset value mispricing and abnormal market sentiment.

Research suggests that target firms from mergers experience a 4 to 8% larger positive cumulative abnormal return during recessions that in non-recessionary periods. Furthermore, target firms from cross-industry mergers generate 5% higher returns on announcement day during recessions (Wann and Lamb, 2016). This can be extrapolated to show that asymmetric returns of M&A transactions upon announcements can also produce asymmetric deviations amongst target stock prices and offer prices allowing arbitrageurs to make a higher profit in times of recessions. The asymmetric returns of M&A transactions as well as the vastly different consumer reactions to M&A transactions between recessions and bull markets is crucial to understanding the potential of greatly differing M&A arbitrage returns. Additionally, with changes in liquidity factors during recessions this should be the cause of greater arbitrage spreads as M&A transactions can generate greater abnormal returns and revert to net zero profits slower during illiquid market periods.

Chapter 4

Methodology

A list of deals is scraped from the Zephyr Mergers and Acquisitions database. For the recessionary period, deals were pulled from 2008 to 2009 between U.S. targets and acquirers for simplicity of data analysis as non-U.S. transactions have different M&A-related risks. The top 500 deals by deal size which included a 100% transfer of ownership were used in the initial transaction data set. The same filters were applied to the bull market period of 2010 to 2021. The bull market period after the great recession is significantly larger than the other set of data due to the rather stable bull market over time the market has experienced even after the initial COVID-19 pandemic shock, however, the same number of deals were used to ensure that the data sets were comparable. These M&A transactions will later be used to calculate gross spread returns for the regression analyses.

The M&A list included: Deal Status, Valuation, Target and Acquiror Name, Announcement date, Close Date, Per Share Offer Price, and Target Stock Price before Announcement. This data is then combed through to eliminate any mergers that do not have adequate data to conduct this analysis. This creates a random selection of relatively large publicly traded M&A transactions to include in the regression analysis.

After the data sets are checked and completed the following are calculated: returns between the offer price and price before the announcement, gross spread, and relative percentage of gross spread to offer price. Returns are calculated using the following formula: (Offer Price - Price Before Announcement)/Price Before Announcement. This is to understand the returns between the trading value of the target and the premium which was offered. The gross spread in dollar terms is calculated by subtracting the before-announcement price from the acquirer's offer price. The relative percentage of gross values is given by dividing the gross spread by the offer price. All of the data preparation and calculations are the same for both the recessionary period and the bull market period.

Statistical Summary of M&A Data

The remaining entries in both data sets are aggregated and summarized in the following tables. The summary statistics listed are for target stock price, offer price, M&A returns, gross spread, and relative gross spread for all deals used in the data set. All statistics in the **table below** are taken from daily data values from each deal and are only for the finalized data set which was previously described. This is to ensure there are not any erroneous values within the summary statistics.

	Target Stock Price	Offer Price	Stock Returns (%)	Gross Spread	Gross Spread (%)
Mean	$71.54	$70.43	19.72%	$10.84	1084.00%
Median	$60.76	$60.00	15.92%	$7.56	13.73%
Standard Deviation	$53.00	$48.43	19.73%	$14.87	13.45%
Sample Variance	$2,809.48	$2,345.61	3.89%	$221.18	1.81%
Skewness	$2.41	$2.16	149.15%	$1.06	-107.05%
Range	$342.74	$297.74	136.66%	$122.42	102.38%
Min	$7.18	$7.65	-34.10%	-$48.30	-51.75%
Max	$349.92	$305.39	102.56%	$74.12	50.63%

Figure 1: Summary Statistics of Bull Market Data

	Target Stock Price	Offer Price	Stock Returns%	Gross Spread	Gross Spread %
Mean	$21.99	$22.89	35.58%	$5.00	21.06%
Median	$16.72	$17.68	26.91%	$3.02	21.21%
Standard Deviation	$19.93	$19.69	40.04%	$5.92	20.70%
Sample Variance	$397.17	$387.66	16.03%	$35.00	4.28%
Skewness	$1.47	$1.40	218.11%	$2.16	-159.06%
Range	$78.84	$78.21	279.28%	$37.42	155.00%
Min	$1.13	$1.79	-45.95%	-$4.25	-85.00%
Max	$79.97	$80.00	233.33%	$33.17	70.00%

Figure 2: Summary Statistics of Recessionary Data

Independent Variable Analysis

All variables used in the regression analysis will be specific data points that correspond with the close date of the merger. This is due to the mismatch in data entries between the daily price of each independent variable and each M&A transaction. Each M&A transaction data set contains 75 M&A deals over the period and even monthly or yearly price action of the independent variables would not create a usable regression analysis. This may lead to misleading data especially if there are significant spikes in price action between the independent variables however, the periods looked at have relatively similar price action amongst their respective period (i.e., the recessionary period is volatile, and the bull market period is gradually increasing). All of the variables are selected based on their importance as recessionary indicators, or their significant difference in level during recessions vs. bull markets. This allows a scenario where the relationship between recessionary price levels and bull market price levels can be tested regarding M&A arbitrage opportunities. This creates a chance to test the correlative factors regarding arbitrage returns during times when the structural integrity of the market is

affected. This is all predicated under the pretense that steep recessionary periods create significantly different levels of liquidity, market returns, and volatility than bull market periods. S&P 500 returns and 10-YR treasury spreads have been leading indicators in dips of the business cycle which validates the large difference between these variables during bull markets and recessions (Marcellino, 2006).

VIX Index

The VIX or Volatility Index is a real-time index that represents the market's expectations for the relative strength of near-term price changes of the S&P 500. It generates a 30-day forward projection of volatility or the velocity of price changes. It is assumed that a heightened level of volatility increases investor fear indicating a recessionary environment. The VIX index as a determinant of the likelihood of recession shows up as a significant predictor (Ercolani and Natoli, 2020). Due to high VIX numbers as an indication of recession, the heightened volatility and fear could have two potential conclusions. The heightened volatility increases gross spreads and therefore increases the opportunity for heightened arbitrage returns. The other hypothesis is that the lower liquidity levels and M&A activity during recessions decrease arbitrage returns because investors are less likely to be optimistic about the merger itself. The VIX index will be graphed using daily data for both recessionary and bull market periods.

Both of the figures below show the daily VIX price for the years 2008-2009 and 2010-2021. In the time leading up to the 2008 financial crisis, the VIX was relatively stable around an average of 22 but there was a spike in the VIX right around the peak of the 2008 financial crisis. As uncertainty increased in the public markets the VIX forward prices responded accordingly.

During the bull market period, there were significant spikes throughout the years however the overall average was still around 20 but during the initial COVID-19 pandemic scare there was a significant spike in the VIX market affecting S&P 500 expectations in the future.

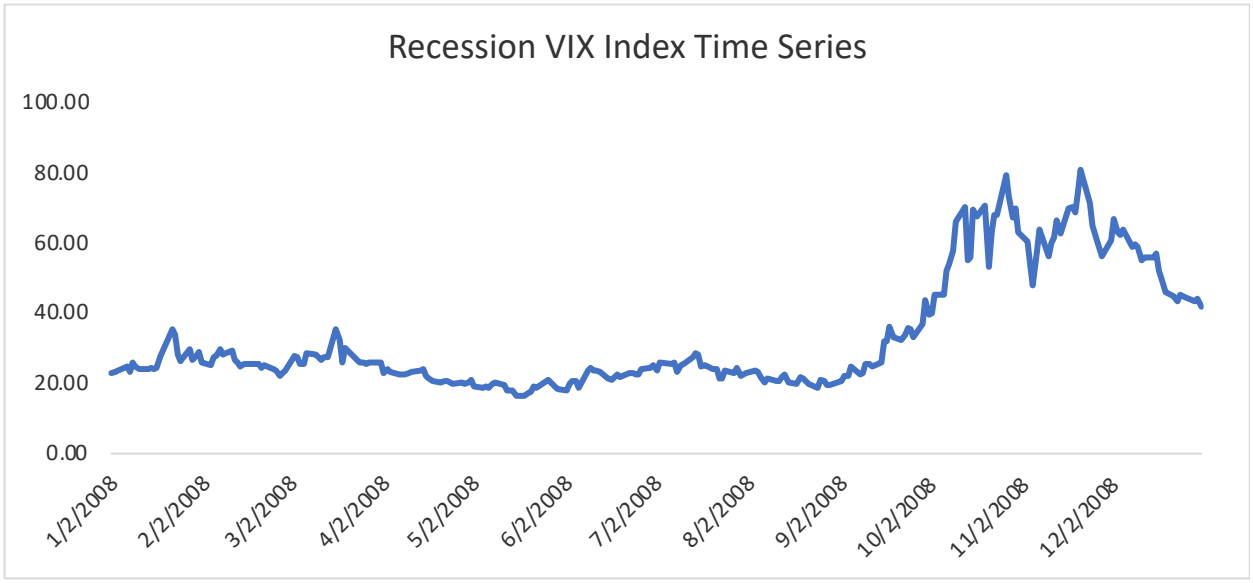

Figure 3: Recessionary VIX Index Time Series

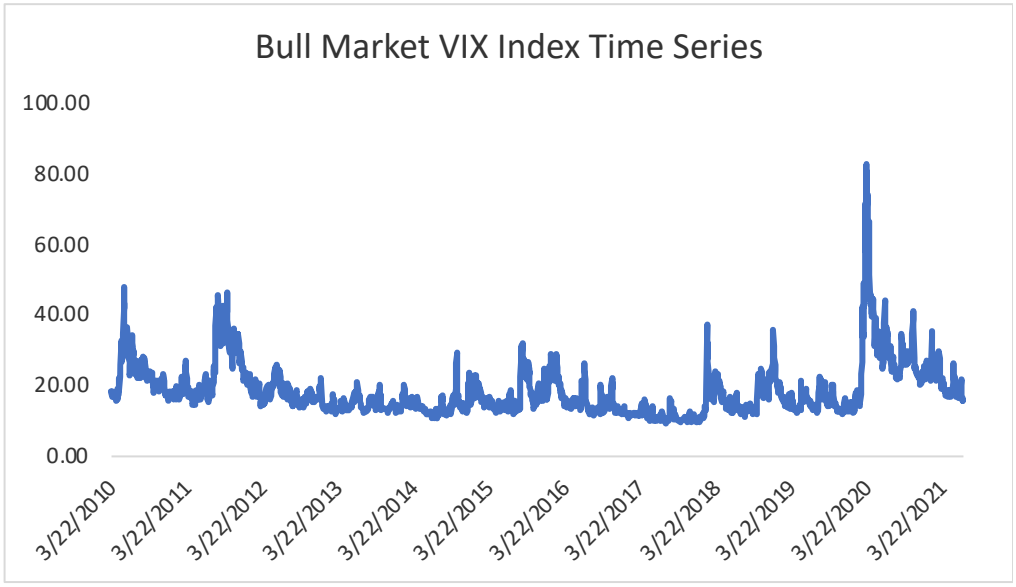

Figure 4: Bull Market VIX Index Time Series

10-YR Treasury Yield

10-YR treasury yield essentially defines the rate of interest earned on US government bonds, which is the lowest-risk investment available to consumers. 10-YR treasury yields are generally used to predict recession as they can be used to predict large increases in unemployment rates (Kiley, 2022). Short-term interest rates should affect the liquidity of markets and create friction which should result in wider gross spreads that arbitrageurs cannot force out of the market. Furthermore, increases in the 10-YR treasury yield should fundamentally devalue most equities, inciting investor fear in holding public market equity and further increasing gross spreads as people are not allocating funds to the public markets. Therefore, the correlation between returns and the 10-YR treasury yield is expected to be positive which is usually seen during recessionary conditions affirming the hypothesis that recessionary periods provide greater arbitrage returns. However, since the Fed's approach to monetary policy was to purchase large quantities of long-term securities to stimulate the economy for investors borrowing after the financial crisis, there may not be restrictions to market activity that increases market spreads.

During the financial crisis, 10-YR treasury yields were relatively high hovering around 4.00% but as the FED decided to stimulate liquidity the 10-YR yield lowered at the end of 2008 to ensure economic activity was going to grow in the long term. During the bull market period, there was a long-term decrease in interest rates over time as the economy grew. This created long-term gains in the S&P 500 with heightened capital markets activity over the last 10 years. Over time the FED continued to keep interest rates at a low level to ensure that economic activity was abundant, and liquidity of money markets was high. However, as said before 10-YR treasury fluctuations are not entirely an indicator of illiquid markets as the FED may manipulate interest

rates to readjust other economic factors that could affect long-term market macroeconomic indicators.

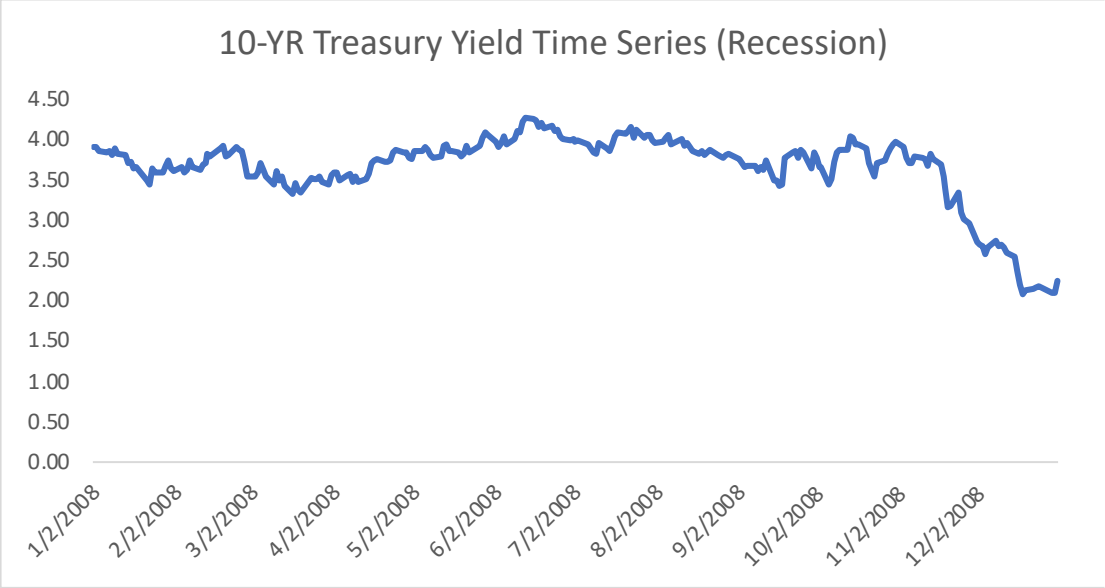

Figure 5: Recessionary 10-YR Treasury Yield Time Series

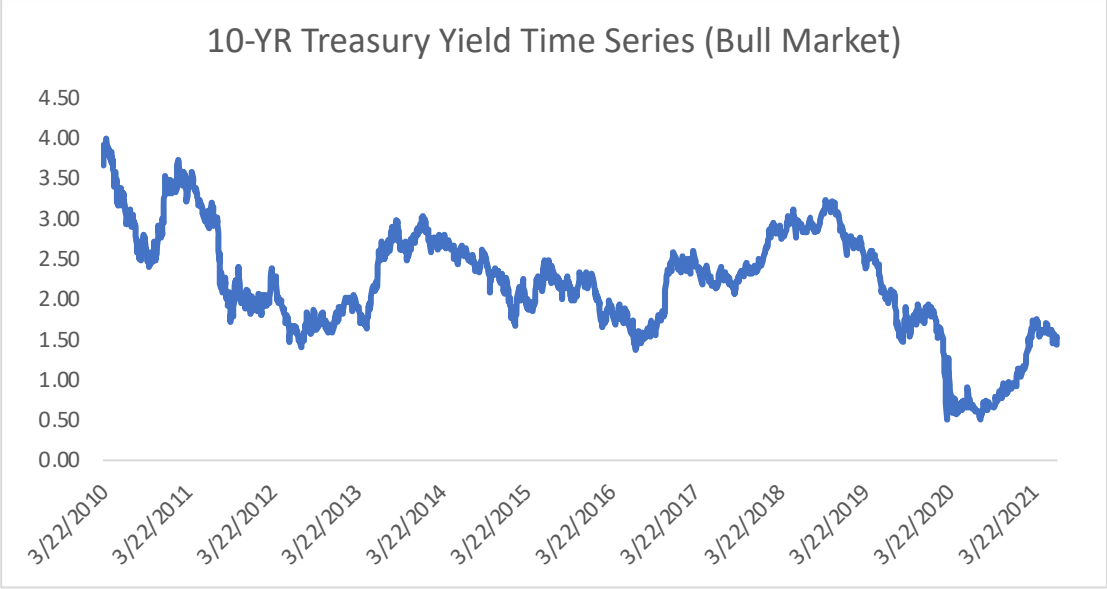

Figure 6: Bull Market 10-YR Treasury Yield Time Series

S&P 500 Returns

S&P 500 returns will act as a proxy for overall market returns as well as the U.S.' place in the business cycle. S&P 500 returns generally act as a short-term recessionary indicator and as a statistically significant regressor of business cycle fluctuations (Marecellino, 2006). More specifically, the correlation between S&P 500 returns and P/E ratios allows for an assertion regarding fundamental asset valuations. Widening M&A spreads provides evidence of deviation in fundamental asset valuation. Jetley and Ji find that the decline in arbitrage spreads and thus in the aggregate alpha of merger arbitrage hedge funds is the result of increased trading in the target's stock following the merger announcement. This finding shows that one of the consequences of the increase in capital devoted to merger arbitrage is reduced aggregate profitability of merger arbitrage hedge funds (Jetley & Ji, 2018). Generally, trading volumes increase during times of reinforced positive news and greater returns. Increased trading and liquidity in markets can force out arbitrage returns and make M&A spreads smaller. Therefore, during recessionary and volatile periods of S&P 500 returns, we are expected to see larger spreads especially as stock market participants are less likely to act during times of economic uncertainty.

The following graphs show significantly different levels of S&P 500 returns. The bull market has periods of loss however the general trend is strictly positive over time even with the economic downturn of COVID-19. However, the recessionary period shows the start of a downward trend in market returns leading up to the peak of the recession. Arbitrage spreads during the recession also likely increased as there was a significant change in asset valuations and many restructuring efforts of bankrupt companies could have affected valuation spreads in the near term. S&P 500 returns provide either positive or negative reinforcement for asset

valuations and equity trading that can create a feedback loop of information that could encourage or deter large amounts of capital markets activity. Therefore, it should be expected that when S&P 500 returns are low there are larger arbitrage spreads.

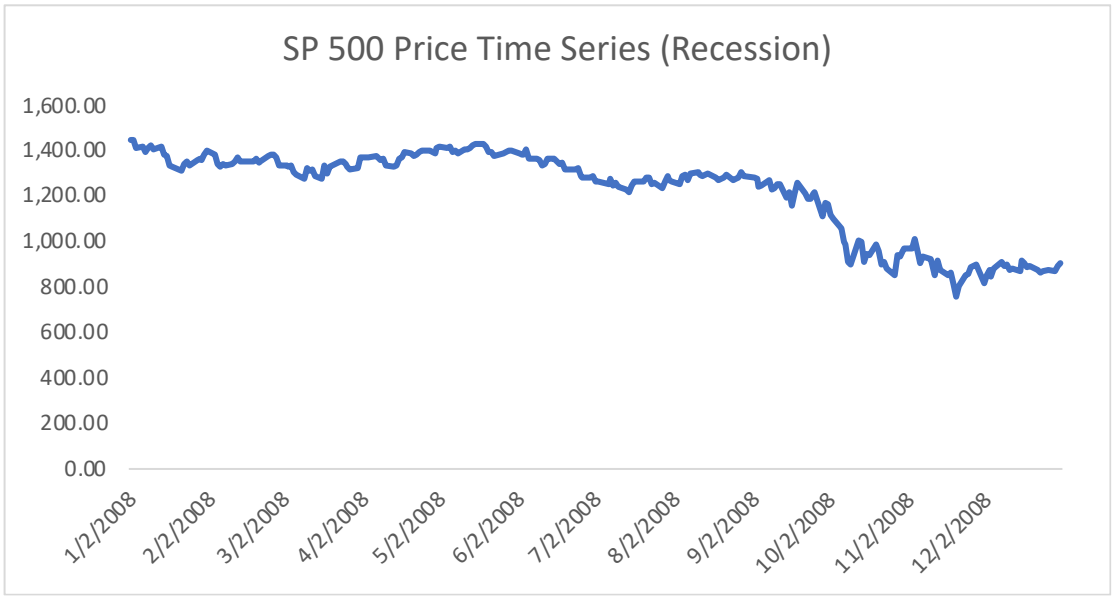

Figure 7: Recessionary S&P 500 Returns Time Series

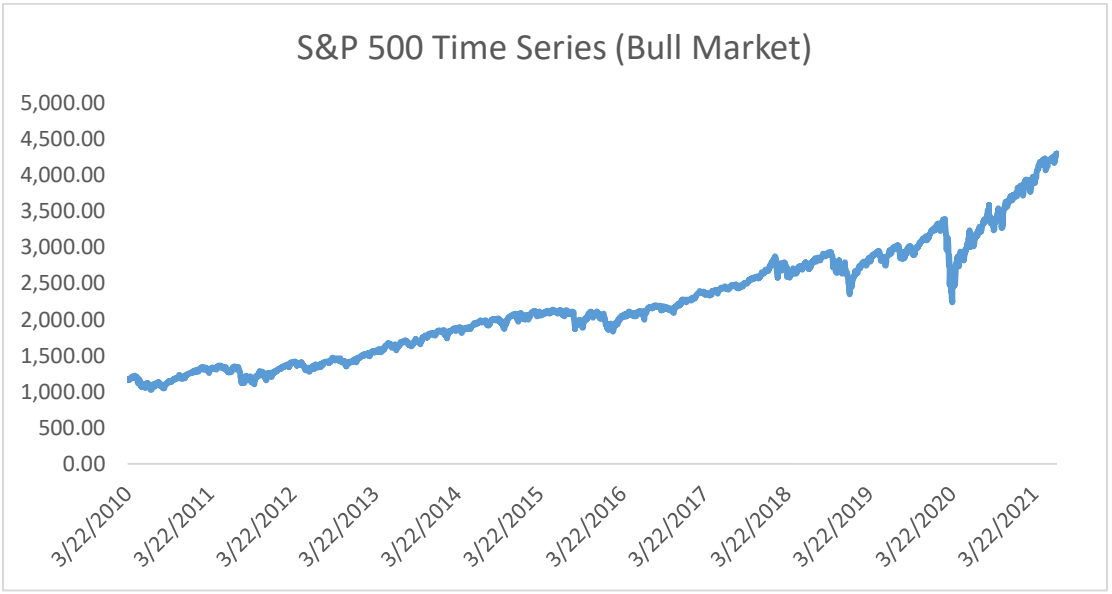

Figure 8: Bull Market S&P 500 Returns Time Series

Chapter 5

Single Variable Analysis and Results

Regressions testing the relationships between each of the independent variables and gross spread returns (%) of every deal between the recessionary period and the bull market period. During the tests, I will be analyzing the R-Square, independent variable coefficient, and the P-value to gauge the statistical significance and relationship between each variable. In general, it is expected that the recessionary periods will have a stronger correlation between all the variables as arbitrage spreads are less likely to be optimized due to volatility, and uncertainty amongst capital markets.

For this data analysis, the hypothesis will be accepted for a P-value < .10. P-value signals the strength of the evidence against the null hypothesis. A higher p-value indicates that the current hypothesis is invalidated and that the null hypothesis (i.e., no significant observable effect) is valid. This will give greater insight into what recessionary indicators could have a significant effect on M&A spreads.

VIX and Gross Spread Return Regression

The results from the VIX vs. Gross Spread Return regression for the recessionary period show an insignificant R-Square value. This seems to assert that the variation of the gross spread return of the deal is not significantly explained by the volatility of the daily VIX. This could perhaps be due to the data not being an aggregate of trends over time but rather the spot rate for the index on the day. The regressions p-value also exceeds 0.10 and therefore the null hypothesis is accepted for the VIX's effect on merger arbitrage spreads and the data does not present

statistical significance. However, the correlation is slightly positive suggesting that returns are higher when the VIX prices are higher. However, the data used shows relatively stable VIX pricing for most of the year which may have skewed the results and created a situation where there is not enough M&A data during the increase shown in the time series (recession) graph. Therefore, more data at heightened VIX levels during the recession might have provided more accurate and statistically significant data.

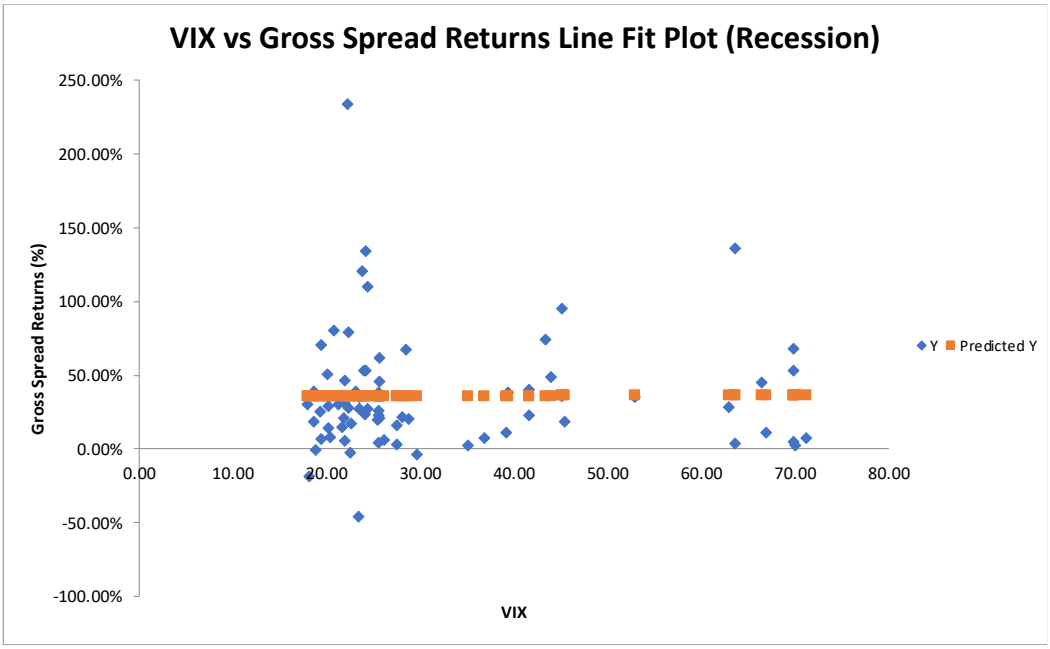

Figure 9: VIX vs. Gross Spread Returns Regression (Recession)

SUMMARY OUTPUT(Recession)

Regression Statistics	
Multiple R	0.00746006
R Square	5.5653E-05
Adjusted R Square	-0.01383246
Standard Error	0.40317812
Observations	74

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.00065138	0.000651382	0.00400721	0.94970103
Residual	72	11.703787	0.162552597		
Total	73	11.7044384			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.3497698	0.10639964	3.28732134	0.00156571	0.137666	0.56187359	0.137666	0.56187359
VIX	0.00018698	0.00295383	0.063302511	0.94970103	-0.00570136	0.00607533	-0.00570136	0.00607533

Figure 10: VIX vs. Gross Spread Returns Regression Output (Recession)

The results from the VIX vs. Gross Spread Return regression for the bull market period show a more significant R-square value at ~.07. This asserts there is a slightly more explanatory relationship between the two variables during a bull market. This may be due to the unique nature of the time period where there were significant spikes in the average VIX value over time. The P-value for the bull market test does not exceed 0.10, and in turn, the null hypothesis is rejected and retains statistical significance. The correlation is also positive showing that there is some relationship between heightened VIX prices and gross spread returns. Overall, the regression output provides significant evidence to support the idea that as market volatility increases, quick fluctuations in asset pricing may cause prices to deviate from their fundamental values. The reasoning behind the positive correlation may be different from what was previously stated. VIX prices are a leading indicator of recessionary conditions, but VIX prices can also increase due to positive feedback loops of new information which could affect arbitrage spreads.

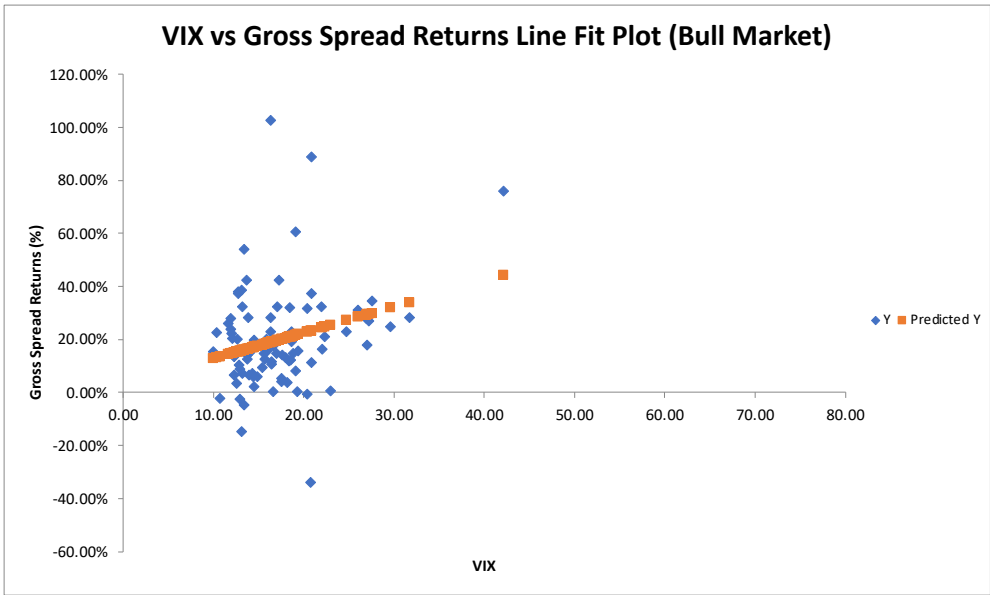

Figure 11: VIX vs. Gross Spread Returns Regression (Bull Market)

SUMMARY OUTPUT (Bull Market)

Regression Statistics	
Multiple R	0.26743843
R Square	0.07152331
Adjusted R Sq	0.06020043
Standard Erro	0.19124916
Observations	84

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.23104127	0.23104127	6.31670328	0.01391844
Residual	82	2.99925192	0.03657624		
Total	83	3.2302932			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.02711573	0.07081494	0.38290973	0.7027775	-0.11375774	0.1679892	-0.11375774	0.1679892
VIX	0.00979512	0.00389731	2.51330525	0.01391844	0.00204214	0.01754811	0.00204214	0.01754811

Figure 12: VIX vs. Gross Spread Returns Regression Output (Bull Market)

10-YR Treasury Yield and Gross Spread Returns

The results from the 10-YR Treasury Yield vs. Gross Spread Return regression for the recessionary period also show an insignificant R-squared value at 0.005 which does not assert anything about the strength of the relationship. The p-value for the recessionary period is also significantly higher than the 0.10 threshold. Therefore, during the recessionary period, the data does not show any sign of significance as an indicator for gross spread returns during recessions. The 10-yr treasury yield remained relatively high over the time period which could have affected the results of the regression. Without large changes in the independent variable, it is difficult to assert the role of the variable in determining M&A arbitrage returns. However, the correlation does show a negative trend over time that lower returns occur when there are higher treasury yields. This could be due to the lack of activity in the equity markets when there are spikes in the 10-YR treasury yield potentially asserting that equity market activities could play a role in arbitrage returns.

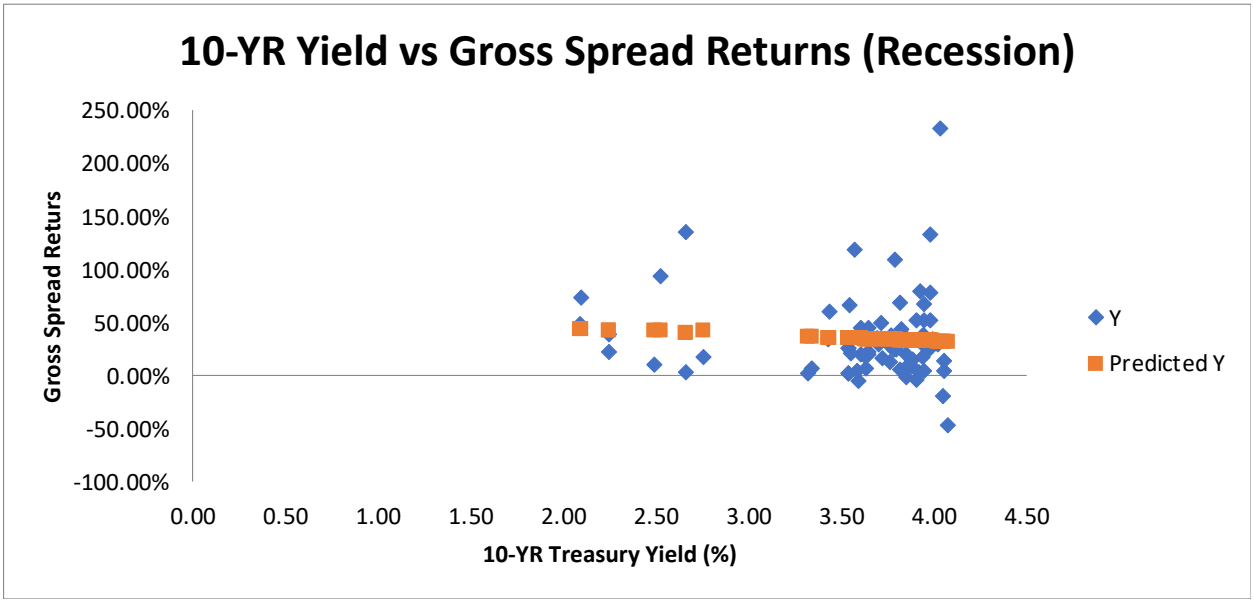

Figure 13: 10-YR Treasury Yield vs. Gross Spread Returns Regression (Recession)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.07605226
R Square	0.00578395
Adjusted R Sq	-0.00802461
Standard Erroı	0.40202164
Observations	74

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.06769785	0.06769785	0.41886687	0.51956116
Residual	72	11.6367406	0.1616214		
Total	73	11.7044384			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.56607208	0.32821418	1.72470331	0.08887163	-0.08821093	1.22035509	-0.08821093	1.22035509
X Variable 1	-0.05847523	0.0903512	-0.64719925	0.51956116	-0.23858704	0.12163659	-0.23858704	0.12163659

Figure 14: 10-YR Treasury Yield vs. Gross Spread Returns Regression Output (Recession)

The 10-YR treasury vs Gross Spread bull market regression yielded an R-squared statistic of .026 which is more explanatory than the recessionary time period, but that could also be due to the larger time period that data was randomly selected from. The p-value is slightly above 0.10 at 0.14 which means the data is insignificant at a 90% CI but could be significant if the parameters of the experiment were an 85% CI. The correlation is negative which shows lower

gross spread returns as the 10-YR treasury Yield shows. Rather than a lack of liquidity or recessionary conditions affecting arbitrage spreads it could be increased M&A activity and volatile trading that affects widening spreads. Increased liquidity and positive information in the market could increase the returns that we see from M&A transactions rather than the volatility of market downturns.

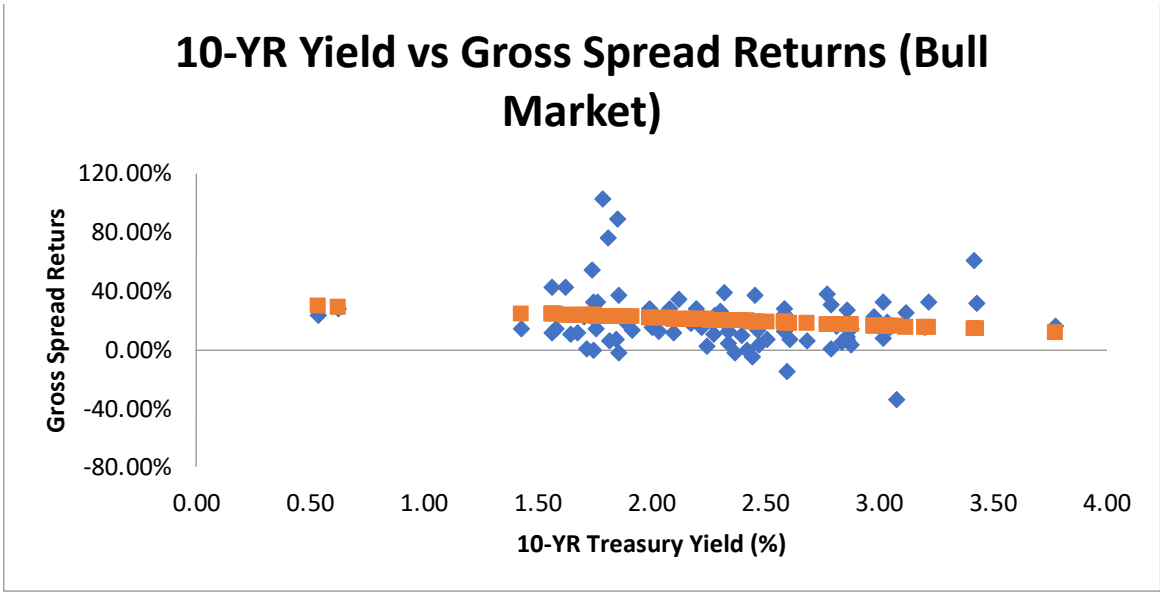

Figure 15: 10-YR Treasury Yield vs. Gross Spread Returns Regression (Bull Market)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.16215593
R Square	0.02629455
Adjusted R Sq	0.01442009
Standard Erroı	0.19585193
Observations	84

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.08493909	0.08493909	2.21437889	0.14056578
Residual	82	3.1453541	0.03835798		
Total	83	3.2302932			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.32216893	0.08666081	3.71758493	0.00036655	0.14977297	0.4945649	0.14977297	0.4945649
X Variable 1	-0.05402146	0.03630282	-1.48807892	0.14056578	-0.12623933	0.01819641	-0.12623933	0.01819641

Figure 16: 10-YR Treasury Yield vs. Gross Spread Returns Regression Output (Bull Market)

S&P 500 Returns and Gross Spread Returns (%)

The S&P 500 returns vs. Gross Spread recessionary regression yielded an R-Squared statistic that did not show any explanatory strength through the R-Squared variable. This is likely due to the data set not accurately reflecting the downturn or the lack of long-term trends in the S&P 500. The P-value also did not yield a statistically significant result, meaning the null hypothesis could be rejected that 10-YR treasury yield during the 2008 financial crisis did not directly influence gross spread returns in M&A transactions. It is important to note that the correlation for this data set is also negative showing that as S&P 500 price increases the gross spread returns increase. This is the only variable that has any explanatory power that shows recessionary time periods cause a widening of gross margins. This is important to consider especially as S&P 500 returns can directly affect the quantity and valuations that mergers get because the offer price of M&A transactions is usually pegged around the current market price of the target.

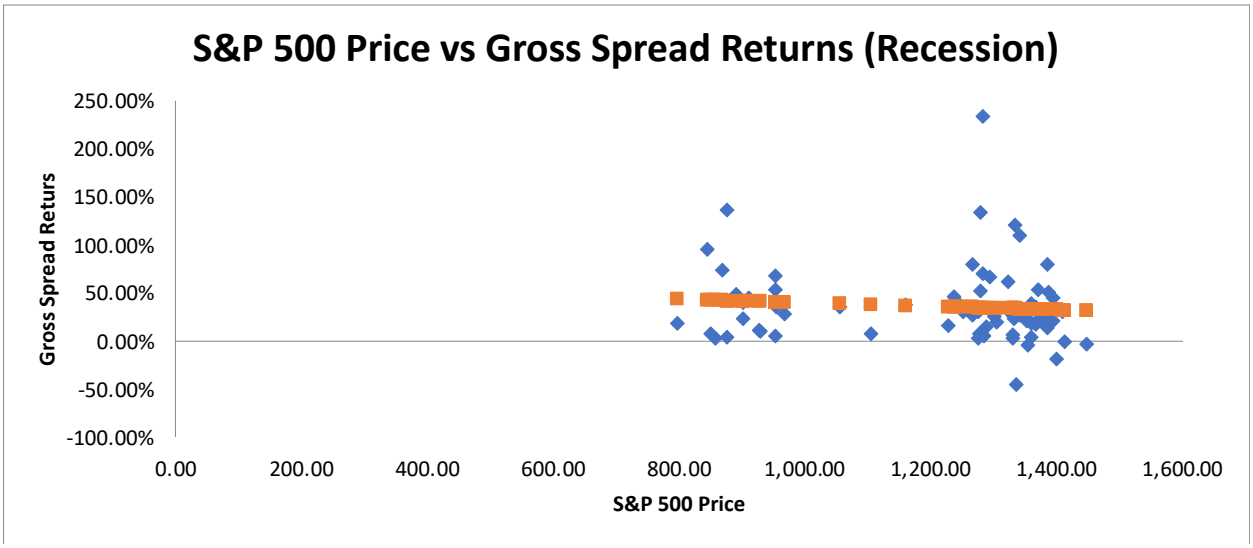

Figure 17: S&P 500 Returns vs. Gross Spread Returns Regression (Recession)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.08675799
R Square	0.00752695
Adjusted R Sq	-0.0062574
Standard Erro	0.40166908
Observations	74

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.08809872	0.08809872	0.54605047	0.4623382
Residual	72	11.6163397	0.16133805		
Total	73	11.7044384			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.57574385	0.30126102	1.91111297	0.05997117	-0.02480903	1.17629672	-0.02480903	1.17629672
X Variable 1	-0.00018068	0.00024451	-0.73895228	0.4623382	-0.0006681	0.00030674	-0.0006681	0.00030674

Figure 18: S&P 500 Returns vs. Gross Spread Returns Regression Output (Recession)

For the bull market time period, there is an R-Squared of .019 showing a weak explanatory link between the two variables. There is a negative correlation between S&P 500 returns and gross spread returns again showing that in times of S&P 500 downturns, there may be some widening of gross spreads. However, the data is insignificant under a 90% CI, but with more standardization of data between S&P 500 returns and gross spread returns over time there may be a greater correlation that would be worth exploring. This is likely due to the increased offloading of equities during downturns which may create larger negative deviations between fundamental valuations and market valuations. Furthermore, less volume and trading in the equity markets could give arbitrageurs less opportunity to fully take advantage and drive arbitrage prices back to their fair value.

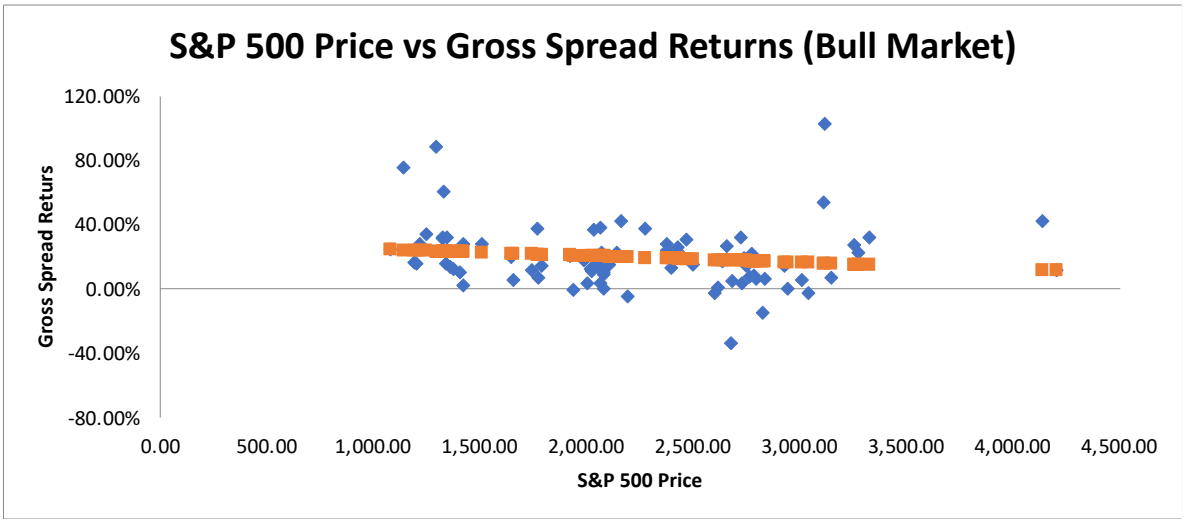

Figure 19: S&P 500 Returns vs. Gross Spread Returns Regression (Bull Market)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.14103383
R Square	0.01989054
Adjusted R Sq	0.00793799
Standard Erroı	0.19649492
Observations	84

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.06425228	0.06425228	1.6641247	0.20067352
Residual	82	3.16604092	0.03861026		
Total	83	3.2302932			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.28840794	0.07388766	3.90333019	0.00019374	0.14142185	0.43539404	0.14142185	0.43539404
X Variable 1	-4.1162E-05	3.1909E-05	-1.29000958	0.20067352	-0.00010464	2.2314E-05	-0.00010464	2.2314E-05

Figure 20: S&P 500 Returns vs. Gross Spread Returns Regression Output (Bull Market)

Chapter 6

Shortcomings and Discussion of Further Analysis

Further Analysis Potential

The results of the experiment would have been much more significant if the data was standardized in terms of sheer size. There are less M&A deals for the recessionary period due to the time frame the data set includes. Additionally, the bull market period also provided a wider range of deals which also may include instances of large mispricing just as a nature of chance. Also, if there were a better way to normalize the returns of the independent variable rather than comparing spot rate of each index to close value of the M&A transaction may have also produced stronger results. If the time period size could be normalized while also being able to field enough M&A transactions to fulfill the necessary data set size it would have made the comparison process of each data set to each index significantly easier. Furthermore, changes in the proposed methodology would also contribute to a different framing of the experiment and therefore potentially stronger results. A focused experiment on the liquidity principles that affect arbitrage spreads while trying to isolate each indices effect on arbitrage spreads.

Short Comings

A major shortcoming of this experiment is the inability to field a complete M&A data set due to missing information. Many of the M&A deals that were pulled from, the Zephyr database were missing crucial information that would allow the deal to be eligible for the experiment. Due to missing information the M&A deal size, and conditions was scattered affecting the pool of

results. For future studies of merger arbitrage returns, a greater sample size would have helped the accuracy of the experiment. Additionally, samples including failed deals might affect the potential for returns in both periods as that is an important consideration for calculating returns of arbitrage spreads from an arbitrageurs point of view.

Another application of the experiment that could provide more information is analysis of a multivariate regression model amongst the most statistically significant explanatory variables and each M&A dataset. Furthermore, the multicollinearity amongst the x-variables could have been better analyzed to see the impact of certain indices on one another. This could help better identify the reasoning behind movements in merger arbitrage spreads in relation to recessionary indicators.

Finally, the results of this study offer potential insight into the comparative relationship of merger arbitrage returns during recessions and bull markets, through the lens of market liquidity. A larger selection of explanatory variable, with a more comprehensive deal sample would also provide more comprehensive results and conclusions.

Chapter 7

Conclusion

Much of the existing theory and quantitative research surrounding M&A arbitrage establish that illiquid market conditions create situations of inaccurate market pricings which lead to slower mean reversion of arbitrage spreads. This gives arbitrageurs more opportunity to capitalize on the mispricing presented. Past studies are focused on the effects of illiquidity on M&A transaction deal flows, pricing, and trading opportunities. Specifically in this paper, we analyze the potential differences between different market conditions to conclude on the optimal time frame to take advantage of potential mispricing. We use liquidity and recessionary indicators as established by previous studies to determine the explanatory variables. The paper uses the Zephyr M&A database to field transactions between the 2008 financial crisis and the overall bull market over the past 14 years.

Ultimately, the results are inconsistent with previous research where we see greater arbitrage opportunities over the bull market periods. However, this is likely due to sheer sample size of the experiment rather than actual macroeconomic factors affecting M&A spreads. The significance of the results could have been improved if the indices were normalized through the time that the M&A transaction was announced and closed. Overall, the data did see some results that showed recessionary conditions affect M&A spread returns which could be a point of further research. As a theory, illiquidity in markets keep M&A spreads larger as people cannot capitalize on the mispricing as easily due to lack of capital, or fearful emotions to the market. Further studies should focus on a more standardized to measure the two time periods so that the results

could be accurately compared to gauge the extent of recessionary conditions on M&A spreads. M&A spreads and arbitrage mispricing in general is a major factor in trading strategies which merits further analysis in order to optimize future trading strategies.

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EDUCATION

The Pennsylvania State University | Schreyer Honors College — **University Park, PA**
Smeal College of Business | B.S. in Finance — *Graduating May 2023*
College of the Liberal Arts | B.S. in Economics

RELEVANT EXPERIENCE

Morgan Stanley — **New York City, NY**
Incoming Investment Banking Analyst | Technology Group — *Jul 2023*

Morgan Stanley — **New York City, NY**
Investment Banking Summer Analyst | Technology Group — *Jun 2022 - Aug 2022*

- Worked across Industrial Technology, Optical Networking, and Consumer Technology verticals; received 2023 full-time return offer
- Built Discounted Equity Value and Discounted Cash Flow model for potential industrial technology sell-side M&A transactions
- Constructed research reports, and engaged in management discussions involving development, M&A target maps and IPO positioning

Chatham Financial — **Kennett Square, PA**
Corporates Sector | Implementations Team — *May 2021 - Aug 2021*

- Launched Chatham Financial's first third-party risk management software implementation program by creating implementation guides and conducting analysis of the company's risk management software platform
- Analyzed previous risk management software implementation material to identify gaps and devise potential solutions for the program
- Designed a Business Case presentation for senior management on the feasibility of third-party risk management software implementation

Nittany Lion Fund, LLC — **University Park, PA**
VP of Development (Executive Board) — *Dec 2021 – Jan 2023*

- Facilitates the development of 30+ Associate and Lead Fund Managers by conducting three meetings each semester to assess technical knowledge, Fund Manager performance, and investment strategy to ensure the Nittany Lion Fund generates outperformance
- Designed and oversaw onboarding projects for 12 new associates, which provided important technical and market education

Fund Manager — *Dec 2020 - Dec 2021*

- Managed Penn State's ~$14.50 MM student-run investment fund of private investor capital by generating investment theses and creating equity pitch presentations with a goal of outperforming the S&P 500
- Conducted qualitative and quantitative analyses for equities using discounted cash flow models, public comparables, and ratio analysis by utilizing data gathered from the Bloomberg Terminal, FactSet, and SEC filings to allocate portfolio capital
- Generated trading emails as well as weekly, monthly, quarterly, and earnings reports to update fund managers and investors on portfolio-moving news and significant macroeconomic events

SafeStamp — **San Francisco, CA**
Business Analyst Intern (remote) — *Aug 2020 - Jan 2021*

- Organized and taught "VC 101," "Fundraising 101," and capitalization table seminars to 30+ interns that focused on general VC firm structure, company-specific fundraising strategy, and startup equity structuring to prepare interns for the company's fundraising round
- Produced lateral memorandums for management, including the Head of Sales Compensation Structure memorandum, which outlines the optimal equity vesting schedule and payment compensation for a potential new sales executive

Clyde AI — **New York, NY**
Financial Analyst Intern (remote) — *Aug 2020 - Jan 2021*

- Provided financial analysis and SEO content for credit cards, loans, and other financial products to build a minimal viable product
- Graded performance of financial writing by analyzing bi-weekly marketing SEO feedback to ensure stable website visitor generation
- Co-authored a 130+ page personal finance book designed to help college students and young adults navigate the finance world

Wall Street Bootcamp — **University Park, PA**
Teaching Assistant — *Jan 2021 – May 2022*

- Selected as one of 50 students from hundreds of applicants to participate in an exclusive training program held by Wall Street professionals, gaining an extensive understanding and elevated knowledge of Wall Street career paths
- Guides students during Wall Street Bootcamp classes and leads sessions discussing career paths and other opportunities on Wall Street

LEADERSHIP EXPERIENCE

Happy Valley Venture Capital — **University Park, PA**
Partner — *Dec 2020 – Feb 2023*

- Collaborates with the Executive Board to facilitate Bluestart, Penn State's first student run venture capital and startup week, to help students navigate the entrepreneurial landscape with seminars and educations from professionals in the industry
- Preparing an investment procedure and due diligence framework to review startups in the Penn State entrepreneurial ecosystem
- Presents educational workshops on startup fundraising, venture capital investment procedure, and career opportunities in venture capital to develop the new cohort of HVVC analysts for Investment Committee Director interviews

HONORS & INTERESTS

Honors: Academic Excellence Scholarship, IB Diploma Recipient, Outstanding Achievement in the Spanish Language, Dean's List
Interests: Soccer, tennis, Hip-Hop/Rap, K-pop, *Super Smash Bros. Ultimate/Melee*, anime, chess, poker