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Analysis of U.S. Derivative Trading Hedge Fund Returns during the Rapid Increase in Retail
Options Trading From 2019 to 2023

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ABSTRACT

Retail options trading has become increasingly popular since the introduction of zero-commission brokerage platforms; however, retail traders have historically performed poorly in the options market. A contributing factor to these poor returns has been retail options traders' tendencies to prefer to trade contracts around high volatility events. Due to the focus on high volatility contracts, retail options traders recently popularized the 0 days to expiration contracts (0DTE).

The excessive size of retail traders' losses in the market due to trading high volatility events has sparked interest in hedge fund returns, and whether returns have increased due to derivatives-trading hedge funds taking advantage of retail options traders' losses. To evaluate this phenomenon, we completed a regression analysis of derivative-trading hedge funds' relative performance to all hedge funds and various variables linked to hedge fund performance to determine if variables such as retail options' volume have impacted derivative-trading hedge funds' relative performance. The data did not show a statistically significant correlation between any of the variables tested and derivative-trading hedge funds' relative performance. Due to the shortage of data on retail trading of options as a result of its relatively new growth, further analysis may yield clearer results once a longer history with more data is available.

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Introduction

The concept of options, which are legal contracts to exchange a financial asset such as a share of stock at an agreed upon price in the future, has been around for centuries. However, options were officially standardized in 1973 with the formation of the Chicago Board of Options Exchange (CBOE), the first exchange dedicated to the trading of options. Following the formation of the CBOE, options were typically traded between sophisticated investors who focused on using options to decrease the risk of their portfolio or of a certain position. Experienced investors were typically using options in combination with other investments to de-risk a portfolio, leading to a perception that options are inherently less risky than other types of investments. It wasn't until recently that retail traders even knew about options contracts and how they worked. However, since the introduction of options contracts to retail investors, they have been massively popular due to the high risk and high reward that can accompany them. This drastic increase in the popularity of options has led to certain impacts on the market, such as higher liquidity for options which are popular among retail investors, such as calls and puts on indexes like the S&P 500.

The History of Options Trading

Delving into the history of options trading provides insight into how the tool has evolved. It is important to understand that an options contract grants the right, but not the obligation, to buy or sell a real asset, commodity, or security at a later date, under stated conditions. Options contracts can come in many forms. In the present day the contracts are most commonly in the form of calls and puts. A “call” is a contract which allows the purchaser to buy the underlying asset, typically a stock, at a specified price at a specified date in time, while a “put” is a contract that allows the purchaser to sell the underlying asset, typically a stock, at a specified price at a specified date in time. In ancient times options contracts were typically embedded in goods transactions and were seen as important to commerce (Poitras, 2009). This means that typically when trade was being conducted, there would be an option written into the contract for the purchaser to purchase more of a good at a specified price at a specified date in time.

The evolution of exchange trading for standalone option contracts began between the 16th and 18th centuries. Both forward and option contracts started to trade regularly on the Antwerp bourse during the 16th century. These contracts increased in importance as their utilization rate grew on the Amsterdam market, which was enabled by a significantly advanced clearing process (Poitras, 2009). During this time options trading was typically done by a specialized group of traders, similar to what was seen with early options contracts traded on the Chicago Board Options Exchange (CBOE) several centuries later. This specialized group of traders were very sophisticated and had a deep understanding of the contracts being traded.

The formation of the CBOE ultimately paved the way for the future and ultimately revolutionized the way stocks and bonds were traded, which included incorporating risk and increased utilization in corporate finance. Most importantly, the formation of the CBOE created a standardized exchange that guaranteed the safety of each party involved in the trade. The

CBOE had the power to ensure both parties fulfilled their obligations as per the contract. Instantly, traders were handed a tool which gave them the power to turn \$1 into \$1,000, or \$1,000 into \$0. When options were first introduced, traders were unsure of their true potential, as demonstrated by the measly 1.12 million contracts written in 1973; however, they quickly became popular, as demonstrated by the over 3000-fold increase to 3.69 billion contracts written in 2017 (Li, K., 2021).

Options markets have grown from being a niche financial instrument to a tool that can be used to assess the health of emerging economies. In a study by Oliinyk, Burdenko, Volynets & Yatsenko (2019), options markets correlate to eight different economic indicators, which together provide significant insight into the health of the economy. The study analyzed not only whether options markets are correlated with economic indicators but also how options trading improved efficiency of financial markets. This efficiency is usually achieved through large investment firms like hedge funds correcting any inefficiencies in the market.

Hedge funds, which rely on trading to make money, are the most frequent buyers and sellers of options. Not all hedge funds use options though, as some hedge funds just invest in stocks while others are long-short, which means the hedge fund can invest in stocks or bet against stocks. A third option for hedge funds is to invest in alternative assets like the purchase of private companies. Beyond just what kind of assets a hedge fund invests in, some hedge funds are created with a sector focus. A sector focus is when a hedge fund focuses on a specific sector of the market to become an expert in and trade. A sector is a category of the market, such as healthcare, financials, or consumer discretionary. For example, some hedge funds will trade only in healthcare stocks, while others will trade only indices. This is important for this paper as this paper will study three categories of hedge funds. The first category is simply all hedge funds, the

second category is options trading hedge funds, and the last category is options trading hedge funds with a sector focus on indices.

While risk might be a simple concept when applied outside of finance, such as it is less risky to have a guard rail than to not have one on a bridge, financial risk is much more difficult to define. Many analysts have tried to quantify different aspects of risk such as market risk, which is risk to the entire market, and nonmarket risk, such as risk that only pertains to one stock or other assets. The issue is the many assumptions which need to be made that are not universally agreed upon and therefore do not always lead to a useful definition (Artzner, Delbaen, Eber, and Heath, 1999). Because a definition is essential for the purposes of analysis, risk will be defined in this paper as the standard deviation of the returns from hedge fund portfolios when compared to the standard deviation of the returns from the S&P 500. This simply means that risk will be defined as how volatile a portfolio is in comparison to the volatility of the S&P 500. The larger the difference, the greater the risk.

This concept of volatility and risk is of paramount importance when discussing hedge funds and hedge fund returns. While there is a lot of conflicting information on whether hedge funds generate higher returns than the index to which it compares its performance, typically the S&P 500, studies show that hedge funds which use options outperform indexes like the S&P 500 (Aragon & Martin, 2012). The study showed that hedge funds which utilized options returned 1.55% more each quarter than hedge funds that did not use options. This resulted in alpha, or excess returns above the S&P, of 10.68% a year. Surprisingly, this study also found that hedge funds using options had less risk than those which did not use options. This study made use of the same database being used in this paper, which is the Lipper TASS database. This database includes 4,693 hedge funds and 2,296 defunct funds. Aragon and Martin used data from this

database between 1999-2006, so it is important to keep in mind that this data may be slightly outdated.

Chapter 2

Retail Options Trading Catches Traction

While hedge funds trade the most options by volume, options contracts have become increasingly popular with non-institutional traders. The non-institutional traders this paper will focus on are called retail traders, which is anyone who trades assets such as equities or derivatives for their own portfolio account. Retail trading in options has not always been as popular as it has been in recent years. Prior to the introduction of zero-commission trading in stocks and options, retail trading in options was something only sophisticated retail traders knew about or dared to venture into. In fact, retail trading in options has grown more than ten-fold over the past decade when looking at dollar volume traded. In 2015, Robinhood and other commission-free brokerages became extremely popular with retail customers (Bryzgalova, Pavlova, and Sikorskaya, 2023).

Prior to the explosive growth in the retail trading of options, there were actually studies being done which showed that more retail traders should actually be participating in the retail options trading market due to the benefits from a perspective of decreasing risk in a portfolio such as a retirement account. While the benefit was fairly marginal after taking into account transaction costs, it is still important to point out that the effects of demand for retail derivatives has been an interesting point of study (Branger, 2008)

The recent growth in retail investors has sparked much interest in what these retail investors are interested in, and what impact they are having on the markets. To start, retail investors have been known to be attracted to companies with more media attention, such as large market cap companies and companies expected to make an important announcement. These

types of announcements could include an earnings announcement, or a clinical trial data readout.

These types of announcements have attracted retail investors due to retail investors' interest in highly volatile assets with anticipated spikes in volatility (e.g., Noh, So, and Verdi 2021).

Chapter 3

Effects of Retail Options Trading

The spike in popularity of retail trading in options was seen as a positive by some, as it resulted in increased liquidity and volume in most markets, which helped to increase market efficiency. However, on the negative side it introduced many unsophisticated investors to sophisticated investment tools such as options trading. The nuances in an option contract and details such as how time decay impacts the price of the option are not well understood by the average retail investor. As it is typically not advisable for investors to participate in an investment which is beyond their understanding, the introduction of these contracts to retail investors could be seen as a negative. Robinhood reached its peak in late 2021 when it was reported to have 21.3 million active monthly users, most if not all of whom were retail traders (Bryzgalova, Pavlova, and Sikorskaya, 2023). This surge in users, as expected, correlated to an increase in retail trading of options as indicated by the 68% jump in single stock option trading. CBOE cited retail traders using zero or low-commission brokerage accounts as the top driver of this trend, supporting the idea that platforms like Robinhood were driving this growth.

This growth has had some interesting effects not only on retail traders, but on the market as well. According to a recent study, at the same time of Robinhood's introduction of options, options volume increased, and volatility also increased for U.S. securities (Lipson, 2023). The paper cites the source of this increase in volatility to be market makers hedging their exposure. Another interesting finding from the study was that this increase in volatility and retail options trading has resulted in an increase in liquidity in the markets in which retail options traders are

active. This increase in liquidity should theoretically be valuable to every participant in the market, as higher liquidity typically means lower effective spreads.

Unlike hedge funds, retail traders have preferred to trade the riskiest types of options, and rarely use them in combination with other investments such as was the practice in typical historical options strategies. Retail traders have recently popularized options contracts which expire that same day, called “0DTE” options. According to Beckmeyer, Branger, and Gayda, nearly the entire growth of trading in S&P 500 index can be traced back to demand for 0DTE options. The authors go on to state that more than 75% of retail trades in S&P 500 options today are in 0DTE contracts. While admittedly these contracts do have some benefits for retail investors, such as price improvements and lower effective spread, they still pose a considerable threat to retail investors’ capital. These options are considered by some to be pure gambling due to their payoff structure. Due to the options contracts expiring the same day on which they are purchased, they are essentially only worth however much the stock price moves in that same day. Instead of betting on long-term moves of a stock or the market based on market trends and data, retail traders are betting on an extremely short-term move in whatever the underlying asset the contract is written on. Beckmeyer, Branger, and Gayda even go as far as to describe them as having “lottery-like payoffs.” While historically investing has been seen as a way to make consistent gains over a long period of time, this type of investing is being compared more to a casino than an investment.

Similar to a casino, in these short-term investments favored by retail investors, the house always has an edge. The house in this scenario is the writer of the contract. Between February 2021 and February 2023, retail traders lost \$70 million. \$20 million was due to poor positioning, meaning that retail investors lost \$20 million due to their incorrect speculations on the market.

The other \$50 million was due to options premiums (Beckmeyer, Branger, and Gayda). Options premiums are the price which the buyer pays the writer of the contract to take on the risk of writing the contract. These premiums typically are slightly higher than the expected value of the contract, meaning that for the purchaser to make money, they have to have strong conviction in the movement of the underlying asset, and ultimately be correct. The \$50 million clearly demonstrates just how significant these option premiums are, and that even with zero-commission brokerage accounts, retail traders are still at a disadvantage when purchasing these options due to the premiums charged by the writers of the contracts.

Another study suggests that “retail investors lose 5-to-9% of option investments around earnings announcements on average, and 10-to-14% for high expected announcement volatility announcements” (de Silva, Tim and Smith, Kevin and So, and Eric C.). It is clear that retail investors are consistently losing on these kinds of investments, however not all retail options trades are so drastic in investors’ losses. DeSilva et al describe how, outside of high expected volatility announcements, retail traders in the Netherlands lost only 1.81% per month on average. Overall, the study concludes that retail investors generate losses in options markets due to overpaying for “options relative to realized volatility, trade in options with large bid-ask spreads, and continue to hold options post-announcement as their prices predictably decay.”

The history of options contracts, hedge funds involvement in the market, and retail traders’ recent frenzy purchasing of options have all been studied thoroughly. As demonstrated above, the market for options contracts is ever-evolving, however some key recent trends such as retail traders investing heavily in ODTE options are starting to raise some questions as to how this will impact other players in the market. This paper will take a deeper look at the effects of retail traders involvement in the options market on hedge funds, specifically hedge funds which

trade options. This will be done using similar methodologies to some of the studies mentioned above, such as the use of the same database, the Lipper TASS database. By comparing options trading hedge funds to their non-options trading hedge fund counterparts, this paper will attempt to assess how the trend of retail traders participating in the options market affects not only the risk profile, but also the returns of options-trading hedge funds.

Chapter 4

Methodology

A list of Hedge Funds was collected from the Lipper TASS database. For the rise in retail trading of options, Hedge Fund return data was pulled from January 1, 2019, to January 1, 2024. All Funds within the database were included in the initial dataset. The database includes 3,732 unique Funds, including graveyard funds, however only 350 of which trade options. Funds which did not report data for the entire length of time being studied in this paper were excluded to create a more uniform dataset. Graveyard funds (which no longer exist) were also excluded from the dataset in an effort to again create a more uniform dataset. The list of funds was then divided into three categories. The first category was all hedge funds, the second category was all options-trading hedge funds, and the third category was options-trading hedge funds with a sector focus of indexes.

The Hedge Fund list included: Rate of Return, Fund Name, Options Trading, Sector Focus, Graveyard, and Date. This data is then combed through to eliminate any funds which did not report data for the full length of the study or was considered a graveyard fund. This creates a random selection of Hedge Funds to include in the regression analysis.

After the data set was checked and completed, the full year returns was calculated. Full year returns were calculated using the formula $(1+r_1) (1+r_2) (1+r_3) \dots (1+r_{12})$. This was used to capture the compounding nature of the full year's returns from January to December based on the month-by-month data given.

Statistical Summary of Hedge Fund Data

After removing the excluded data entries, the remaining data was aggregated and summarized in the following tables. The summary statistics listed are for all hedge funds in the data set, and hedge funds which trade derivatives in the data set. All statistics included in the table below are from monthly data of all hedge funds which were included in the finalized data set previously described. This was to ensure the data being used would not be skewed within the summary statistics. Summary statistics are shown for each year included in the final data set.

		2019							
		Average	Median	Standard Deviation	Sample Variance	Skewness	Range	Min	Max
All Funds		11.19%	8.39%	29.33%	0.086039213	21.08095105	959.73%	-88.77%	870.96%
Deriv Funds		11.88%	9.62%	15.33%	0.023494596	3.245546298	137.07%	-21.26%	115.82%

Figure 1: Summary Statistics 2019

		2020							
		Average	Median	Standard Deviation	Sample Variance	Skewness	Range	Min	Max
All Funds		11.19%	7.34%	21.71%	0.047126382	4.078989771	287.30%	-48.43%	238.88%
Deriv Funds		11.65%	8.95%	22.06%	0.048674325	4.534724052	236.79%	-22.47%	214.32%

Figure 2: Summary Statistics of 2020

		2021							
		Average	Median	Standard Deviation	Sample Variance	Skewness	Range	Min	Max
All Funds		8.43%	4.88%	17.02%	0.028966834	3.8100349	371.82%	-83.87%	287.95%
Deriv Funds		10.84%	8.23%	20.02%	0.040070414	2.983339292	199.95%	-48.82%	151.13%

Figure 3: Summary Statistics of 2021

		2022							
		Average	Median	Standard Deviation	Sample Variance	Skewness	Range	Min	Max
All Funds		-1.80%	-0.42%	18.87%	0.035612696	2.341762292	295.14%	-89.50%	205.64%
Deriv Funds		-3.34%	-1.56%	18.01%	0.032450721	-0.623610896	133.66%	-77.60%	56.06%

Figure 4: Summary Statistics of 2022

		2023							
		Average	Median	Standard Deviation	Sample Variance	Skewness	Range	Min	Max
All Funds		8.00%	6.60%	20.51%	0.042077001	14.99639858	704.34%	-91.66%	612.68%
Deriv Funds		7.47%	6.06%	13.38%	0.01790166	0.906400653	127.45%	-48.46%	78.99%

Figure 5: Summary Statistics of 2023

Independent Variable Analysis

All variables included in the regression analysis were annualized to match the annualized nature of the hedge fund returns. In total, 2,515 hedge funds were included in the category of all hedge funds, while only 204 hedge funds were included in the derivative-trading hedge fund category. All variables used in the analysis were selected based on their importance as drivers of performance of hedge funds, specifically derivatives-trading hedge funds. While the primary focus of the study was to study the relationship between retail options trading volume and the relative performance of derivative-trading hedge funds, it was important to include other variables which could also contribute to the relative performance of derivative-trading hedge funds. This allowed a scenario where the relationship between all hedge fund returns, and derivatives-trading hedge fund returns could be tested with respect to retail options trading volume. This in turn allows the opportunity to test the correlative factors regarding derivative-trading hedge fund returns as the retail trading of options volume changes.

Options Volume

Options volume, as measured by the Options Clearing Corporation (OCC), is the number of options contracts bought or sold, typically measured in the time frame of a day, week, quarter, or year. Options volume is important as it is essentially a proxy for liquidity in the options market. Higher volume is a strong indicator of greater liquidity, meaning lower effective spreads for the purchasers of options. Lower effective spreads in turn means lower effective prices,

meaning increases in options trading volume could have a direct impact on the price paid for an option contract.

The figure below shows annual options volume for the years 2019-2023. There is a very noticeable increase in options volume from 2019-2020, attributed mostly to the COVID-19 pandemic and increased retail options trading volume due to the pandemic. This period also had heightened volatility having multiple different effects, such as increasing the need to manage risks through hedging and increasing the rewards for speculators to gather private information to exploit and profit from trade (Emm EE, Gay GD, Ma H, Ren H, 2022). Since this explosive growth in 2019, options have continued to increase in volume every year since. Important factors contributing to this growth include increased access to high-quality data and trading tools for retail investors, zero-commission retail trading, volatility in markets driven by macroeconomic and geopolitical events and stock splits (2024 Options Outlook, NASDAQ).

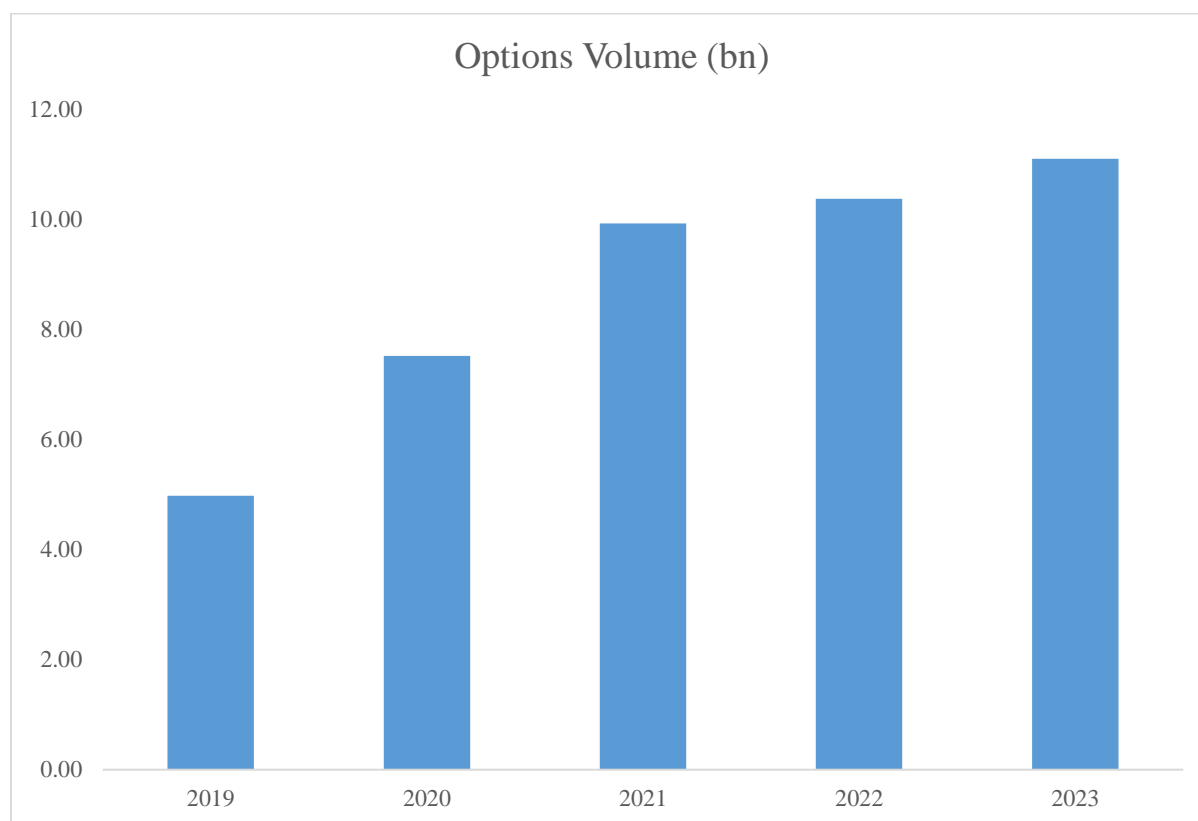


Figure 6: Options Volume 2019-2023

Retail Options Volume

Retail options volume is very similar to the above (all options volume,), however it carries a few distinct differences. Most importantly, this is the options volume of only retail traders, meaning that all the options counted in this metric are bought or sold by individual retail traders. There are a few different ways to calculate this metric, however the one used for the purpose of this study was from the market data research company SpiderRock. The value is derived from a combination of three estimators of the retail order flow: a single leg auction non-intermarket-sweep, small value trades, and a combination of small lots and small value trades

(Rizner, 2023). This estimation produced results that were in line with other methods of estimating retail options volume.

The figure below shows a substantial increase in retail options trading volume from 2019 to 2021. This increase has been attributed to multiple factors, however the main factors include the meme stock spikes during COVID-19, high market volatility, zero-commission brokerage platforms, and the rise in popularity of 0DTE options. This explosive growth could have substantial impacts on market participants, especially due to the kind of options retail traders are buying. 0DTE as mentioned above have become increasingly popular among retail traders, and are starting to raise some concerns over how these contracts and their newfound popularity could influence other market participants.

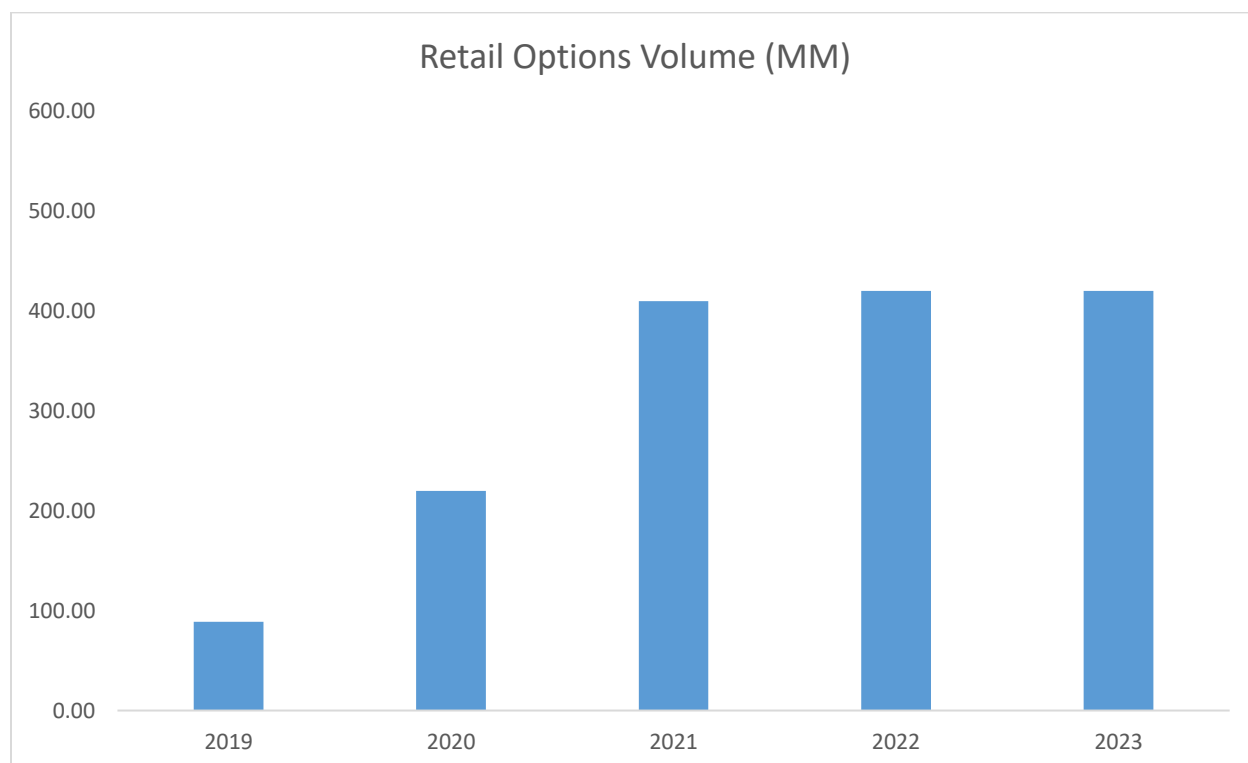


Figure 7: Retail Options Volume 2019-2023

S&P 500 Returns

S&P 500 Returns have long been compared to hedge fund returns as they act as a proxy for overall market returns. While hedge fund returns are tightly linked to the market, they impact different kinds of funds differently. Hedge funds which do not trade derivatives will be more heavily compared to the S&P 500 because there are generally more factors impacting derivatives' returns such as implied volatility and time to expiration. Hedge funds on average have reliably lower returns than the S&P 500, although this is not true for every fund.

The following graph shows the annual return of the S&P 500 for each year from 2019 to 2023. The first three years included in this study saw abnormally high S&P 500 returns, with the S&P 500 seeing returns above 30%. The study also includes a down year in the S&P 500, showing returns of -18.11% in 2022. It is important to note that these returns are fairly abnormal for the S&P 500, with three years in this set having over 25% returns, which was only the case six times in the last 25 years. It is also important to note that these returns were heavily impacted by the COVID-19 pandemic which began in 2020.

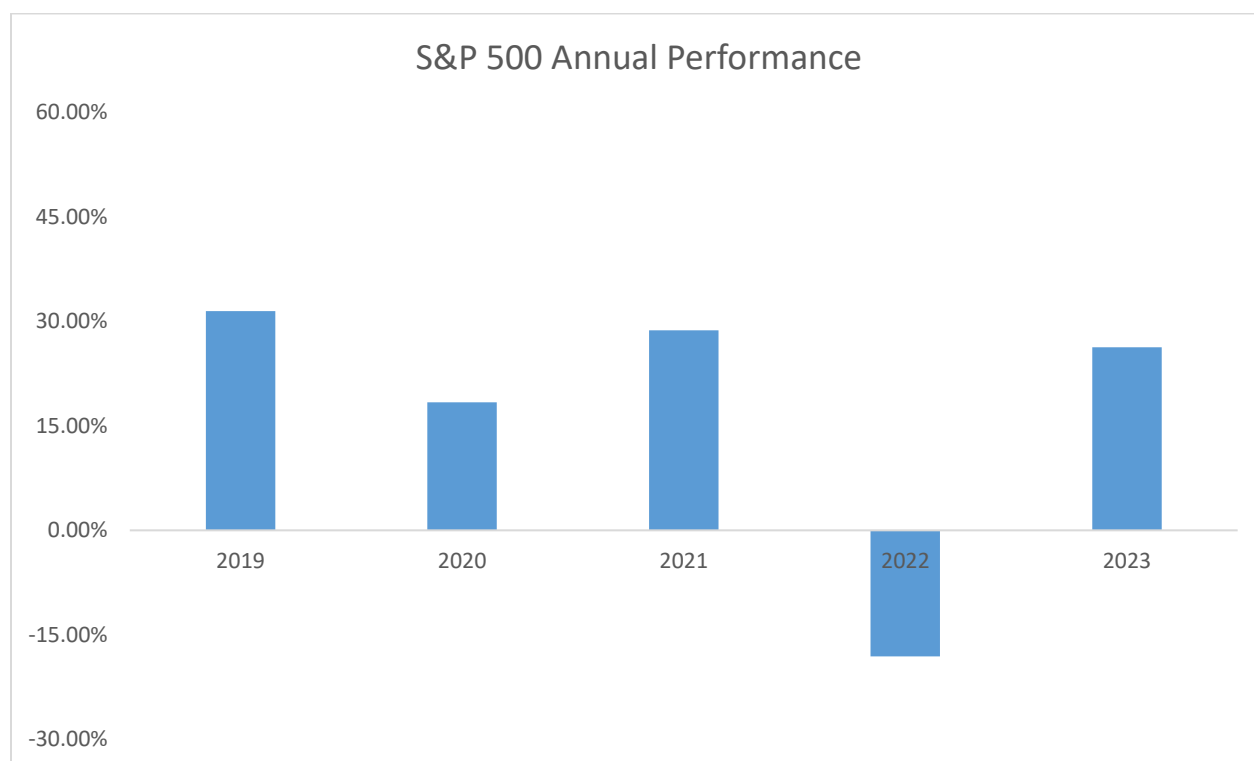


Figure 8: S&P 500 Annual performance 2019-2023

VIX Index

The VIX, or Volatility Index is the annualized implied volatility of a hypothetical S&P 500 stock option with 30 days to expiration (*Understanding VIX or Volatility Index*). While the VIX only measures the volatility of the S&P 500 index, it is broadly used as a benchmark for the volatility of the entire U.S. stock market. The VIX typically has a strong negative correlation with the S&P 500, meaning that increases in the VIX usually correlate to decreases in the S&P 500 due to heightened fears from investors. The VIX is also important for options, as an increase

in the VIX can increase options premiums due to higher implied volatility, while a decrease in the VIX can do the opposite due to lower implied volatility.

The figure below shows average VIX prices for the years 2019-2023. In the time leading up to COVID-19 Pandemic, the VIX had an average price of ~\$15.00, demonstrating a relatively low volatility period in the market. In 2020, the market saw a period of heightened volatility, demonstrated by the average price of the VIX being ~\$30.00. Following 2020, the average price of the VIX was somewhat near the long-term average of ~\$20.00, showing a relatively average period of volatility. In 2022, the average price of the VIX was significantly higher than the long-term average, showing another heightened period of volatility. Lastly, in 2023 the average price of the VIX was again slightly lower than the long-term average of ~\$20.00.

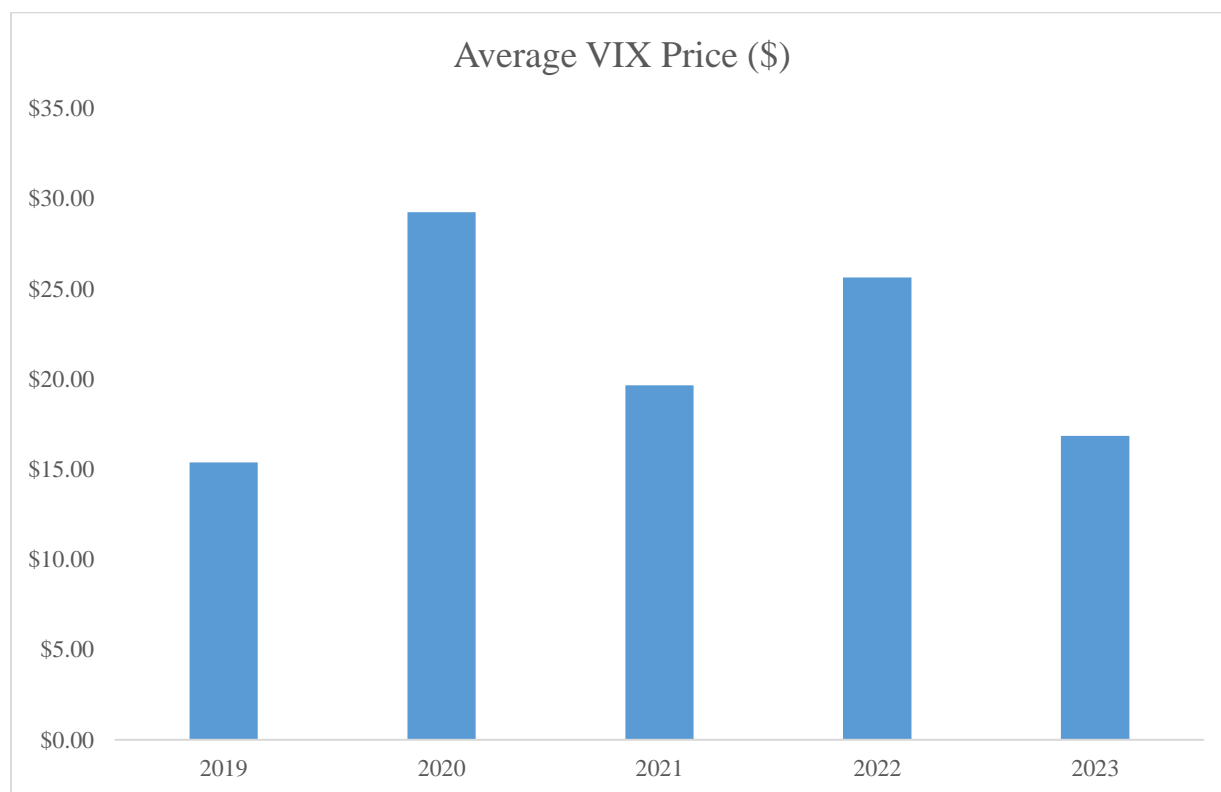


Figure 9: Average VIX Price 2019-2023

Chapter 5

Single Variable Analysis and Results

Regressions were run testing the relationships between each of the independent variables and the relative performance of derivative-trading hedge funds to all hedge funds. During the tests, the statistical significance and correlation between each variable was assessed by analyzing the R-Square, independent variable coefficient, and the P-value. It was expected that retail options trading volume would have the strongest correlation, as derivatives trading hedge funds should be able to capitalize on the losses of retail options traders.

In this data analysis, the hypothesis would be accepted if the data results in a P-value < .10. P-value is used to signal the strength of evidence against the null hypothesis. A P-value greater than .10 indicates that the null hypothesis stands, and that the current hypothesis is invalidated. Overall, this gave better insight into whether any of the variables have a significant effect on the relative performance of derivative- trading hedge funds.

Options Volume and Derivative-Trading Hedge Funds' Relative Performance Regression

The results from the Options Volume and Derivative-Trading Hedge Funds' Relative Performance regression show an insignificant R-square value. This means that the data does not demonstrate a significant correlation between options volume and the relative performance of derivative-trading hedge fund. This could be due to the sample size not being large enough and the existence of outside impacts such as the COVID-19 pandemic impacting derivative-trading

hedge funds' relative performance. The regressions p-value also exceeds 0.10, meaning that the null hypothesis is accepted for the options volume's effect on derivative-trading hedge funds' relative performance and the data does not present as statistical significance. The correlation is also negative, suggesting that as options trading volume increases, derivative-trading hedge funds' relative performance decreases. However, again the data being used in the study is a small sample size, therefore a study with more data over a longer period of time might provide more accurate and statistically significant data.

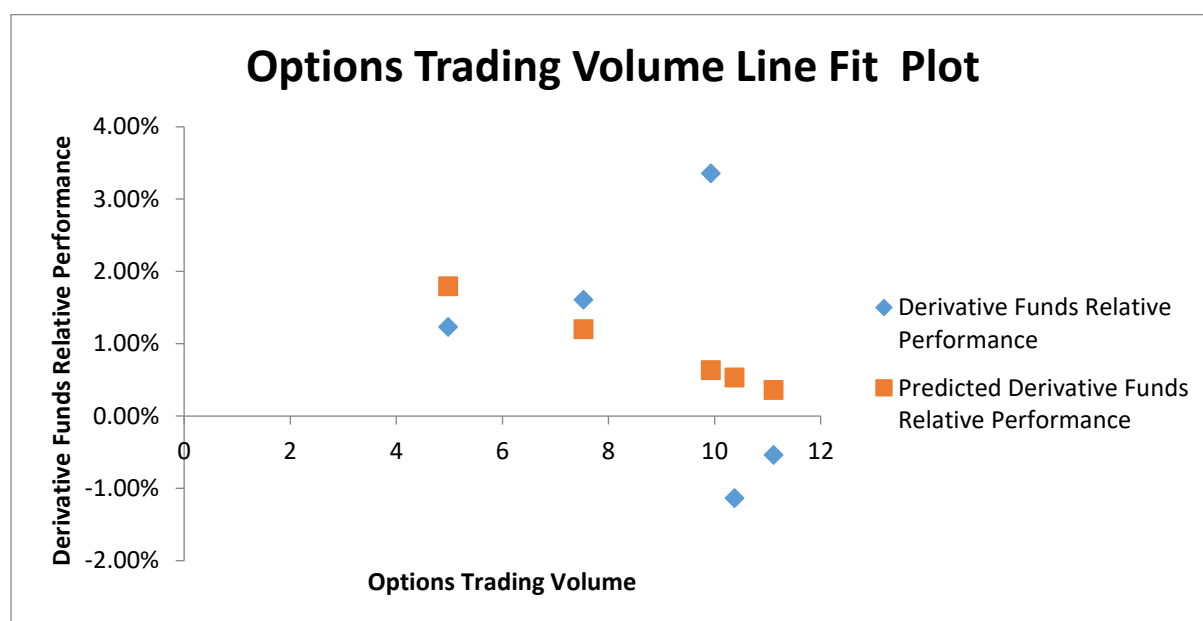


Figure 10: Options Trading Volume vs. Derivative Trading Hedge Funds Relative Performance Regression

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.328702131
R Square	0.108045091
Adjusted R Square	-0.189273212
Standard Error	0.019549717
Observations	5

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.000138888	0.000138888	0.36339872	0.58914701
Residual	3	0.001146574	0.000382191		
Total	4	0.001285462			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.029605309	0.035222105	0.840532079	0.462320117	-0.08248715	0.141697768	-0.08248715	0.141697768
Options Trading Volume	-0.002341424	0.003884082	-0.602825613	0.58914701	-0.014702307	0.010019458	-0.014702307	0.010019458

Figure 11: Options Trading Volume vs. Derivative Trading Hedge Funds Relative Performance Regression Output

Retail Options Volume and Derivative-Trading Hedge Funds Relative Performance Regression

The results from the Retail Options Trading Volume and Derivative-Trading Hedge Funds' Relative Performance regression also shows an insignificant R-square value. The P-value is significantly higher than 0.10, which means that the data is insignificant at a 90% confidence interval, and the null hypothesis is accepted. Similar to the options volume regression, the correlation is negative, which suggests lower relative performance for derivative-trading hedge funds as retail options volume increases. This was a surprise and could warrant further investigation as the study expected this correlation to be positive due to heightened liquidity due to higher options volume, and the expectation that derivatives trading hedge funds could capitalize on retail options traders poor performance metrics mentioned above.

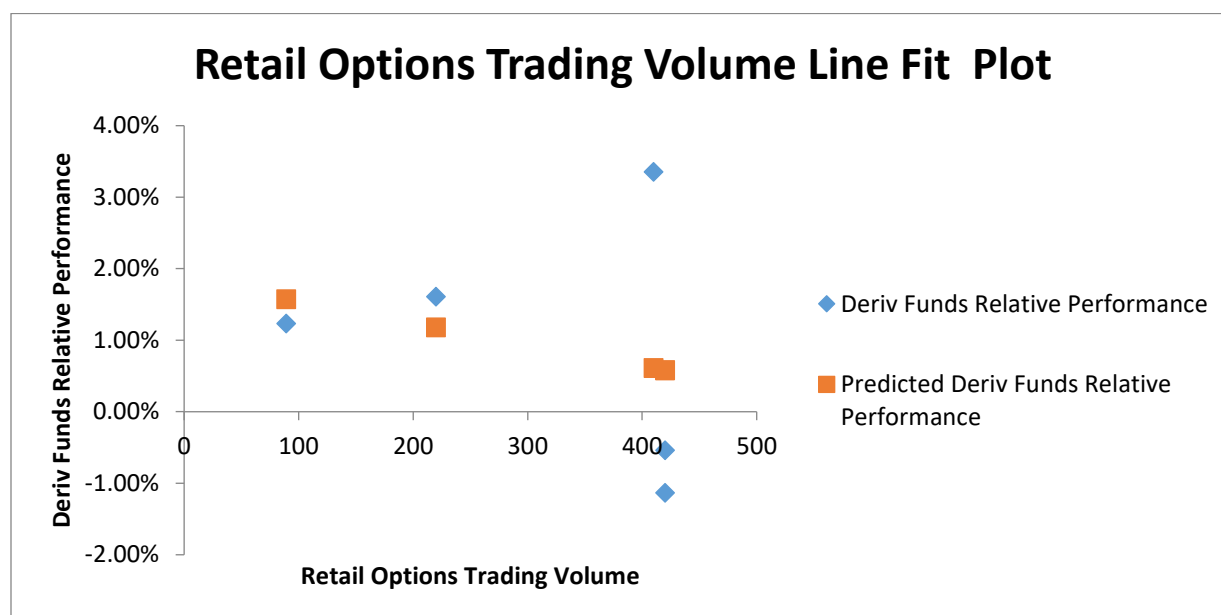


Figure 12: Retail Options Trading Volume vs. Derivative Trading Hedge Funds Relative Performance Regression

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.253081228
R Square	0.064050108
Adjusted R Square	-0.247933189
Standard Error	0.020026052
Observations	5

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	8.2334E-05	8.2334E-05	0.205299799	0.681240644
Residual	3	0.001203128	0.000401043		
Total	4	0.001285462			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.018409367	0.022540477	0.816724838	0.473909076	-0.05332449	0.090143225	-0.05332449	0.090143225
Retail Options Trading Volume	-3.00588E-05	6.63402E-05	-0.453100208	0.681240644	-0.000241183	0.000181065	-0.000241183	0.000181065

Figure 13: Retail Options Trading Volume vs. Derivative Trading Hedge Funds Relative Performance Regression Output

S&P 500 Returns and Derivative-Trading Hedge Funds' Relative Performance Regression

The results from the S&P 500 Annual Returns and Derivative-Trading Hedge Funds' Relative Performance regression show a more significant R-squared statistic at 0.40, which is interesting as prior literature had not found any correlation between heightened S&P 500 returns and better relative performance from derivatives-trading hedge funds. The P-value is lower than all other variables, however it is still above the 0.10 threshold, meaning the data is insignificant and the null hypothesis is accepted. The correlation is also positive, indicating that as S&P 500 returns increase, derivative-trading hedge funds' relative performance should also increase. This presents a possible correlation that warrants studying with a larger dataset in the future.

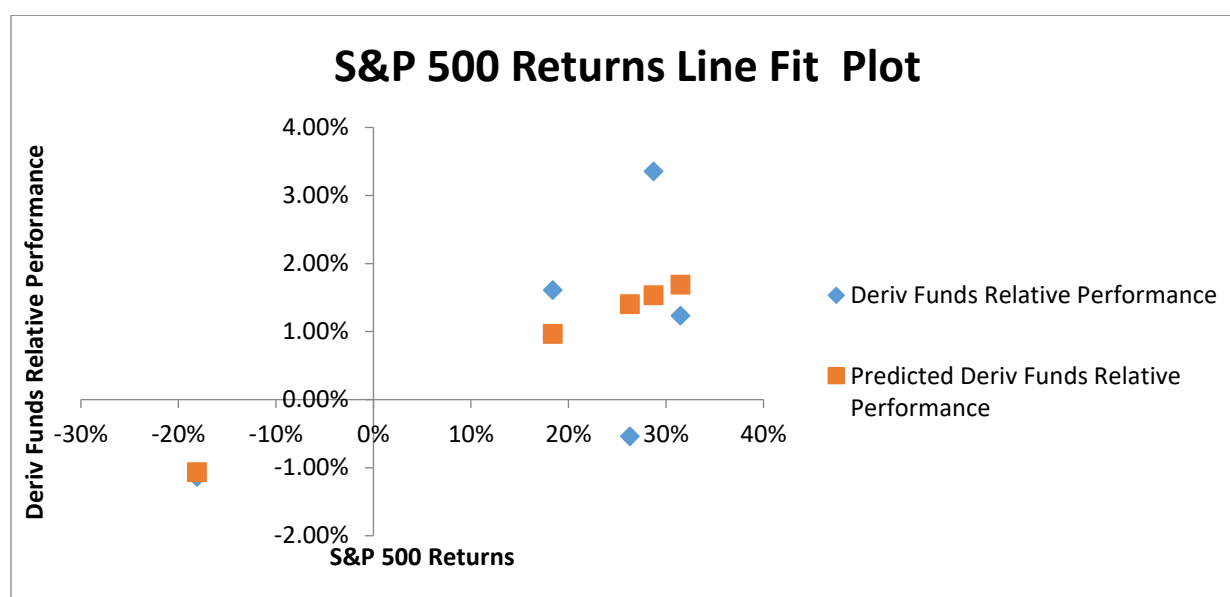


Figure 14: S&P 500 Returns vs. Derivative Trading Hedge Funds Relative Performance Regression

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.632849249
R Square	0.400498172
Adjusted R Square	0.200664229
Standard Error	0.016027445
Observations	5

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.000514825	0.000514825	2.004154881	0.251827275
Residual	3	0.000770637	0.000256879		
Total	4	0.001285462			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-0.000606937	0.009888506	-0.061378022	0.954918427	-0.032076575	0.030862701	-0.032076575	0.030862701
S&P 500 Returns	0.05556567	0.039250113	1.415681773	0.251827275	-0.069345708	0.180477047	-0.069345708	0.180477047

Figure 15: S&P 500 Returns vs. Derivative Trading Hedge Funds Relative Performance Regression Output

Average Annual VIX Price and Derivative-Trading Hedge Funds' Relative Performance Regression

The results from the VIX Index Average Price and Derivative-Trading Hedge Funds' Relative Performance regression show a non-statistically significant R-square value at .004, demonstrating an insignificant explanatory relationship between the two variables. One possible contributing factor to this could be that the average annual VIX price does not consider the spikes in index for short periods of time. While it shows an annual average, short yet important peaks in the VIX could have significant impacts on derivative-trading hedge fund performance, which would not have been properly considered with the metric used. The P-value for the test also does not exceed 0.10, meaning that the null hypothesis is again accepted. The regression output showed negative correlation between the VIX index's average price and derivative-

trading hedge funds' relative performance, suggesting that the higher the average price of the VIX that year, the lower the derivative-trading funds' relative performance will be. However given how weak the correlation is, it would require a larger sample size to fully evaluate the correlation.

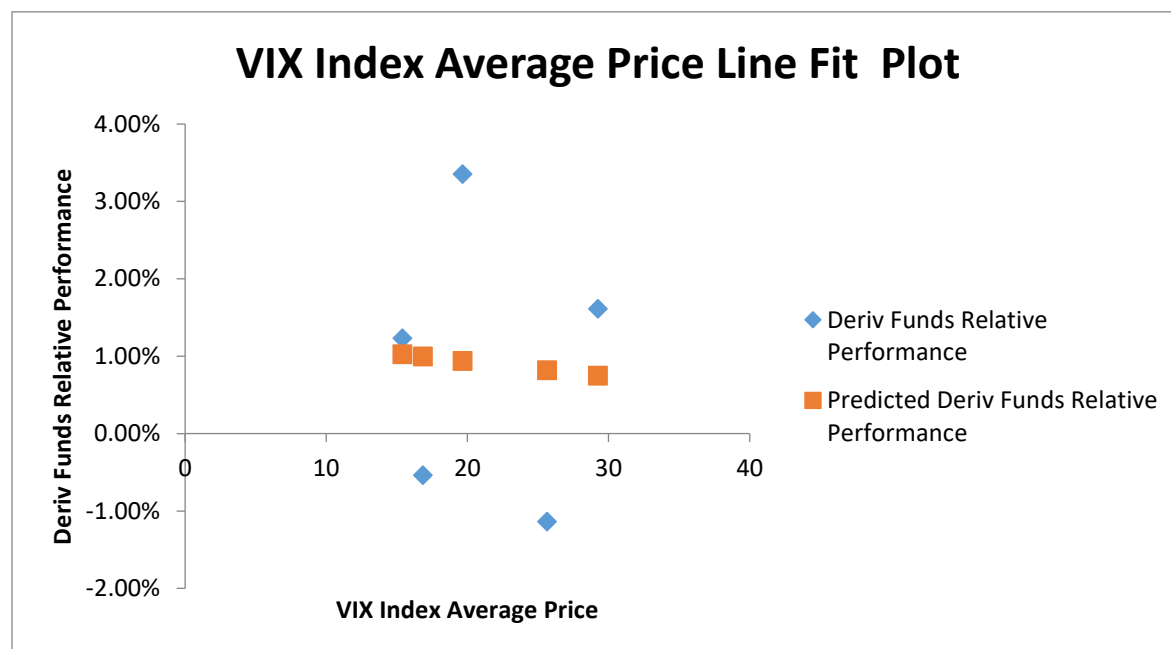


Figure 16: VIX Index Average Price vs. Derivative Trading Hedge Funds Relative Performance Regression

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.065494051
R Square	0.004289471
Adjusted R Square	-0.327614039
Standard Error	0.020655494
Observations	5

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5.51395E-06	5.51395E-06	0.012923849	0.916670039
Residual	3	0.001279948	0.000426649		
Total	4	0.001285462			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.013284176	0.038484497	0.345182537	0.752741782	-0.109190668	0.13575902	-0.109190668	0.13575902
VIX Index Average Price	-0.000198855	0.001749201	-0.113683106	0.916670039	-0.005765591	0.005367882	-0.005765591	0.005367882

Figure 17: VIX Index Average Price vs. Derivative Trading Hedge Funds Relative Performance Regression Output

Chapter 6

Discussion of Further Analysis and Shortcomings

Further Analysis Potential

The results of the experiment would have been much more significant if there was more data on retail options trading volume, allowing the study to have a longer time frame and more data points. If there was potentially a database which tracked retail options trading and the volume at which it was growing, this could be a valuable addition to the literature on retail options trading. Due to the way retail volume of options was calculated, and how new the trend is, there was not enough data to field a conclusive statistically significant study. There is significant potential in the future to rerun this study in 5 to 10 years if retail trading of options continues to grow at a rapid pace. Other methods are also available to compare derivative-trading hedge funds' relative performance to the VIX index which could be explored further. Because the negative correlation was unexpected, further study could be helpful to fully understand the reasons for this. Additionally, the correlation between the S&P 500 annual returns and the derivative-trading hedge funds' relative performance could warrant further study as the output for that regression seemed to indicate there was at least some link between the two variables. While it was not statistically significant, running a longer-term study on those two variables could provide valuable insights. There may also be merit to running a study with derivatives-trading hedge funds which only trade indices or equity options. Prior literature suggests that

retail options traders are very fond of 0DTE options and options that have upcoming high volatility events, so there could be potential to isolate these types of funds to see if they have seen higher returns as retail trading of options has increased.

Shortcomings

A major shortcoming of this experiment is the time frame over which the study was conducted. This was largely due to the recency of the increased popularity in retail trading of options. Because data on retail options trading volume prior to 2019 is very limited, and the data that exists represents a much smaller sample size compared with the recent level of retail options trading, the likelihood of a statistically significant study was greatly reduced. Also since retail options trading is relatively new, the number of new trends such as the 0DTE options, is relatively small. It will be interesting to see what retail traders do next with options and if that has any impact on the focus of this study.

Another addition to this experiment that could provide more information is analysis of a multivariate regression model with the most statistically significant variables. By using a multivariate regression model, there could be more significant conclusions drawn behind movements in the relative performance of derivative trading hedge funds.

Lastly, there is ample opportunity to introduce a larger selection of explanatory variables with longer-term data that could provide more comprehensive results and conclusions.

If the hypothesis of this study were to be correct, that could have some serious implications to the retail trading of options and hedge funds. This would mean that retail traders

are not only performing poorly in the market due to incorrect directional picks, but also could be targeted by hedge funds. There is also an argument to be made that if this is the case, then there should be more protection for retail options traders. Retail options traders just recently were given the ability to trade the volatile contracts, so maybe some restrictions should be in place preventing uninformed retail traders from participating in this market since they are at such a huge disadvantage.

Chapter 7

Conclusion

Retail options traders are seeing substantial, growing losses in the market. Between February 2021 and February 2023 retail traders lost \$70 million. Prior literature suggests that these losses are primarily due to options premiums, however there were also significant losses due to poor positioning (Beckmeyer, Branger, and Gayda). This presents the opportunity for other market participants to profit off these losses. Specifically, in this paper, we analyze derivatives-trading hedge funds' relative performance to determine whether or not derivative-trading hedge funds are the market participants who are profiting off of these losses. The paper uses the Lipper TASS database to generate a database of hedge fund returns for derivatives-trading hedge funds and all hedge funds which reported data between 2019-2023.

The results of the study are statistically insignificant; however, this is likely due to the size and limited time frame of the sample which made it more difficult to see trends. The significance of the results could be improved if retail options trading volume data was available for a longer time frame and could be studied over a period of 10-20 years. Overall, the data did show some signs that derivatives trading hedge funds relative performance could be linked to the S&P 500 returns, which could warrant some further studies. However this was again statistically insignificant and would need to be further evaluated with a larger data set to determine if the trends are accurate. Moreover, studies in the future could focus more on the specificity of the dataset being fielded. If studies in the future could isolate hedge funds which trade index options, or options more heavily traded by retail options traders such as 0DTE options, there could be

more statistically significant data. Retail options trading is generally a new development in how retail traders are choosing to spend their time investing, warranting further analysis into their strategies.

BIBLIOGRAPHY

- Aragon, G. O. (2007). Share restrictions and asset pricing: Evidence from the hedge fund industry. *Journal of Financial Economics*, 83(1), 33–58. <https://doi.org/10.1016/j.jfineco.2005.11.001>
- Aragon, G. O., & Martin, J. Spencer. (2012). A unique view of hedge fund derivatives usage: Safeguard or speculation? *Journal of Financial Economics*, 105(2).
<https://doi.org/10.1016/j.jfineco.2012.02.004>
- Barber, Brad M and Terrance Odean (2008), “All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors.” *The review of financial studies*, 21
- Beckmeyer, Heiner and Branger, Nicole and Gayda, Leander, Retail Traders Love 0DTE Options... But Should They? (March 30, 2023).
<http://dx.doi.org/10.2139/ssrn.4404704>
- Branger, N., & Breuer, B. (2008). *The Optimal Demand for Retail Derivatives* (SSRN Scholarly Paper 1101399). <https://doi.org/10.2139/ssrn.1101399>
- Bryzgalova, Svetlana and Pavlova, Anna and Sikorskaya, Taisiya, Retail Trading in Options and the Rise of the Big Three Wholesalers (September 3, 2023). *Journal of Finance* forthcoming,
<http://dx.doi.org/10.2139/ssrn.4065019>
- Chen, Y. (2011). Derivatives use and risk taking: Evidence from the hedge fund industry. *Journal of Financial and Quantitative Analysis*, 46(4), 1073–1106.
<https://doi.org/10.1017/S0022109011000238>
- de Silva, Tim and Smith, Kevin and So, Eric C., Losing is Optional: Retail Option Trading and Expected Announcement Volatility (June 8, 2023).
<http://dx.doi.org/10.2139/ssrn.4050165>

- Ding, B., & Shawky, H. A. (2007). The performance of hedge fund strategies and the asymmetry of return distributions. *European Financial Management*, 13(2), 309–331.
<https://doi.org/10.1111/j.1468-036X.2006.00356.x>
- Emm EE, Gay GD, Ma H, Ren H. Effects of the Covid-19 pandemic on derivatives markets: Evidence from global futures and options exchanges. *Journal of Futures Markets*. 2022 May;42(5):823–51.
doi: 10.1002/fut.22310
- Hammer, D. what is options trading? | Wealthsimple. Published July 6, 2020. Accessed April 5, 2023. <https://www.wealthsimple.com/en-ca/learn/what-is-options-trading>
- Kaniel, R., & Wang, P. (2022). Unmasking mutual fund derivative use. Advanced online publication.
<https://doi.org/10.2139/ssrn.3692838>
- Li K. The effect of option trading. *Financial Innovation*. 2021;7(1):65. doi:[10.1186/s40854-021-00279-5](https://doi.org/10.1186/s40854-021-00279-5)
- Lipson, M. L., Tomio, D., & Zhang, J. (2023). *A Real Cost of Free Trades: Retail Option Trading Increases the Volatility of Underlying Securities* (SSRN Scholarly Paper 4383463). <https://doi.org/10.2139/ssrn.4383463>
- McCarthy, D. F., & Wong, B. M. (2020). A performance update—Hedge funds versus hedged mutual funds: An examination of equity long–short funds. *The Journal of Alternative Investments*, 23(2), 35–47. <https://doi.org/10.3905/jai.2020.1.103>
- Oliinyk, V., Burdenko, I., Volynets, O., & Yatsenko, V. (2019). Organized derivatives market and economical growth: Relationship and impact. *Periodicals of Engineering and Natural Sciences (PEN)*, 7(2), Article 2. <https://doi.org/10.21533/pen.v7i2.585>

Poitras, G. (2009). The Early History of Option Contracts. In: Hafner, W., Zimmermann, H. (eds)

Vinzenz Bronzin's Option Pricing Models. Springer, Berlin, Heidelberg.

https://doi.org/10.1007/978-3-540-85711-2_24

Rizner, B. (2023, March 15). Retail Volume and the 0-DTE Options Trading

Frenzy. SpiderRock. <https://www.spiderrock.net/retail-volume-and-the-0-dte-options-trading-frenzy/>

Understanding VIX or Volatility Index. (n.d.). Retrieved March 12, 2024,

from <https://www.td.com/ca/en/investing/direct-investing/articles/understanding-vix>

2024 Options Outlook | Nasdaq. (n.d.). Retrieved March 11, 2024,

from <https://www.nasdaq.com/articles/2024-options-outlook>

EDUCATION

The Pennsylvania State University / Schreyer Honors College

Smeal College of Business | Intended B.S. in Finance

College of the Liberal Arts | Intended Minor in Chinese Language

Important Classes Taken | Finance, Marketing, Accounting, MIS (Excel), Management, Supply Chain Management

University Park, PA

Graduation May 2024

Penncrest High School

Media, PA

RELEVANT EXPERIENCE

SVB Securities

Investment Banking Summer Analyst

Charlotte, NC

Jun 2023 – Sep 2023

- Supported the Biopharma and Pharma Services teams across multiple transactions; received 2024 full-time offer
- Built detailed financial valuations to evaluate at what price the client should consider a bid
- Drafted client discussion materials and communicated with clients to execute financing or merger transactions
- Engaged in management discussions, due diligence meetings, and strategic alternative conversations for clients
- Led calls on a road show with potential investors for a client in need of equity financing

Nittany Lion Fund

Director of PSIA | Lead Analyst of Healthcare

University Park, PA

Dec 2021 – Present

- Trusted to organize meetings for the Nittany Lion Fund's feeder organization which has around 200 members every semester
- Spearheaded investment decisions in the \$2.00 MM Healthcare sector of the Nittany Lion Fund
- Gained experience working as an analyst in the Consumer Staples Sector for a student run hedge fund
- Assessed various securities and pitched investments in selected companies to be added to the Nittany Lion Fund
- Obtained familiarity with fundamental valuation of equities using discounted cash flow analysis and comparable ratios

Penn State Fixed Income Association

Member

University Park, PA

Aug 2020 – Dec 2021

- Evaluated non-investment grade bonds to deepen understanding of fixed income markets
- Familiarized with fundamental debt valuation analysis using discounted cash flow modelling incorporating relevant bond risk premiums

LEADERSHIP EXPERIENCE

Penn State Scholar Assistant

Team Member

University Park, PA

Aug 2021 – May 2022

- One of four students selected for highly competitive Scholar Assistant positions winning a housing scholarship and stipend
- Programmed events for members to build a better sense of community in the Living Learning Special Living Option
- Fall semester Team Lead responsible for programming events, coordinating with residence life, and team communications
- Hosted two successful welcome events which have been recommended to become recurring events to be hosted by future scholars teams
- Learned leadership and time management skills while balancing a heavy academic workload

Saxbys

Team Lead

University Park, PA

Jun 2022 – August 2023

- Trusted as a leader within both the front of house and back of house in the cafe
- Gained familiarity with each team members strengths to strengthen efficiency and collaboration within the cafe
- Interacted with guests to make sure each individual guest had a positive experience in the café
- Passed the ServSafe exam and gained the certification, demonstrating a commitment to safe food handling

HONORS, SCHOLARSHIPS, & INTERESTS

- **High School Honors and Scholarships:** AP Scholar with Distinction, National Honors Society Member, Academic Excellence Award after junior year, National World Language Honor Society, Math Honor Society, National World History Honor Society, Student Athlete Award (Fall 2016, 2017; Spring 2017, 2018), Honor Roll
- **College Honors and Scholarships:** Schreyer Honors Scholar, Dean's List 7/7 semester
- **Interests:** Soccer, basketball, frisbee golf, snowboarding, Spikeball, traveling, Japanese cooking