OneChicago

Via Electronic Submission

April 27, 2020

Vanessa A. Countryman
Secretary
Securities and Exchange Commission
100 F. St. NE
Washington, D.C. 20549

Christopher Kirkpatrick
Secretary of the Commission
Commodity Futures Trading Commission
Three Lafayette Centre
1155 21st Street NW
Washington, D.C. 20581

**Re: Customer Margin Rules Relating to Security Futures**

Dear Ms. Countryman and Mr. Kirkpatrick:

OneChicago, LLC ("OneChicago") appreciates the opportunity to comment on the Commodity Futures Trading Commission's ("CFTC's") and the Securities and Exchange Commission's ("SEC's") proposed rule for Customer Margin Rules Relating to Security Futures. Based on discussions with SEC staff, we have prepared two documents; a set of statistical analyses which tests the proposition that single stock futures ("SSFs") and equity options are not comparable which is included as Attachment A and a comparison between option strategies and SSFs that is included as Attachment B.

If you have any questions of comments regarding this submission, please feel free to contact me at any time by phone at [redacted] or through email at [redacted]

Sincerely,

Thomas G. McCabe

Thomas G. McCabe
Chief Regulatory Officer
OneChicago, LLC

# Executive Summary

The following five empirical analyses were conducted to test the theory that Single Stock Futures ("SSFs") and equity options are not comparable and do not trade interchangeably.

Analysis 1: Looks at the trading patterns of Cboe S&P 500 Options ("SPX Options") and CME E-mini S&P 500 futures ("E-mini") to see if there is evidence that there is regulatory arbitrage between products based on margin level. Specifically, the analysis looks at whether changes in the E-mini margin rate caused changes in the ratio of SPX options to E-mini futures. The results are evaluated using both hypothesis testing and confidence intervals.

Analysis 2: Examines every STARS® (Security Transfer and Return Spreads) position created at OneChicago in 2018 and 2019 to observe how the positions were adjusted by market participants after they initially established the positions. This analysist tests the claim that market participants only use STARS to establish and maintain delta-neutral positions.

Analysis 3: Examines differences in 1) average contracts per trade, 2) average notional value per trade , and 3) average percentage of contracts delivered for equity options, SSFs, and STARS. The means in each category are then hypothesis tested to see if there is a statistically significant difference between the means.

Analysis 4: Compares sensitivity in stock prices between SSFs and equity options. Specifically tests to see if there is a statistically significant correlation between changes in stock price and changes in Open Interest ("OI") for SSFs and equity options. The correlation coefficients for each product are then evaluated using both a hypothesis test and a confidence interval to see if there is a statistically significant difference between the correlation coefficients.

Analysis 5: Examines whether there is a correlation in trading patterns between SSFs and equity options. Compares changes in Equity option OI to changes in SSF OI for a given underlying security to see if there is a correlation between when the products trade. The sample is both evaluated as a whole and then further broken down into the individual underlying securities used in the sample.

The most significant results and conclusions from each analysis are explained in the Analysis sections of this document. The full explanations of datasets, methodology, and results are explained in the Appendices.

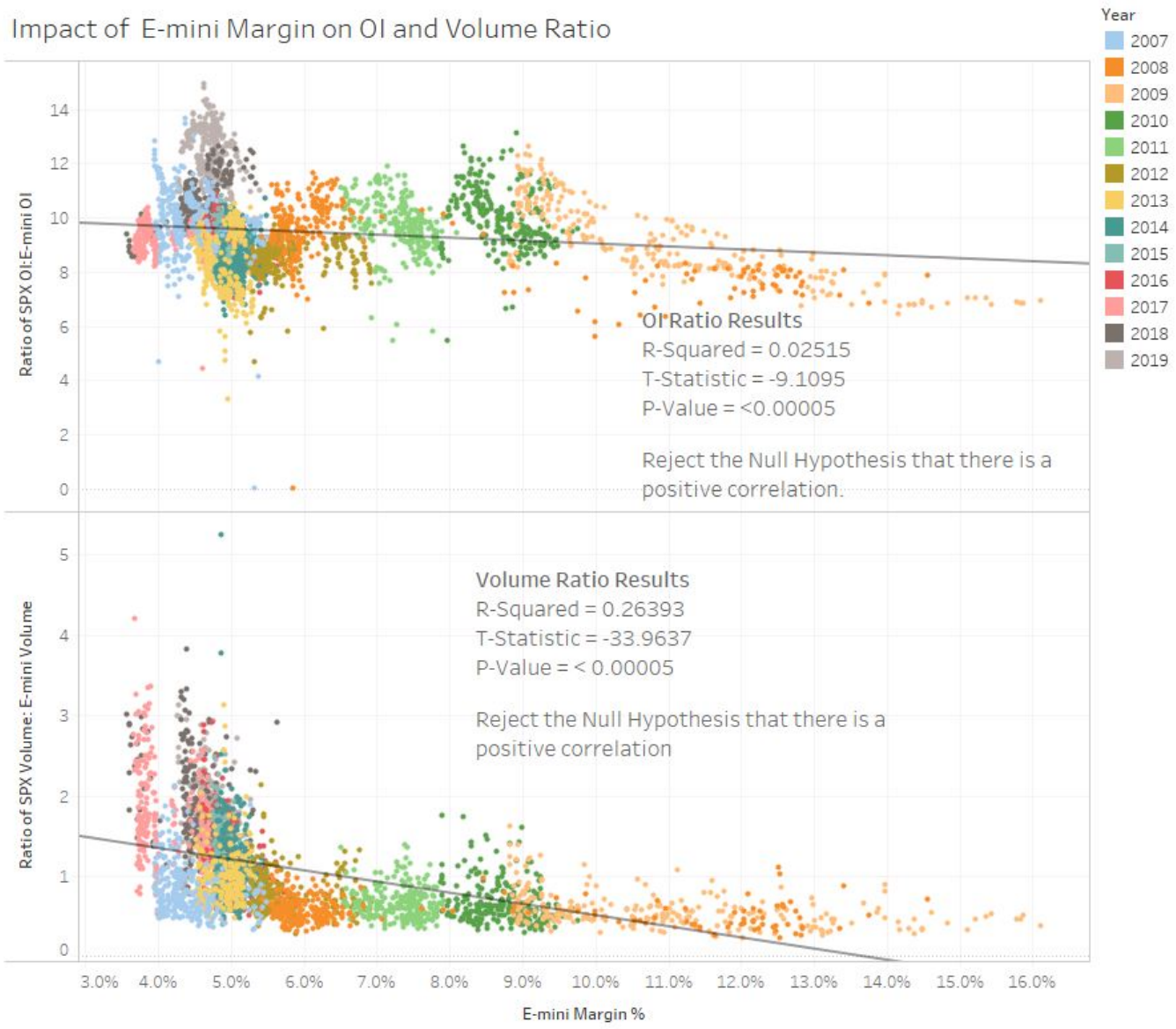
## Contents

# Analysis 1: Effect of Futures Margin on SPX Option trading

One challenge of performing statistical analyses on SSFs is that the data on SSFs is fairly sparse due to low volumes and infrequent trading. To account for this, this analysis compares two products with some of the highest levels of daily volume, open interest, and liquidity of any products in US financial markets. The products chosen for this analysis are CME E-mini futures and Cboe SPX options . If there is no evidence that margin rates cause regulatory arbitrage in these products, it should also follow that the same is true for SSFs and equity options.

While SPX options have a constant 8% maximum initial margin in a portfolio margin account,[1] E-mini initial margins are risk-based and fluctuate. As a result, it is possible to see how changes in the E-mini margin impact relative levels of SPX trading. Of particular interest is the period during the Financial Crisis from 2008-2010 when the level of E-mini margin was higher than 8% and thus higher than SPX margin. If the products are comparable, there should be significantly more SPX trading during this period relative to E-mini trading than at other periods of time. To test this, the analysis examines how E-mini margin rates impact the ratio of SPX options OI to E-mini OI and SPX volume to E-mini volume. If there are more SPX options relative to the number of E-mini futures, then the ratio will be higher. If the products were comparable and margin rates were a source of regulatory arbitrage from one product to the other, we would expect the ratio to rise during periods of time when E-mini margins rise.

[1] The SEC approved a pilot program for portfolio margining of Cboe options which went into effect on April 2, 2007. Exchange Act Release No. 54919 (December 12, 2006). This program was made permanent on July 29, 2008. Exchange Act Release No. 58243 (July 29, 2008).




In both cases we can reject the null hypothesis that there is a positive correlation between the SPX/E-mini ratio and E-mini margin rates.

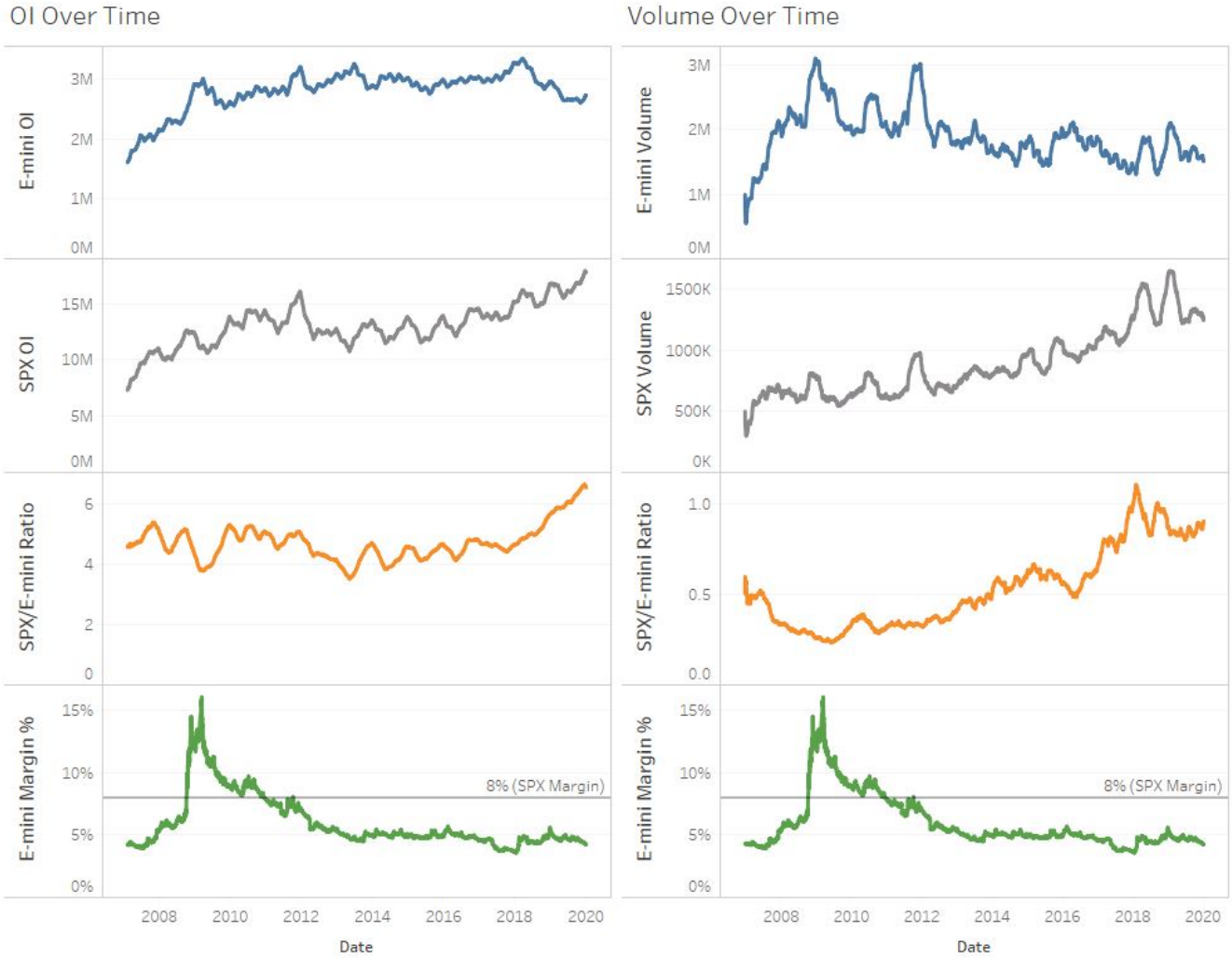
The confidence intervals for the slopes of both correlation lines confirm the result that there is not a positive correlation.

| Statistic | Test Stat | Standard Error | 95% Confidence Interval | 99% Confidence Interval |
|---|---|---|---|---|
| OI Ratio Slope | -10.871 | 1.193 | (-13.209, -8.533) | (-13.949, -7.793) |
| OI Ratio R Coefficient | -0.159 | 0.018 | (-0.194, -0.123) | (-0.205, -0.112) |
| Volume Ratio Slope | -13.917 | 0.410 | (-14.721, -13.113) | (-14.975, -12.859) |
| Volume R Coefficient | -0.514 | 0.018 | (-0.549, -0.478) | (-0.560, -0.467) |

In all cases the upper bounds of both the 95% and 99% confidence intervals are well below zero.

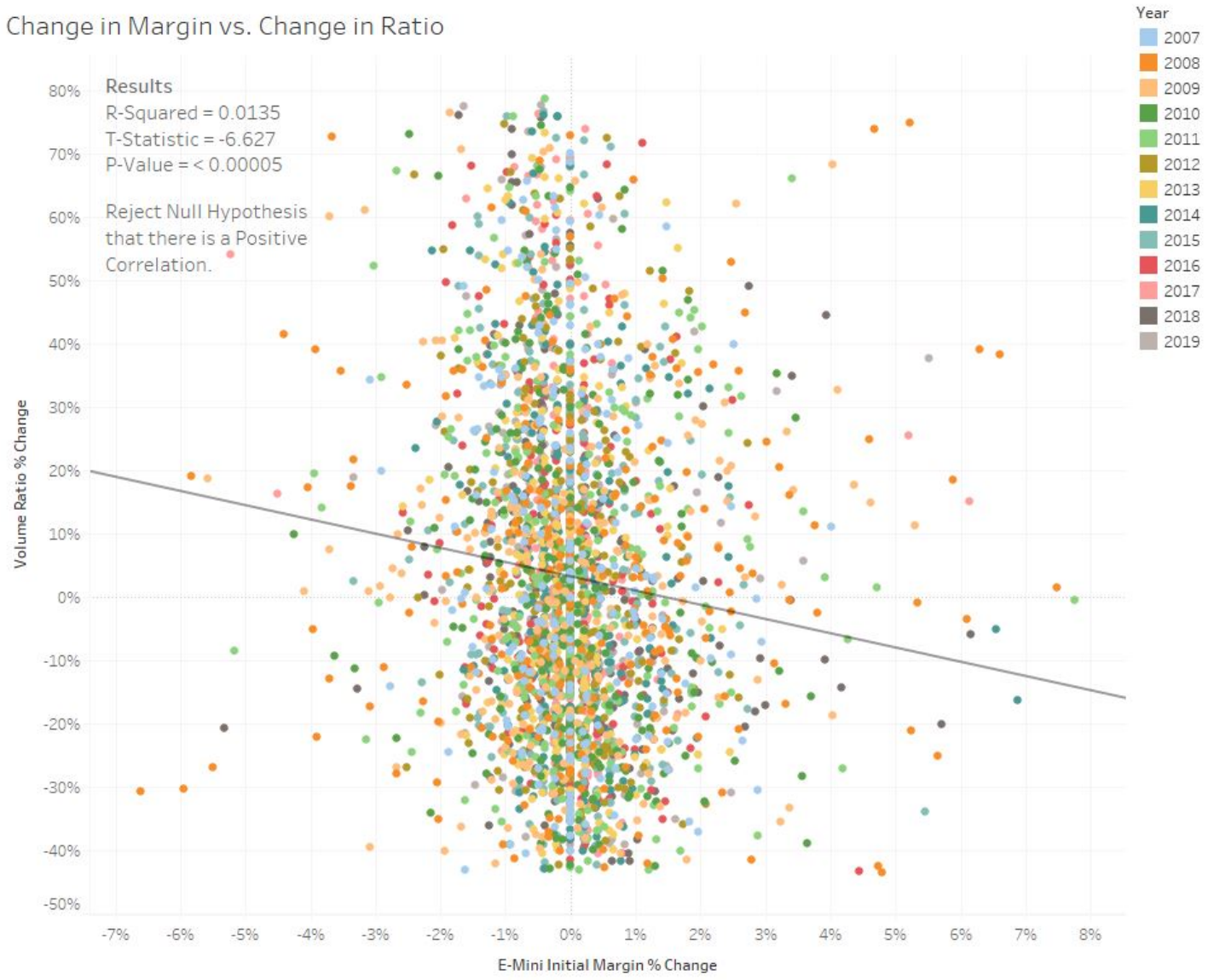
If regulatory arbitrage existed between the products, and they traded interchangeably, more SPX options should trade relative to E-mini futures when E-mini margins are higher (increased SPX/E-mini ratio). This is clearly not what the data shows.

Interestingly, the data shows a statistically significant negative correlation between the OI and Volume Ratios and the E-mini margin rate. This correlation explains 2.5% of the variation in the data for OI and a surprising 26% of the variation in volume. This shows that SPX trading decreases when E-mini margin rates rise. A possible explanation for this result is that SPX volumes have been gradually increasing over the last decade.




E-mini margins were lowest during the latter half of the 2010s, but this was also the time period when SPX OI and volume increased the most. It is not likely that the E-mini margins caused the increase in SPX volumes as E-mini margins were relatively flat during this period. This makes it likely that long-term factors not accounted for in the model are causing SPX trading to increase and that this is causing the negative correlation. This also explains why the correlation was stronger for volume than the correlation for OI. The spike in the SPX/E-mini ratio is much more noticeable in volume than in OI because E-mini volumes also declined during that period. That an unaccounted-for factor is causing the negative correlation is also made more likely by how clustered the data is by year.

To account for this, we ran the test a second time, instead comparing on the daily change in margin with the daily change in the SPX/E-mini Volume ratio. By looking at the changes from one day to the next, this should eliminate any long-term effects that external factors have upon the data. The results of this analysis are below.




The data in this analysis is no longer clustered by year, showing that it successfully corrected for the long-term trends that were influencing the dataset. The data still allows us to reject the null hypothesis that there is a positive correlation and conclude that SPX options and E-mini futures do not trade interchangeably. However, we still have a statistically significant negative correlation. In this case, the correlation is much weaker. It explains only 1.3% of the change in volume instead of 26% of the change. However, as shown in the scatterplot above, the datapoints are very nearly randomly distributed.

When run for OI instead of volume the results are similar:

| Statistic | Value |
|---|---|
| R-Squared | 0.0026 |
| T-Statistic | -2.878 |
| P-Value | 0.0020 |

We can reject the null hypothesis that there is a positive correlation. Though it is statistically significant, the negative correlation does not even explain 0.3% of the variation in the dataset. Any residual negative correlation is likely due to the wider options spreads that occur when volatility increases, as higher volatility would be closely correlated with E-mini

margin rates. The wider spreads could cause a decline in SPX trading during periods of high volatility. It is also possible that the negative correlation only appears significant because of the large sample size used in the analysis.

The confidence intervals for both analyses are below. Again, they confirm the hypothesis testing results and allow a conclusion that there is a 99% or greater chance that the correlation is not positive.

| Statistic | Test Stat | Standard Error | 95% Confidence Interval | 99% Confidence Interval |
|---|---|---|---|---|
| OI Ratio Slope | -0.257 | 0.089 | (-0.431, -0.083) | (-0.487, -0.027) |
| OI Ratio R Coefficient | -0.051 | 0.018 | (-0.086, -0.015) | (-0.097, -0.004) |
| Volume Ratio Slope | -2.482 | 0.374 | (-3.215, -1.749) | (-3.447, -1.517) |
| Volume R Coefficient | -0.514 | 0.018 | (-0.549, -0.478) | (-0.560, -0.467) |

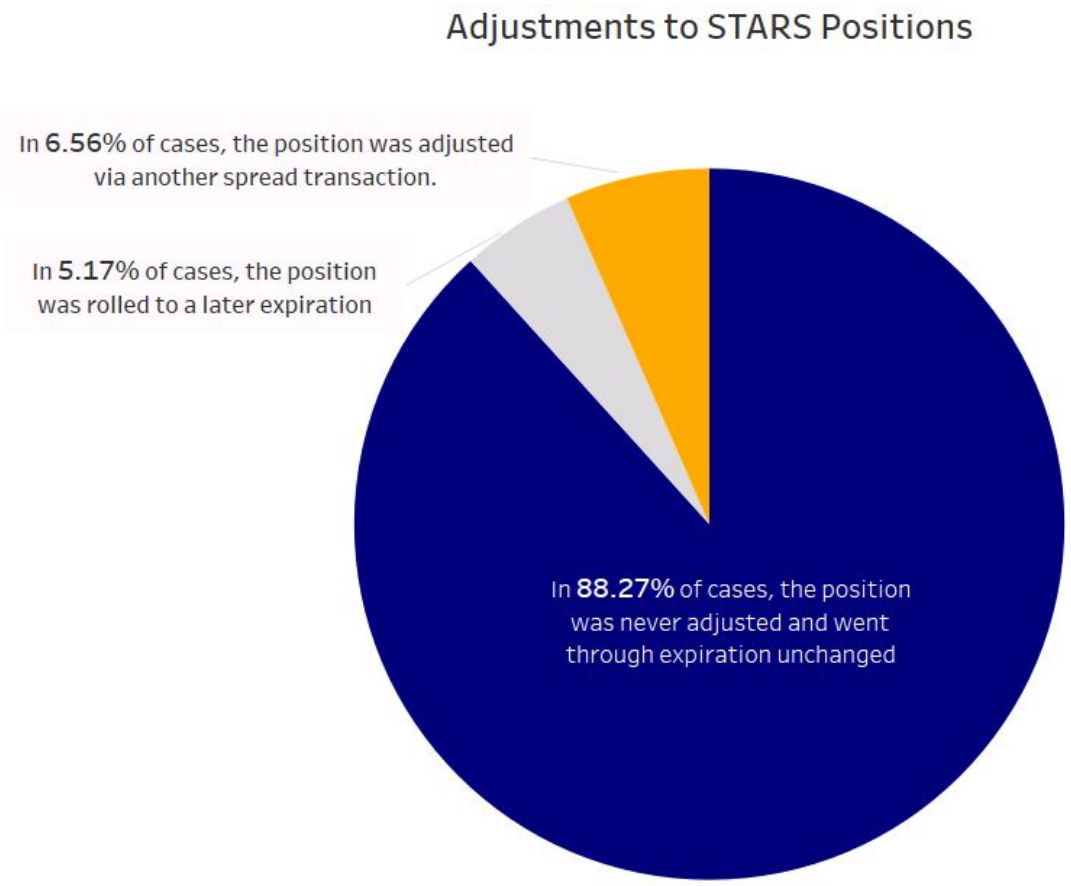
**It should be clear from this analysis that E-mini margin rates do not cause regulatory arbitrage between SPX options and E-mini futures. Future's margin rates do not impact option trading patterns.** The length of period over which the analysis was conducted as well as the high levels of volume, open interest, and liquidity in SPX and E-mini products should instill a great level of confidence in the statistical robustness of the result.

These results support a conclusion that risk-based margining will not cause regulatory arbitrage between SSFs and equity options. It would be difficult to argue that while SSFs and equity options are comparable products, SPX options and E-mini futures are not.[2]

[2] In fact, SSFs and equity options are less comparable than SPX options and E-mini futures for three reasons:
1) OneChicago SSFs have No Dividend Risk by adjusting for all dividends and distributions whereas equity options have dividend risk. This creates a difference in risk profile between SSFs and equity options. On the other hand, both SPX options and E-mini futures have the same dividend/distribution treatment, so there is no difference in risk profile in this respect.
2) Equity Options on individual securities are American-style options meaning that they have assignment risk. SSFs, as a future, cannot be delivered early. This creates a difference in risk profile between SSFs and equity options. This difference does not exist between SPX options and E-mini futures because SPX options are European-style and can only be exercised on their maturity date.
3) Because SSFs are physically settled, market participants use SSFs to transfer securities as part of a security financing transaction. Equity options cannot be used for securities finance because of pin risk, dividend risk, and assignment risk. This creates a distinction in what the products can be used for. SPX options and E-mini futures are both cash settled, so neither product has the ability to be used as a securities financing tool. Because SSFs and equity options are less comparable than SPX options and E-mini futures, it becomes even less likely that risk-based SSF margins would cause arbitrage with equity options.

# Analysis 2: Adjustments to STARS positions

This analysis examine how STARS positions are adjusted after the initial transaction. As OneChicago has explained in our comment letters,[3] participants entering STARS transactions are not looking for exposure to the underlying stock. This means that after entering a STARS position, one would not expect market participants to execute a transaction that would change their exposure to the underlying security. Outright SSF transactions change exposure to the stock whereas spread transactions, either to change the size of a position or to roll the position to a further expiration, do not change exposure. The below analysis followed each STARS position established on OneChicago in 2018-2019 and recorded how and if each position was adjusted over time. The hypothesis is that there should be little or no adjustments to STARS positions which change exposure to the underlying security. This hypothesis is supported by the data.




There was not a single instance where after entering a STARS transaction, the position was adjusted via a traditional SSF contract. **100%** of the time, market participants never changed their exposure to the underlying stock through a SSF after executing a STARS.

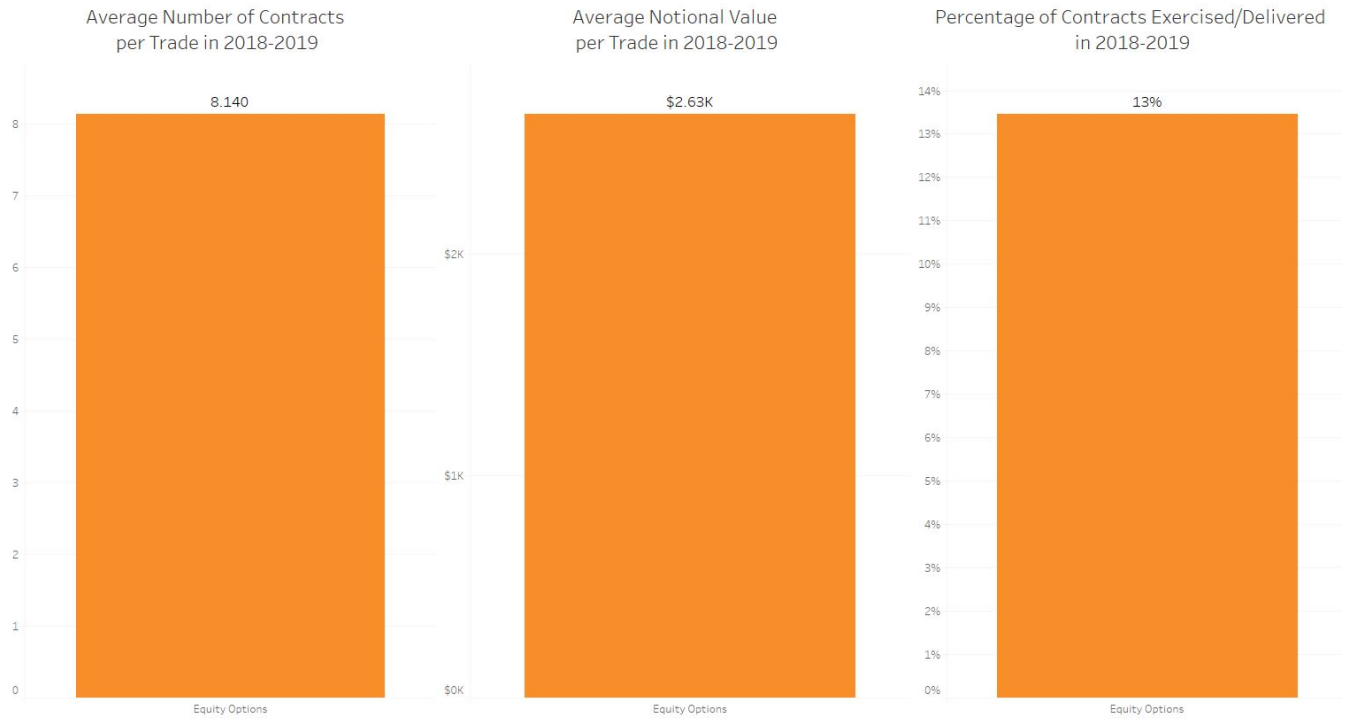
Most STARS are never adjusted. Among those that were, the adjustments were not used to alter exposure to the underlying stock. There are no options used this way. The fact that there is not even a single instance where a STARS was adjusted to impact exposure to the underlying security provides strong evidence that STARS are not comparable to options.

[3] See OneChicago Comment Letter by Thomas G. McCabe, August 26, 2019. https://www.sec.gov/comments/s7-09-19/s70919-6021592-191208.pdf

# Analysis 3: Contract Sizes and Delivery Rates

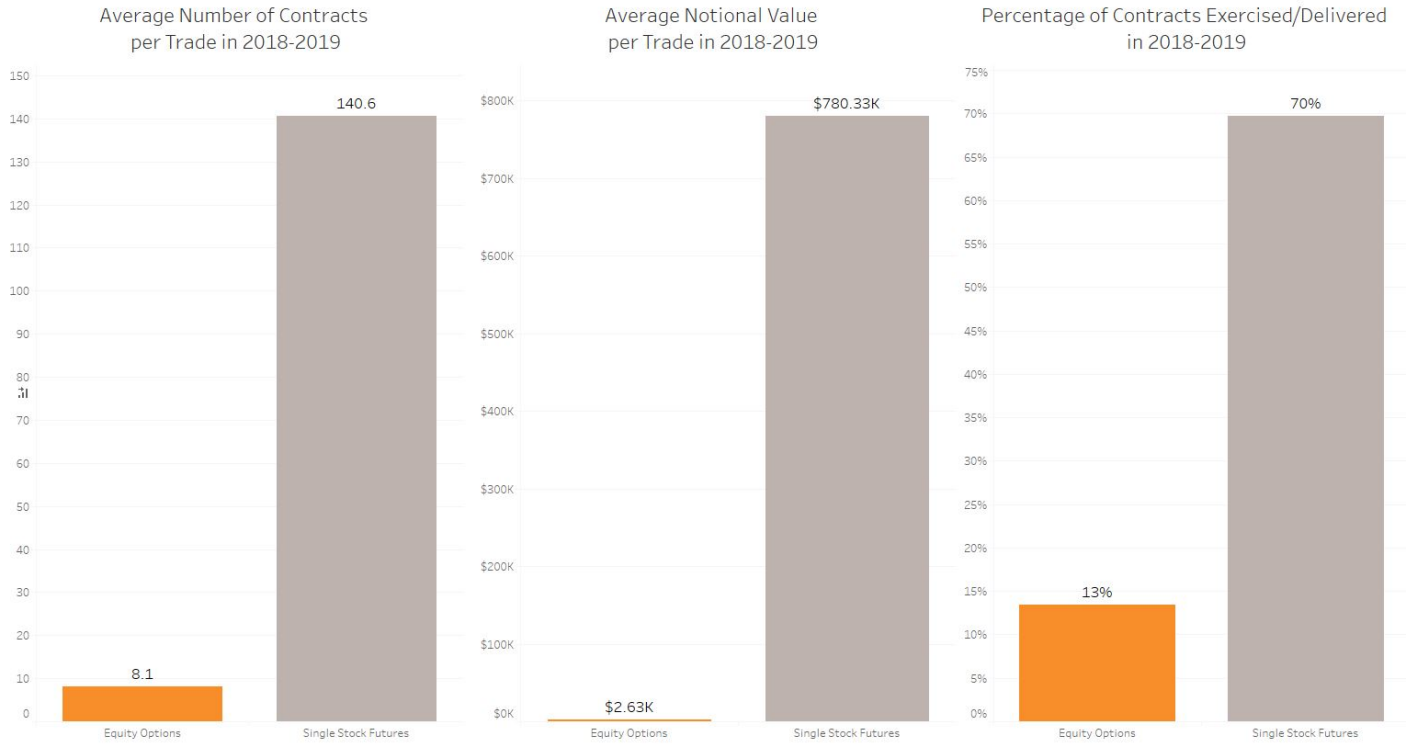
This analysis examines whether equity options and SSFs have different trading patterns. A significant difference in trading patterns provides evidence that the products are used for separate purposes by market participants.

Below are three data categories over 2018-2019: 1) Average Number of Contracts per Trade, 2) Average Notional Value per Trade, and 3) Percentage of Contracts Exercised (options)/Delivered (futures).




In this first visualization, we see the statistics for equity options. On average, just over 8 contracts are traded per transaction with a total notional value slightly over $2,500. About 13% of options are exercised on expiration. Most options are offset prior to expiration or expire worthless as in most circumstances, it is preferable not to take delivery of the underlying stock. The exception is when participants exercise contracts because an upcoming dividend is larger than the remaining time value of the option.

The below visualization shows the same categories compared between options and SSFs:



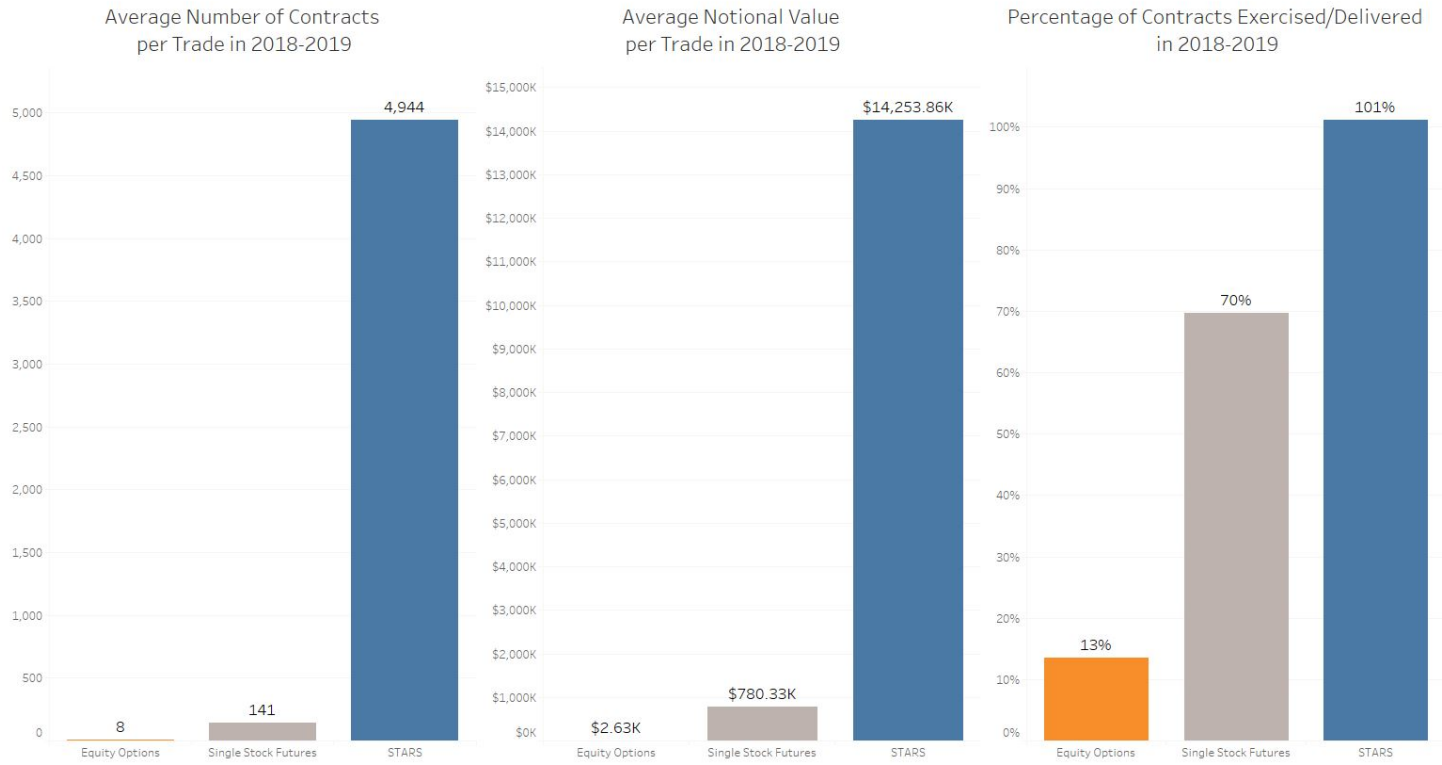

In every category there is a marked contrast between the option and the SSF data. The average number of contracts in an SSF trade is 140 with an average of $780,000 in notional value. Both numbers are at least one order of magnitude greater than in options.

SSFs have a much higher average number of contracts and notional value because of the type of trading that is taking place. Market participants use SSFs for securities financing trades. This means that they are using the SSFs as they would a total return swap ("TRS")[4], equity repo, or stock loan. One side of the SSF trade uses the position to finance equity exposure, in that the participants will establish a position, and hold that position for a significant amount of time. The other side is a pure financing transaction and will hedge their SSF exposure with stock. There are no day traders or high frequency traders in SSFs because SSFs are used as a financing tool.

There is also a much higher percentage of SSF contracts that go through delivery as compared with options. Most market participants enter a SSF position with the intention of taking the contracts through delivery. When a liquidity provider executes a trade, they earn profit based on the interest rate of transaction. They are guaranteed to receive this interest rate if they allow the contract to expire, so they allow the contracts to go through delivery as doing anything else would introduce additional risks and impact the rate of return. Some contracts are rolled to a later expiration where they will be either rolled again or taken to delivery. This is again a very different process from options where for most participants, exercising in the money positions to take delivery is more expensive than offsetting the position.

[4] The Corporate Finance Institute definition of a TRS is "A Total Return Swap is a contract between two parties who exchange the return from a financial asset between them. In this agreement, one party makes payments based on a set rate while the other party makes payments based on the total return of an underlying asset. The underlying asset may be a bond, equity interest, or loan. Banks and other financial institutions use TRS agreements to manage risk exposure with minimal cash outlay." SSFs are an exchange traded equivalent to an equity TRS.

The differences only become more striking when SSFs are further divided into STARS products




The statistics for STARS dwarf both the equity options numbers and the SSF numbers. The average STARS trade has close to 5,000 contracts which is three orders of magnitude larger than equity options whereas the average notional value for a STARS transaction is over $14M which is four orders of magnitude larger than equity options. Based on this data, it should be clear that the products are traded differently by market participants.

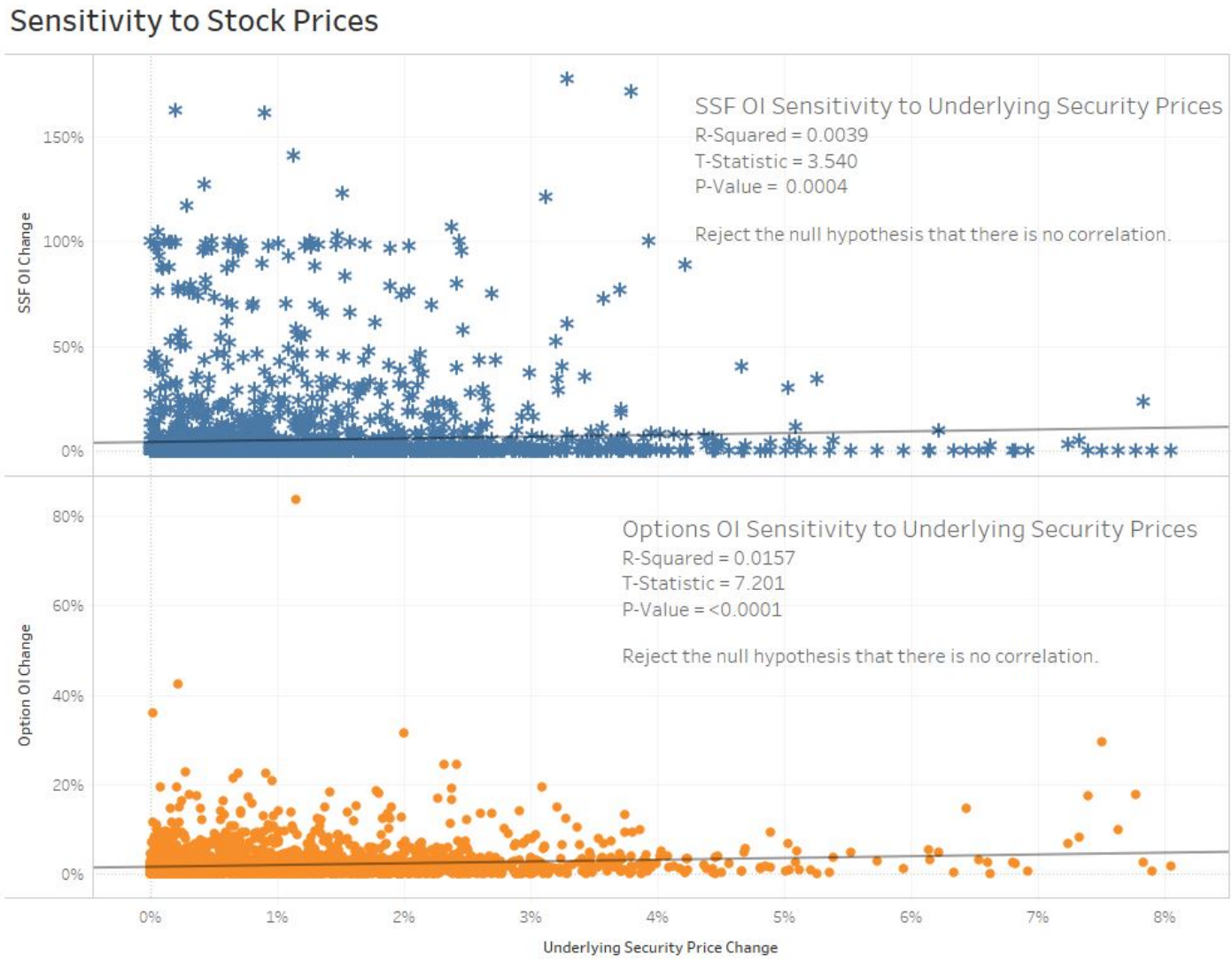
STARS transactions occur primarily between large participants exchanging cash for securities in large financing trades. Neither party wants to change their risk exposure to the underlying stocks, so they will not adjust their position after it has been established. The front leg of the transaction transfers securities to one party and cash to the other and the back leg reverses this transfer, returning both parties to their initial positions. This allows participants to optimize their balance sheets to reduce carrying costs.

A similar conclusion can be drawn from the delivery rates. Just over 100% of initial STARS contracts are delivered.[5] The delivery rate is close to 100% because market participants do not want to change their risk exposure to the underlying stock. If they enter a STARS position and allow it to expire unchanged, they will achieve this aim.[6] As such, once they have entered a STARS, there is no reason for them to do anything but allow it to expire. The data clearly bears this out. Options do not work like this; they need to be continually adjusted to reflect changes in delta and volatility; there is a clear difference in how they trade. Unsurprisingly, the differences between all three categories in all three subsets of products are statistically significant. From this data, it should be easy to conclude that equity options and SSFs (and especially STARS) are traded differently, and for different purposes. As a result, it is hard to justify a position which claims that the products are equivalent.

[5] The number is over 100% because occasionally, market participants will increase their size of their back-leg position through another STARS transaction. See the analysis of STARS trading Pattern in Analysis 2 for more details.
[6] Market participants can also achieve this goal by rolling their position (if they eventually allow the position to expire), or if they adjust the position with an additional STARS transaction.

# Analysis 4: Sensitivity to Underlying Stock Price

This analysis examines SSF and equity option sensitivity to stock prices. Because the stock price is a pricing input in both products, we should expect that there should be a statistically significant correlation between changes in stock prices and changes in open interest in both products. When the stock price moves, and as a result volatility moves, the trading patterns should show changes as well. However, because SSFs are primarily used for financing transactions, they should be less impacted by the underlying stock's price than options. To test this, we analyzed the change in OI for the SSF symbols with the highest OI, and the corresponding option symbols, and compared change in OI to the change in underlying security price.




Neither derivative exhibits a strong correlation with changes in the underlying security's price. For SSFs, the $R^2$ value indicates that the underlying security price changes explain 0.3% of the variation in OI, whereas they explain 1.5% of the variation in option OI. Nevertheless, because of the relatively large sample size, both analyses show a statistically significant correlation based on P-values.

Using the Fischer R-to-Z transformation, we can compare the statistical significance of the two correlation coefficients. This test yields a P-value of: **P = 0.0106.** As a result, the difference between the two correlation coefficients is statistically significant. This provides evidence that options traders are more sensitive to stock prices that SSF traders.

Confidence intervals were also used to test whether there was a significant difference between the correlation coefficients. The confidence intervals are below:

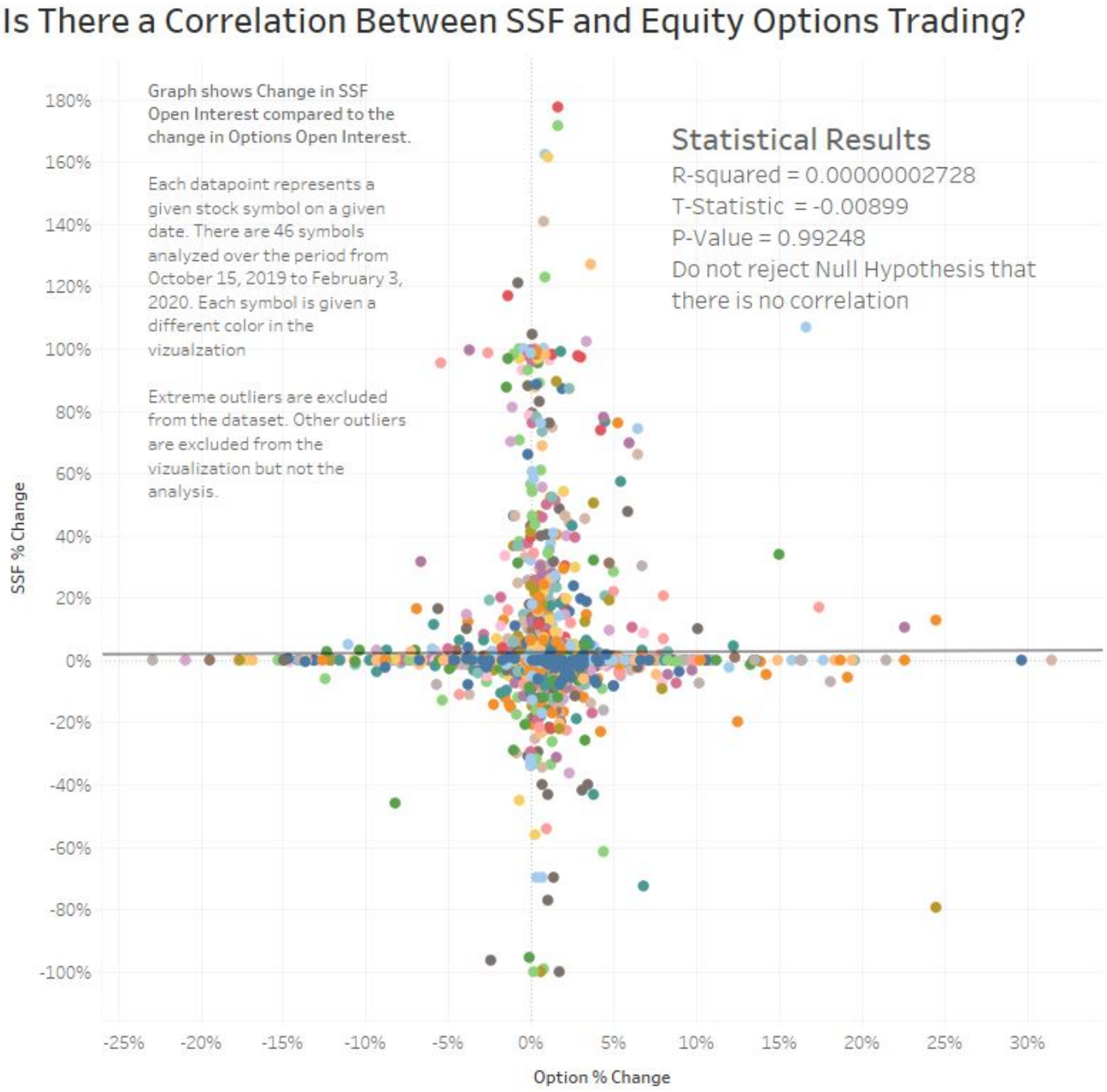
| Derivative | Sample R-value | 95% Interval | 99% Interval |
|---|---|---|---|
| SSF | 0.062 | (0.027, 0.098) | (0.016, 0.108) |
| Options | 0.125 | (0.090, 0.160) | (0.079, 0.171) |

These results show that for the 95% confidence interval and the 99% confidence interval both sample's correlation coefficients do not overlap with the sample correlation coefficient for the other derivative. This further strengthens the result that the there is a statistically significant difference between the correlation coefficients. The correlation coefficient test reduces the possibility that a statistically significant result is only showing due to the large sample size used in the model.

However, we do not find the conclusion in this instance particularly strong. Both correlations are weak, and the difference between them is explaining just over 1% of the variation in the data. Though the difference is technically statistically significant, we consider the results of this analysis to be ambiguous.

# Analysis 5: Correlation between SSF and Equity Options Open Interest

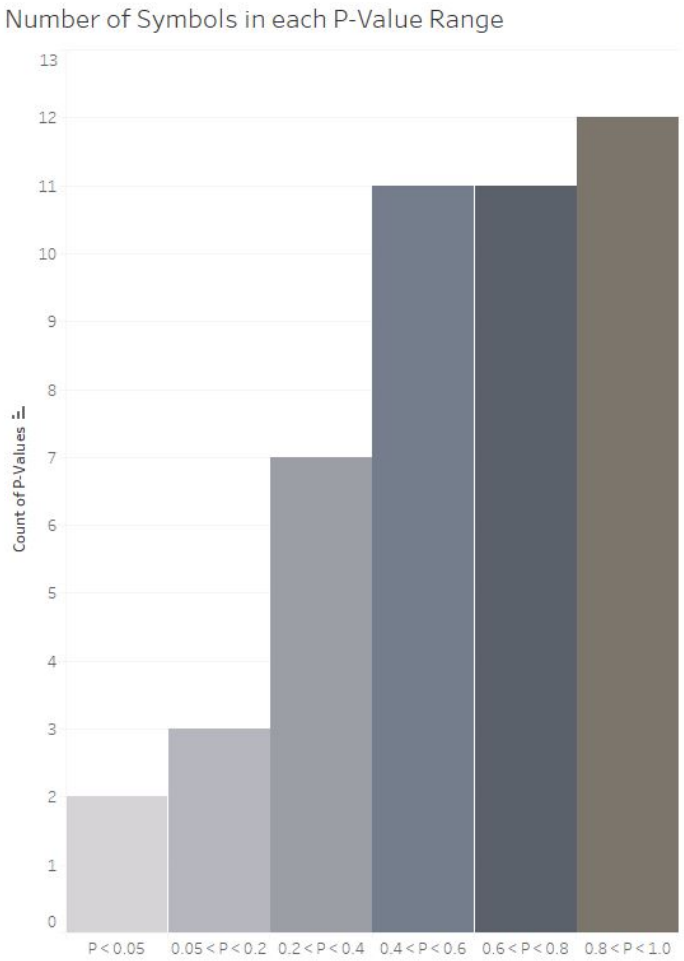
To more accurately gauge whether SSFs and equity options trade in a similar manner, we directly compare open interest statistics in SSFs and open interest statistics in options. If similar factors cause market participants to trade the products, then there should be a correlation between open interest in the products.[7] Even if only some of the factors which cause trading are similar, there should still be a correlation in the data given the large sample size (over 3,200 observations). The below graph shows a scatterplot of the change in SSF OI against the change in Option OI.

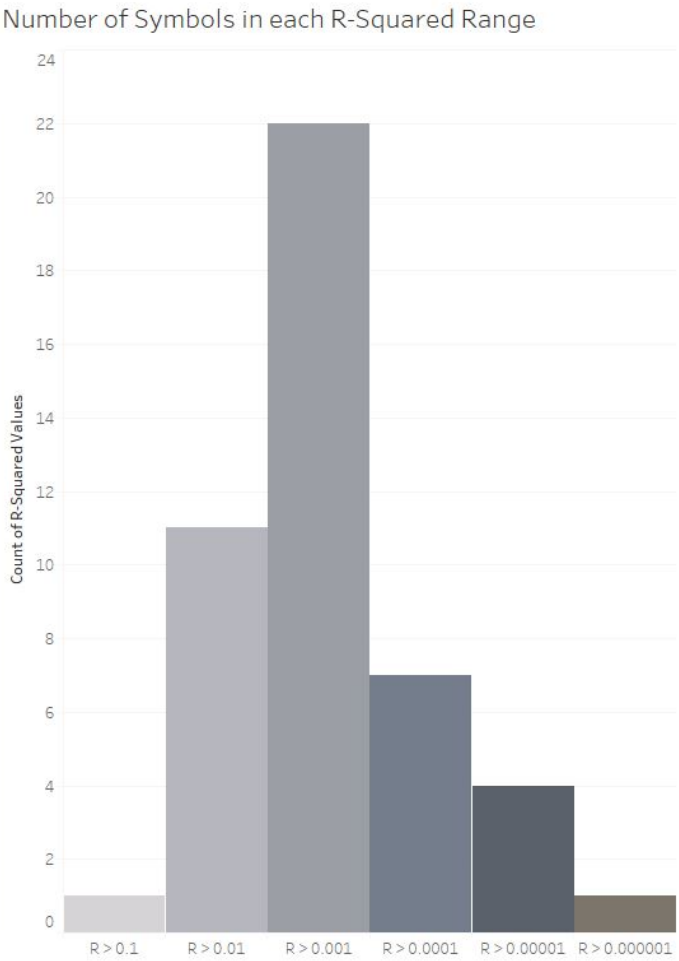



[7] Either a positive or negative correlation could be interpreted as showing that the products are related. While a positive correlation would be strongest in showing that the products trade similarly, a small negative correlation (a large increase in futures trading causes a small decrease in options trading) could show that the products are acting as substitutes.

It would be hard to find a less correlated dataset. The best fit line explains 2 millionths of 1% of the variation. The P-value is over 0.99. Even a small correlation would be observable given a sample size over 3,000. The lack of one here is telling.

As a further step, the analysis broke the data down into the 46 symbols examined in the study. Of the 46 symbols, 44 showed no statistically significant correlation between SSF and equity option OI levels. The two symbols that did show a statistically significant correlation were dependent on a single outlier datapoint for the correlation to be significant. A summary of P-values and R-squared ranges is shown below.




The majority of P-values are well above the 0.05 significance threshold. The R-squared values also show that the correlation explains very little variation. In 34 cases, the best fit line explains less than 1% of the variation in the datasets. In all 46 cases, the correlation is weak.

Taken together, both the population and symbol level data provide strong evidence that SSFs and options trade differently. This supports OneChicago's conclusion that market participants have discrete uses for SSFs and equity options and that the derivatives are not interchangeable. This could easily be the basis of a determination finding that SSFs and equity options are not comparable products. If two products have different risk profiles, trade in different patterns, are traded for different purposes, and are not used interchangeably, then there is no possibility for regulatory arbitrage and the products should not be considered comparable.

# Conclusion

Taken together, the five analyses presented here provide strong statistical support for the proposition that equity options and SSFs are different. An examination of SPX options and E-mini futures shows no evidence of regulatory arbitrage between SSFs and options. STARS products trade differently than any options products in that they are never used to change exposure to the underlying security. There are statistically significant differences in the product's contract sizes and delivery rates. There is no correlation between the trading of equity options and the trading of SSFs and no evidence that they trade in a similar or substitute manner. The Commissions should feel confident in determining that options and futures are not comparable.

# Appendix 1: Effect of Futures Margin on SPX Options Trading

Given the sparseness of data in SSFs, we determined to look at other markets to see if there was evidence that the products trade interchangeably. Confirming the conclusions of the SSF data in other markets would eliminate any concern about SSFs having too low liquidity for the analysis to be meaningful.

The products chosen for this analysis are CME's S&P 500 e-mini futures ("E-mini Futures") and Cboe's S&P 500 Options ("SPX Options"). It is important to note that these products share more similarities than equity options and OneChicago No Dividend Risk Single Stock Futures. Cboe's SPX options are European exercise and neither product is dividend adjusted, meaning that while exercise risk and dividend risk differentiate SSFs and equity options, those risks do not differentiate SPX options and the E-mini. Further, because both indexes are cash settled, E-mini futures cannot be used for securities lending transactions because there is no way to transfer securities via the future. If there is no evidence that these products change interchangeably, it is even less likely that OneChicago SSFs and equity options are competitive.

Because SPX options are on a High-Capitalization Broad-Based Index, in a portfolio margin account, they are shocked at levels up to +6/-8%, meaning that the maximum margin on a naked position is 8%. By contrast, S&P 500 e-mini futures are margined using risk-based SPAN margining. This margin fluctuates as market volatility changes. Importantly, while the level of SPX margin is constant, the E-mini margin changes often. As a result, it is possible to see how different changes in the E-mini margin impact relative levels of SPX trading. Of particular interest is the period during the Financial Crisis from 2008-2010 when the level of E-mini margin was higher than 8% and thus higher than SPX margin. If the products trade interchangeably, there should be significantly more SPX trading during this period relative to E-mini trading than at other periods of time.

If there was a connection between SPX and E-mini trading, the data should show that as E-mini margins increase, the amount of SPX trading increases relative to E-mini trading and vice versa. A lack of a correlation or a negative correlation would demonstrate that the products do not trade as substitutes.

## Dataset

Using a Bloomberg terminal, the following data was collected for each business date between 12/19/2006 and 12/31/2019:

- SPX Trading Volume
- SPX Open Interest
- SPX Call Open Interest
- SPX Put Open Interest
- SPX Last Price
- E-mini Trading Volume
- E-mini Open Interest
- E-mini Last Price
- E-mini Initial Margin

There were a number of null values in the dataset. Different columns were missing data for different days. If a business had null values for any of the above values on a given business date, all of that day's data was removed from the dataset. Determining the relative values of SPX options requires data for both SPX and E-mini in order to compare the two values. If one is missing, the analysis cannot be completed for that day so the entire day is removed from the dataset. With this change there are still 3,225 business days in the dataset.

Using this data several additional datapoints were created for each day:

- E-mini Initial Margin Rate: Using last price and initial margin data, the initial margin was expressed as a percentage of contract value.

Open Interest Ratio: The relative amount of SPX Open Interest was expressed by creating a ratio equal to SPX Open Interest over E-mini Open Interest.
Volume Ratio: The same as the Open Interest Ratio but with the Volume statistics.

## Methodology

Two scatterplots are mapped showing the Open Interest Ratio and the Volume Ratio respectively on the Y Axis and the E-mini margin rate on the X Axis. A linear line of best fit is created according to the below formula:

$Y = B_0X + B_1$

Where:
$B_0$ = Slope
$B_1$ = Intercept

The line of best fit is then tested via a one-tailed T significance test to determine whether there is a statistically significant correlation. As the goal of this study is test whether an increase in E-mini margin causes an increase in SPX option trading, the Null and Alternate Hypothesis are formulated as follows

$H_0 : B_0 > 0$
$H_a : B_0 <= 0$

Rejecting the null hypothesis would provide evidence that there is not a positive correlation between the relative amount of SPX options trading and E-mini. Because only a positive correlation would demonstrate that the products trade interchangeably due to differences in margin, a one-tailed test is appropriate in this analysis.

Because a One-tailed test is used, we require an equivalently lower P-value to determine significance so that the T-statistic required to determine significance is not reduced. Statistically significant P-values are considered to be:

P-value < 0.025

If the P-value meets the level of statistical significance, the Null Hypothesis is rejected.

In addition to the significance test, we also examine the results by looking at a 95% confidence interval and a 99% confidence interval.

The Confidence intervals are calculated by the following formula:

Confidence Interval = $S +/- Z_{crit} * SE$

Where:
S = Sample Statistic
$Z_{crit}$ = Critical Z-value (1.96 for the 95% interval and 2.58 for the 99% interval)
SE = Standard Error

Confidence Intervals are calculated for both the slope of the regression line and for the correlation coefficient (R) of the regression line.

If the upper bound of the confidence interval is < 0, then we can reject a Null Hypothesis that there is a positive correlation.

## Results

The two regressions yield the following results:

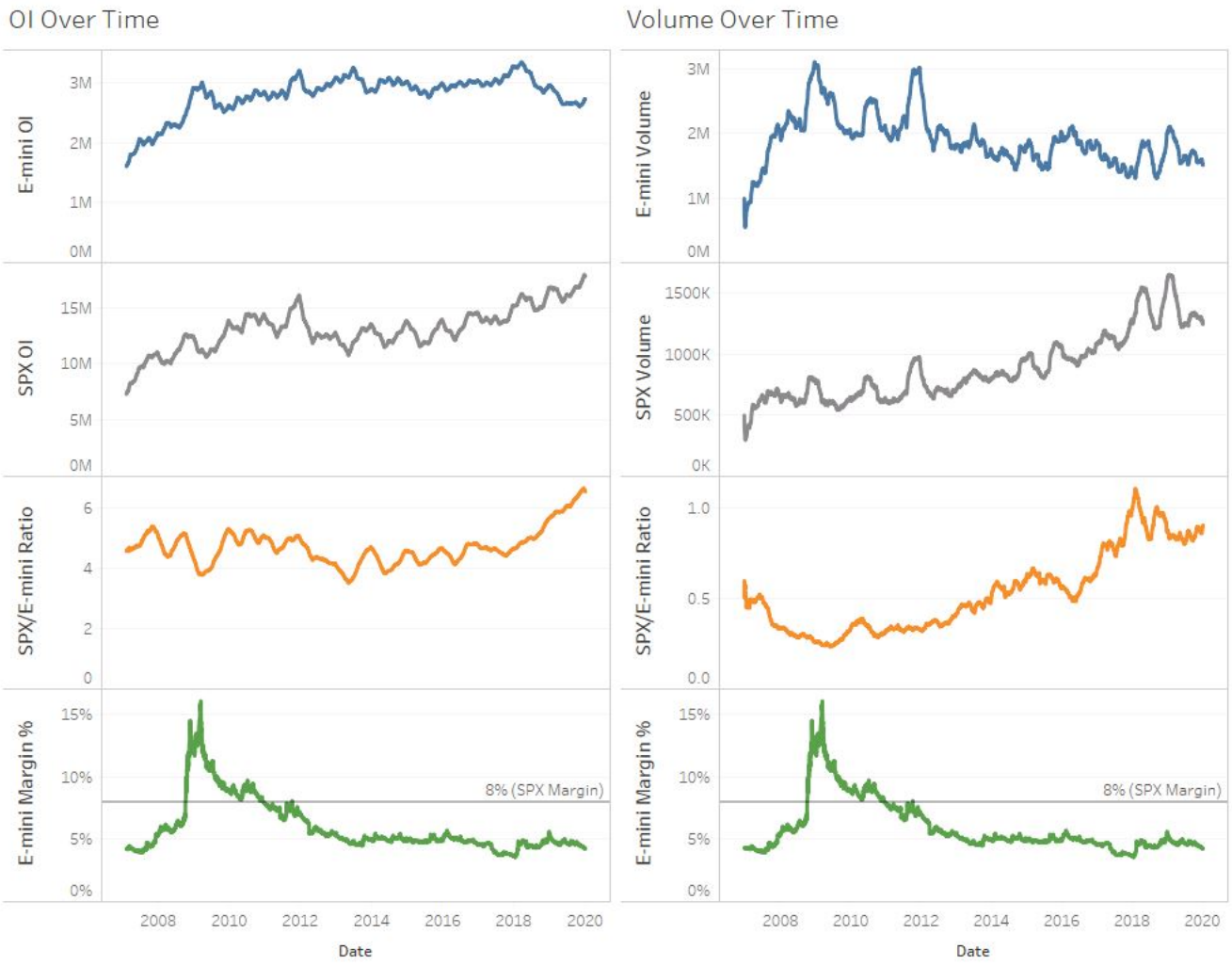
| Ratio | Best Fit Line | R-Squared | T-statistic | P-Value |
|---|---|---|---|---|
| Open Interest | -10.8X+10.121 | 0.02515 | -9.1095 | <0.000005 |
| Volume | -13.9X+1.901 | 0.26393 | -33.9637 | <0.000005 |

Both P-Values are statistically significant. The Null Hypothesis is rejected in both cases. The confidence intervals for the dataset are below:

| Statistic | Test Stat | Standard Error | 95% Confidence Interval | 99% Confidence Interval |
|---|---|---|---|---|
| OI Ratio Slope | -10.871 | 1.193 | (-13.209, -8.533) | (-13.949, -7.793) |
| OI Ratio R Coefficient | -0.159 | 0.018 | (-0.194, -0.123) | (-0.205, -0.112) |
| Volume Ratio Slope | -13.917 | 0.410 | (-14.721, -13.113) | (-14.975, -12.859) |
| Volume R Coefficient | -0.514 | 0.018 | (-0.549, -0.478) | (-0.560, -0.467) |

The results of the Regression provide evidence that the margin rate for E-mini contracts does not impact the trading of SPX options.

One surprising result of the analysis is that there was a statistically significant negative correlation between SPX options and E-mini futures. There are a couple reasons that this could have occurred. First, over the 14-year period examined, volume and open interest for SPX options consistently increased while the volume and open interest for E-mini futures remained relatively constant. This effect was much more pronounced in volume than in open interest. Because lower market volatility meant that margins for E-mini futures were lower at the end of the review period, E-mini margins were lowest during the periods that SPX volumes and Open interest was highest. It is unlikely that the rise in SPX options over the course of the review period was due to E-mini margins as the largest volume changes in SPX options came during periods where there was relatively little change in E-mini margins. This could have caused a false negative correlation if long-term trends not accounted for in the initial analysis are influencing the levels of SPX and E-mini trading.




A second possible explanation has to do with volatility. E-mini margins increase when volatility is high. As volatility is a factor in options pricing, periods of high volatility would have resulted in wider option spreads, which could have resulted in a reduction in option trading. That both SPX option volume and open interest declined during the Financial Crisis, while futures volume remained constant provides support to this theory. It should be noted that the decline in options volumes did not also result in a marked increase in futures volume. This means that people reduced their trading of options and did not resort to using futures as a substitute. If this theory is believed, it provides further support to the idea that SPX options and E-mini futures do not trade interchangeably.

To examine the first explanation, we ran the test a second time, instead comparing on the daily change in margin with the daily change in the SPX/E-mini Volume ratio. By looking at the changes from one day to the next, this should eliminate any long-term effects that external factors have upon the data. The results of this analysis are below.

| Statistic | Volume Ratio | OI Ratio |
|---|---|---|
| R-Squared | 0.0135 | 0.0026 |
| T-Statistic | -6.627 | -2.878 |
| P-Value | < 0.00005 | 0.0020 |

The data still allows us to reject the null hypothesis that there is a positive correlation and conclude that SPX options and E-mini futures do not trade interchangeably. However, we still have a statistically significant negative correlation. In this case, the correlation is much weaker. It explains only 1.3% of the change in volume instead of 26% of the change. Though

it is statistically significant, the negative correlation does not even explain 0.3% of the variation in the dataset. Any residual negative correlation is likely due to the second explanation. It is also possible that there is not a negative correlation, but it is appearing significant given the large sample size used in the analysis. Regardless of any residual negative correlation, both the initial and follow up regressions allow us to conclude with high confidence that there is not a positive correlation between E-mini margins and relative SPX volumes.

This result is again supported by the confidence intervals that result from this analysis:

| Statistic | Test Stat | Standard Error | 95% Confidence Interval | 99% Confidence Interval |
|---|---|---|---|---|
| OI Ratio Slope | -0.257 | 0.089 | (-0.431, -0.083) | (-0.487, -0.027) |
| OI Ratio R Coefficient | -0.051 | 0.018 | (-0.086, -0.015) | (-0.097, -0.004) |
| Volume Ratio Slope | -2.482 | 0.374 | (-3.215, -1.749) | (-3.447, -1.517) |
| Volume R Coefficient | -0.514 | 0.018 | (-0.549, -0.478) | (-0.560, -0.467) |

None of the confidence intervals exceed 0 even at the 99% confidence level. The upper bound of the 99% confidence level does get very close to zero for both OI confidence interval measures.

The analysis provides strong evidence that differences in margin do not cause regulatory arbitrage between SPX options and E-mini futures. Even when futures margin climbed to significantly higher levels than comparable options during the financial crisis in 2008-2010, this did not cause market participants to trade more options compared to futures. Though SPX options and E-mini futures are different than equity options and SSFs, the results of this analysis support the conclusion that there is not regulatory arbitrage between options and SSFs. SSFs and equity options are less similar than E-mini futures and SPX options because No Dividend Risk SSFs do not have dividend risk, and SPX options do not have assignment risk. That there is no evidence that E-mini margins have an impact on SPX option trading makes it even less likely that SSF margin levels would impact equity option trading.

# Appendix 2: STARS Adjustments

STARS (Security Transfer and Return Spreads) are a unique type of transaction on OneChicago that should be differentiated from other SSFs. They consist of a spread transaction where the front leg SSF expires on the day of the transaction and the back leg expires at a point further into the future. They allow market participants to initiate a transfer of stock and guarantee the return of that stock after a pre-determined period. They are designed to replicate securities lending and equity repo in an exchange traded environment. When executed as intended, these transactions are do not change a participant's exposure to the underlying security. This analysis analyzed STARS trading to see whether market participants use STARS in a manner that changes their risk exposure to the underlying security.

## Dataset

1. Options Data

Options data is gathered from OCC's website for 2018-2019. The fields gathered are: No. of Transactions, No. of Contracts traded, Average Premium per Contract. Average Contracts per Trade, Total Premiums, Contracts Delivered, and Open Interest at the beginning of the month. The following additional fields are calculated:
Average Notional per trade[8] and Percentage of Contracts exercised.[9]

2. SSF Data

SSF data is gathered from OneChicago's FTP site for 2018-2019. The fields gathered are: No. of Cleared Trades, No. of Cleared Contracts, Cleared Notional Value, Open Interest at the beginning of the month, and Contracts Delivered. The following additional fields are calculated: Average Contracts per Trade,[10] Average Notional Value per Trade,[11] and Percentage of Contracts Delivered.[12]

3. STARS data

STARS are found by looking at a subset of SSF data. Because the STARS market is relatively small, the dataset was expanded to include STARS-like transactions. Transactions were included in the dataset if they met at least one of the following two conditions:
A. The spread transaction consisted of a T+1 front leg and a T+2 back leg where the T+1 leg expired on the trade date (traditional STARS contract).
B. The spread transaction was used by a market participant to enter into an entirely new position. (i.e. they did not have any SSF positions with the same underlying security).

The transactions meeting the second criteria represent scenarios where market participants entered a position in a way that did not change their exposure to the underlying stock. This is identical to the position of a liquidity provider in an equity repo or stock loan transaction.

From this point the STARS dataset is narrowed by making two additional exclusions. First, market maker trades are excluded from the dataset. Market makers are required to quote markets and must be willing to trade with any participants. Their motivations for trading, and trading patterns will be different than other participants. Second, pricing

[8] Average Premiums Per Contract * Average Contracts Per Trade = Average Notional Per Trade
[9] Contracts Exercised / End of Previous Month OI = Percentage of Contracts Exercised
[10] Total Contracts / Number of Trades = Average Contracts per Trade
[11] Total Notional / Number of Trades = Average Notional value per Trade
[12] Contracts Delivered / Beginning of Month OI = Percentage of Contracts Delivered

arbitrage trades are excluded. On a couple of dates during the study period, a market maker mispriced STARS contracts so that there was an arbitrage opportunity where market participants could buy(sell) a STARS contract and then offset that contract by immediately selling(buying) an EFP or outright SSF and collect a profit on the difference. Opportunistic traders took advantage of these discrepancies by entering and exiting STARS positions almost immediately. These trades represent participants trading due to another participant's error and introduce noise into the dataset.

## Methodology

Each STARS position in the dataset was examined. These positions were given one of the following five designations based on the trading pattern of the market participant after they entered the position.

**a. Increased**. After entering the STARS position, the market participant used a No Dividend Risk SSF to increase the size of back leg position.

**b. Decreased**. After entering the STARS position, the market participant used a No Dividend Risk SSF to decrease the size of back leg position.

**c. Delta-neutral adjustment**. The market participant adjusted the size of their position with another STARS or calendar spread transaction. These adjustments do not change net exposure to the underlying stock.

**d. Roll**. The market participant rolled the back leg of the transaction to a further expiration before letting it expire with no further changes.

**e. Expired unchanged**. The market participant made no adjustments to their position before the back leg expired.

The results are analyzed to see what percentage of the transactions fall into each bucket. The hypothesis is that a very small percentage of STARS trades would fall into either the Increased or Decreased category whereas the vast majority should either be rolled or expire unchanged. This would confirm that these products are not trading like options but are instead trading like securities finance transfers.

## Results

The below table shows how many STARS positions fell into each category:

| STARS | A. Increased | B. Decreased | C. Delta-Neutral | D. Rolled | E. Unchanged | Total |
|---|---|---|---|---|---|---|
| No. of trades | 0 | 0 | 33 | 26 | 444 | 503 |
| Percentage | 0% | 0% | 6.56% | 5.17% | 88.27% | 100% |

The data confirms the hypothesis. There were no instances where a market participant with a STARS position altered their risk exposure to the underlying security. In a minority of cases, the STARS was either adjusted via a delta-neutral transaction or rolled to a further expiration. In nearly 90% of cases, the STARS expired unchanged.

# Appendix 3: Contract Sizes and Delivery Rates

To demonstrate the difference between SSFs and options, one can look at the way that the products trade. A difference in trading patterns should be evident in trading statistics if the products are not comparable.

## Dataset

The same dataset that was used for Analysis 2: STARS Adjustment was used in this analysis.

## Methodology

The means and standard deviations for all of the data are collected. As medians are not available for the option data, the dataset is reported relative to the mean. The three means for each category are analyzed for statistical significance by comparing the means of equity options to SSFs and equity options to STARS for each category. The difference between the means is tested via a two-tailed hypothesis test where the null and alternative hypotheses are formulated as follows:

$H_0 : B_0 = 0$
$H_a : B_0 =/= 0$

The null hypothesis is evaluating using a P-value.

When: $P < 0.05$ the results are considered statistically significant and the null hypothesis can be rejected.

## Results

The Means and Standard deviations for Average Contracts per Trade, Average Notional per Trade, and Percentage of Contracts delivered are reported below.

| Product | Contracts/Trade | Standard Error | Notional/Trade | Standard Error | % Delivered | Standard Error |
|---|---|---|---|---|---|---|
| Equity Options | 8.14 | 0.67 | $2,628.39 | $380.11 | 13.46% | 1.892% |
| SSFs | 140.60 | 48.65 | $780,334.56 | $196,125.15 | 69.72% | 32.080% |
| STARS | 4944.09 | 11503.87 | $14,253,861.92 | $28,122,533.73 | 101.14% | 51.017% |

The Standard Errors for STARS are much higher relatively as compared to equity options and SSFs due to how the data was gathered. The OCC equity options data was analyzed at a monthly granularity (resulting in 24 datapoints). The SSF data was also analyzed at a monthly granularity. However, the STARS[13] data was analyzed at a transactional granularity because trading is not consistent from month to month (i.e. some months would have zero or single digit numbers of transactions). The standard error from transaction to transaction is much higher than the standard error of monthly averages leading to the higher relative standard error.

The difference between the means was significance tested with the following results.

[13] The data also supported the decision to include non-STARS trades into the dataset. The condition A trades exhibited similar characteristics as the combined STARS dataset. Criteria A positions only: 74 observations. Contracts per Trade: 4,367 with 7,681 Standard error; Notional per Trade: $20,401,098 with $27,636,750 Standard error; and Delivery Rate 102.76% with 21.77% Standard error.

| Datapoint | Equity Options vs SSF | | | Equity Options vs STARS | | |
|---|---|---|---|---|---|---|
| | **Contracts** | **Notional** | **Delivery** | **Contracts** | **Notional** | **Delivery** |
| T-Statistic | 13.050 | 19.008 | 8.393 | 2.055 | 2.427 | 8.230 |
| P-Value | < 0.0001 | < 0.0001 | < 0.0001 | 0.0407 | 0.0158 | < 0.0001 |
| Conclusion | Reject $H_0$ | Reject $H_0$ | Reject $H_0$ | Reject $H_0$ | Reject $H_0$ | Reject $H_0$ |

In all cases, the hypothesis that the means are the same can be rejected based on the P-values. This demonstrates there is a statistically significant difference between average contract size, average notional value, and percentage of contracts delivered between equity options and SSFs and equity options and STARS.

# Appendix 4: Sensitivity to Stock Prices

The statistical analysis below is the first of two studies performed to test whether there is a correlation between the trading of options and the trading of single stock futures. The responsiveness of SSFs to the underlying stock is compared to the responsiveness of options to the underlying stock. The hypothesis is that because SSFs are predicted to be substitutes for total return swaps, equity repos, and stock loan transactions, the amount that trading in SSFs responds to changes in stock price should be low compared to the amount that trading in options responds.

## Dataset

While OneChicago possesses SSF data dating back several years, its access to options data is more limited. Accurate options data could only be collected going back until October 7, 2019. As a result, the period that the study analyzed was from October 15, 2019 – February 3, 2020 ("Study Period").

The challenge of analyzing data related to single stock futures, is that although there are SSFs listed on over 1600 underlying securities, there is very little trading activity or OI in most of these products. As a result, we determined to primarily filter the dataset by the SSFs in which there is significant activity. Within the study period, we chose all underlying symbols which had at least 1000 contracts in OI for at least 80% of the study period (this translated to 51 days or more of the 76 trading days in the study period). 46 underlying symbols met this criteria.

The base statistic used to estimate correlation was OI. Specifically, change in OI as compared to the previous trading day. Trading volume would produce noisy data because SSFs are traded much more infrequently than options. Many SSF contracts go several days in between trades even in the symbols where there is significant open interest. Using trading volume would result in too many null values to provide meaningful data. With trades coming sporadically, changes in trading volume from one day to the next does not show a useful statistic. Open interest shows positions, which provides a meaningful dataset even when there are no trades in the product. While the change in open interest is often 0% for SSFs on a given day, this does not produce the significant data swings that going from 1000 contracts traded to 0 contracts traded would if using volume.

Despite these changes, there were three outlier datapoints where the change in SSF OI was unusually large. In all three cases, OI in the SSF contracts started the day at a number significantly lower than 1000 and a single customer put on a large position. This resulted in the percentage change in SSF OI to be extremely large, with the potential to skew the dataset. As a result, datapoints where the change in SSF OI exceeded 1000% were excluded from the dataset resulting in the removal of datapoints where the change in SSF OI was 1,839% (in MRO), 3,525% (in BBD), and 12,305% (in XOP). One final filter was used to pare down the dataset. The business day immediately following an expiration of a third Friday contract was eliminated from the dataset. Both SSFs and options operate on a similar expiration calendar in that their biggest contracts are monthly contracts which expire on the third Friday of each month. Following expiration, the amount of open interest declines significantly because a large number of contracts mature in futures and a large number of contracts either expire worthless or are exercised in options. Because both products see a significant decline in open interest on these days, including this data has the potential to introduce a false positive. Correlation related to these days is likely because both products have a similar expiration calendar, not because the products trade in a similar way. If the days are excluded and there is a correlation between the products, it will still show on other days, whereas if the days are included and there is no correlation, the data could still show a correlation because of this expiration effect. Therefore, excluding the days after expiration is the best method for ensuring an accurate conclusion.

Data for options and stock prices was collected from Bloomberg. Data for SSFs was collected from OneChicago's public FTP site.

## Methodology

The last price for each business day during the target period is converted into a percentage change from the previous day's last price. The open interest number for both options and futures is converted into a percentage change from the previous day. The percentage values are then converted to an absolute percentage value. As both an increase in long activity or short activity would show up as increased OI, both increases in stock price and decreases in stock price could be associated with increased OI. Absolute changes in stock prices and OI will capture these effects whereas non-absolute values would not. The data is then added onto two scatterplots with the percentage change in stock price on the X axis and the percentage change in SSF OI or Options OI on the Y axis. A linear line of best fit is created according to the below formula:

$Y = B_0X + B_1$

Where:
$B_0$ = Slope
$B_1$ = Intercept

The line of best fit is tested via a two-tailed hypothesis test where the null and alternative hypotheses are formulated as follows:

$H_0 : B_0 = 0$
$H_a : B_0 =/= 0$

The null hypothesis is evaluated using a P-value.

When: $P < 0.05$ the results are considered statistically significant and the null hypothesis can be rejected.

If both SSFs and options return a statistically significant correlation coefficient, the two coefficients will be transformed using the Fischer R to Z transformation to test whether there is a statistically significant difference between the correlation coefficients. The test will examine the null hypothesis that there is no statistically significant difference between the coefficients.

When: $P < 0.05$ the results are considered statistically significant and the null hypothesis can be rejected.

In addition to the significance test, we also examine the results by looking at a 95% confidence interval and a 99% confidence interval. It is important to use confidence intervals in this analysis because with a large sample size, the P-values could be skewed and are more likely to cause a type 1 error.

The Confidence intervals are calculated by the following formula for the correlation coefficient (R) of the regression line:

Confidence Interval = $S +/- Z_{crit} * SE$

Where:
S = Sample Statistic
$Z_{crit}$ = Critical Z-value (1.96 for the 95% interval and 2.58 for the 99% interval)
SE = Standard Error = 1/(Sqrt(n)-3) = 0.018

If neither confidence interval encompasses the R value for the other derivative, then the results can be determined to be statistically significant.

## Results

The analysis looked at the relationship between 1) SSF OI and underlying stock price and 2) Equity option OI and underlying stock price. The results of the analysis are shown below:

| Test | Best Fit Line | R-Squared | T-Statistic | P-Value |
|---|---|---|---|---|
| SSF Change | 1.23X+0.0413 | 0.003896 | 3.4505 | 0.0004 |
| Option Change | 0.377X+0.0159 | 0.015658 | 7.2012 | < 0.0001 |

Both lines have statistically significant correlations with stock prices. However, neither correlation is particularly strong. For SSFs, stock price explains 0.3% of the variation in SSF OI. For options, stock price explains 1.5% of the variation in option OI. While this data is in line with the hypothesis that option OI should be more responsive to changes in stock price than SSF OI, the neither correlation is strong and the difference between the two coefficients is small.

To test the significant of the difference between the two correlation coefficients, we use the Fisher r-to-z transformation using the r and n values below.
$R_{opt} = 0.12513$
$N_{opt} = 3262$
$R_{ssf}=0.06242$
$N_{ssf} = 3262$

This gives us: Z = 2.5548

In turn, a z-score of 2.55 generates:

P = 0.0106.

As 0.0106 < 0.05, the null hypothesis that there is no difference between the correlation coefficients is rejected, providing evidence for the alternative hypothesis that there is a statistically significant difference between the two coefficients.

The confidence intervals for the dataset are as follows.

| Derivative | Sample R-value | 95% Interval | 99% Interval |
|---|---|---|---|
| SSF | 0.062 | (0.027, 0.098) | (0.016, 0.108) |
| Options | 0.125 | (0.090, 0.160) | (0.079, 0.171) |

These confidence intervals still provide evidence that there is a statistically significant difference between the correlation coefficients as neither confidence interval crosses over the sampled value in the other derivative.

# Appendix 5: Correlation between SSF and Equity option Open Interest

The statistical analysis below is the second of two studies performed to test whether there is a correlation between the trading of options and the trading of single stock futures. We tested whether there was any correlation between trading in SSFs and trading in options by comparing open interest numbers directly. A positive correlation between the products would provide evidence that traders are using the products for similar purposes. This would support the belief that SSFs and options are interchangeable. A negative correlation could provide evidence that the two products trade as substitutes. If declines in option trading lead to increases in SSF trading, it would provide evidence that the products were interchangeable, and that regulatory arbitrage was possible.

## Dataset

The same dataset that described in Appendix 3 was used in this dataset

## Methodology

The open interest numbers for both options and futures are converted into a percentage change from the previous day. Unlike the sensitivity experiment, the values are not translated into absolute values. If SSFs and options are positively correlated, both variables should move in the same direction. If they are negatively correlated, they should move in opposite directions. Using an absolute value would obscure both results. The datapoints are added to a scatterplot which has change in option OI on the X axis and change in SSF OI on the Y axis. A linear line of best fit is created according to the below formula:

$Y = B_0X + B_1$

Where:
B0 = Slope
B1 = Intercept

The line of best fit is tested via a two-tailed hypothesis test where the null and alternative hypotheses are formulated as follows:

H0 : B0 = 0
Ha : B0 =/= 0

The null hypothesis is evaluated using a P-value.

When: $P < 0.05$ the results are considered statistically significant and the null hypothesis can be rejected.

In addition to the significance test, we also examine the results by looking at a 95% confidence interval and a 99% confidence interval. It is important to use confidence intervals in this analysis because with a large sample size, the P-values could be skewed and are more likely to cause a type 1 error.

The Confidence intervals are calculated by the following formula for the slopes of the regression lines:

Confidence Interval = S +/- Zcrit * SE

Where:

S = Sample Statistic
Zcrit = Critical Z-value (1.96 for the 95% interval and 2.58 for the 99% interval)
SE = Standard Error = 1/(Sqrt(n)-3) = 0.018

If neither confidence interval encompasses the R value for the other derivative, then the results can be determined to be statistically significant.

## Results

The results of the analysis are shown below

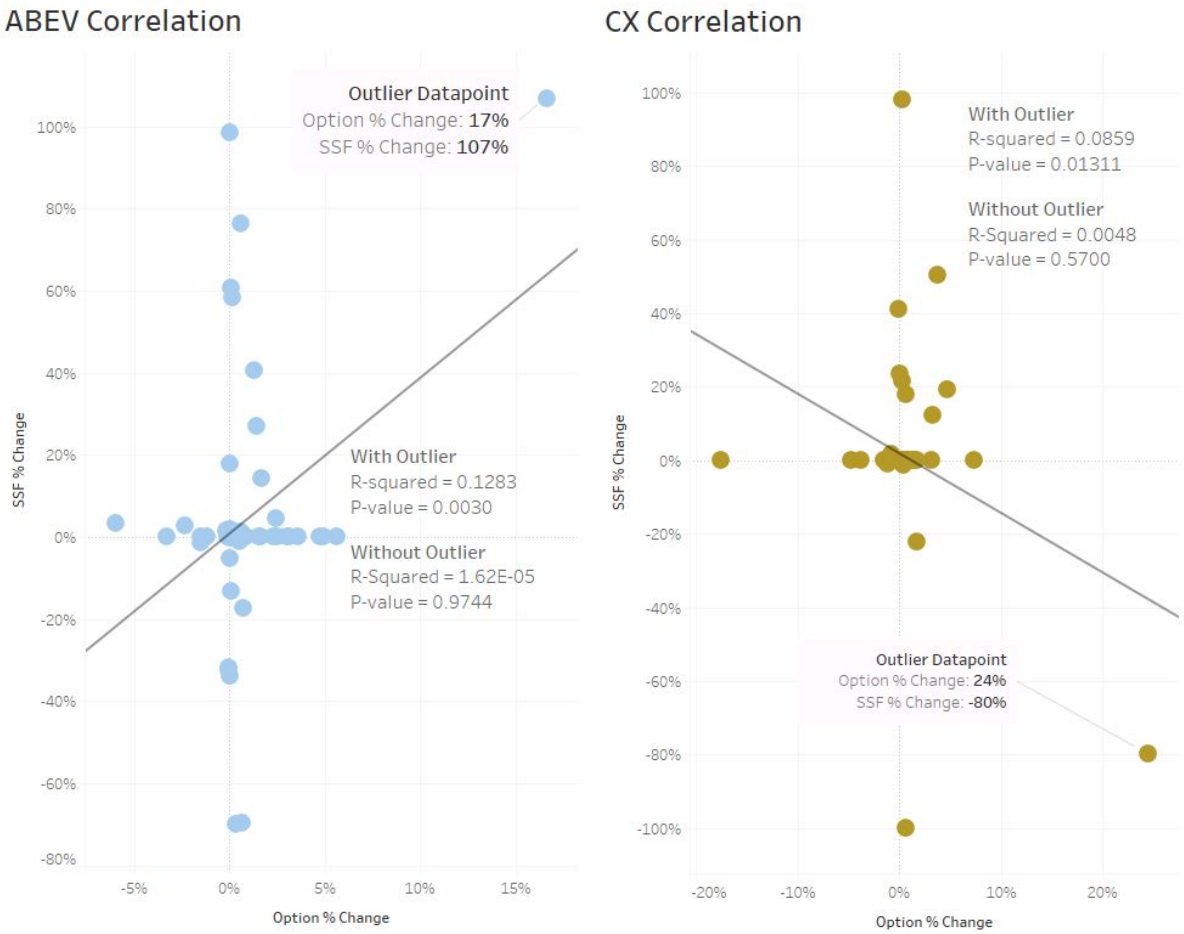
| Symbol | Best Fit Line | R-Squared | T-Statistic | P-Value | Conclusion |
|---|---|---|---|---|---|
| AAPL | -0.233X+0.00419 | 0.009121 | -0.7970 | 0.4282 | Not significant |
| ABEV | 3.79X+0.00734 | 0.1283 | 3.0935 | 0.0030 | Significant |
| AES | -0.0437X+0.022 | 0.00173 | -0.3456 | 0.7307 | Not significant |
| ARNC | 0.00688X+0.0161 | 9.30E-06 | 0.0253 | 0.9799 | Not significant |
| ATVI | 0.165X+0.0258 | 0.00125 | 0.2934 | 0.7701 | Not significant |
| BBD | -0.366X+0.0291 | 0.00167 | -0.3374 | 0.7368 | Not significant |
| CX | -1.62X+0.0194 | 0.0859 | -2.5466 | 0.0131 | Significant |
| F | 1.18X+0.0384 | 0.00589 | 0.6340 | 0.5246 | Not significant |
| FB | 0.294X+0.0198 | 0.00493 | 0.5848 | 0.5606 | Not significant |
| GDX | 0.239X+0.0382 | 9.07E-05 | 0.2503 | 0.8031 | Not significant |
| GDXJ | 2.22X+0.0781 | 0.0183 | 1.1328 | 0.2612 | Not significant |
| GPS | -0.604X+0.0245 | 0.0122 | -0.9267 | 0.3574 | Not significant |
| IBM | -0.197X+0.00697 | 0.00833 | -0.7614 | 0.4490 | Not significant |
| ITB | -0.0596X+1.91E-04 | 0.0307 | -1.4788 | 0.1437 | Not significant |
| ITUB | -0.447X+0.0543 | 0.00166 | -0.3382 | 0.7362 | Not significant |
| IYR | -0.0787X+0.0221 | 0.0003.72 | -0.1601 | 0.8732 | Not significant |
| JCI | 0.392X+0.0176 | 0.008894 | 0.7869 | 0.4340 | Not significant |
| JNJ | -0.443X+0.0335 | 0.00629 | -0.6611 | 0.5107 | Not significant |
| KBE | -0.281X+0.0261 | 0.00492 | -0.5842 | 0.5610 | Not significant |
| KRE | -0.146X+0.0205 | 0.00548 | -0.6163 | 0.5397 | Not significant |
| LB | 0.0107X+0.0252 | 1.86E-05 | 0.0358 | 0.9716 | Not significant |
| MDLZ | -0.362X+0.0733 | 0.00295 | -0.4521 | 0.6526 | Not significant |
| MDT | 0.105X+0.01998 | 0.00109 | 0.2749 | 0.7842 | Not significant |
| MRK | 0.783X+0.0109 | 0.0173 | 1.1032 | 0.2737 | Not significant |
| MRO | -0.0812X-0.00591 | 0.00244 | -0.4076 | 0.6849 | Not significant |
| MS | -0.376X+0.0468 | 0.00112 | -0.2783 | 0.7816 | Not significant |
| MSFT | -0.0938X+0.0152 | 0.000421 | -0.1705 | 0.8651 | Not significant |
| NEM | 1.22X+0.0624 | 0.00465 | 0.5679 | 0.5719 | Not significant |
| NFLX | 0.0237X+0.00421 | 2.41E-05 | 0.0485 | 0.9614 | Not significant |
| NKE | 0.0335X+0.0248 | 0.000139 | 0.0978 | 0.9223 | Not significant |
| OIH | 0.687X+0.0113 | 0.0162 | 1.0659 | 0.2902 | Not significant |
| ORCL | 0.393X+0.00952 | 0.0155 | 1.0423 | 0.3009 | Not significant |
| PBR | -2.37X+0.1082 | 0.00590 | -0.6398 | 0.5244 | Not significant |
| PFE | 0.462X+0.0169 | 0.0150 | 1.0243 | 0.3093 | Not significant |
| PG | -0.485X+0.0432 | 0.00326 | -0.4752 | 0.6362 | Not significant |
| PHM | -0.101X+0.0370 | 0.000617 | -0.2063 | 0.8371 | Not significant |
| SCHW | -0.355X+0.0388 | 0.00564 | -0.6253 | 0.5338 | Not significant |
| SMH | -0.0313X+0.0221 | 0.000102 | -0.0840 | 0.9332 | Not significant |
| TJX | 0.0494X+0.00723 | 0.000238 | 0.1282 | 0.8983 | Not significant |

| | | | | | |
|---|---|---|---|---|---|
| VALE | 1.04X+0.133 | 0.00101 | 0.2644 | 0.7923 | Not significant |
| VZ | 0.215X+0.00678 | 0.00182 | 0.3545 | 0.7240 | Not significant |
| WFC | 1.31X+0.0192 | 0.0439 | 1.7809 | 0.0793 | Not significant |
| WMT | 0.533X-0.00829 | 0.0172 | 1.0973 | 0.2763 | Not significant |
| XHB | 0.0253X+0.219 | 9.16E-05 | 0.0795 | 0.9369 | Not significant |
| XLF | 1.84X-0.0190 | 0.0415 | 1.7284 | 0.0884 | Not significant |
| XOP | 0.319X+0.0160 | 0.000778 | 0.2301 | 0.8187 | Not significant |
| **All Symbols** | **-0.000958X+0.028** | **2.73E-08** | **-0.0090** | **0.9928** | **Not significant** |

No significant correlation between SSF and options OI was found by the analysis. The R-squared of 2.7E-08 and P-value of 0.99 strongly indicate that there is no correlation between the datasets.

When looking at individual symbols, there is no significant correlation between SSF and option OI in 44 of 46 symbols. There is also a fairly random mix of direction on the slope of the best fit line between symbols. 25 of 46 symbols have positive slopes while the remaining 21 have negative slopes. If there was a correlation between the products, the slope would either be expected to be consistently positive or consistently negative.

Even in the two symbols (ABEV and CX) where the P-value showed a statistically significant correlation between SSF and Option OI, the result is suspect because it is dependent on statistical outliers.




As shown in the above graphs, when the statistical outliers are removed, any correlative effect immediately disappears.

We found no evidence to suggest that SSFs and options are related products or that they trade in similar ways. There is no evidence of any correlation between SSF trading and options trading.

One weakness of the above analysis is that it is impossible to prove a negative statistically. Though we determine that there is no evidence that the two products are correlated, we cannot determine that there is evidence that they are not. However, the data is highly suggestive given how low $R^2$ is and how high the P-value is. Second, it is possible that the sample of symbols chosen does not accurately reflect the total population of symbols. Because of the illiquidity of many SSFs, the ability to test many symbols was restricted by the absence of consistent data. Because the sample of symbols was selected based on the areas where consistent data existed instead of using a random sample, there is a possibility that the sample does not accurately reflect the population. However, because the symbols chosen were the most actively traded, they also represent a fairly large percentage of the SSF market which increases the likelihood that the sample is representative.[14] That the result in Analysis 1 also confirms the result here also reduces the likelihood of this influencing the result of the study. Third, the analysis cannot account for different options trading strategies. If there were some options strategies whose trading was correlated with SSF, the correlation could be obscured by the "noise" of other option strategies. However, even if different options strategies would reduce the significance of an effect, we would still expect some correlation to be evident given the large sample size.

[14] For example, on October 15, 2019, the symbols included in the analysis accounted for 57% of total SSF OI.

**Attachment B**

**Single Stock Futures and Equity Options: A Comparison**

At the turn of the century, security futures in the U.S. were authorized by the Commodity Futures Modernization Act of 2000. The Act ended the ban on security futures that had been in place since the mid-1980s. At the time, the prevailing belief was that single stock futures ("SSFs"), a type of security futures, were comparable to equity options and would be used interchangeably. Consequently, the law was written to prevent regulatory arbitrage between the two products. Unfortunately, the prevailing thought was incorrect, SSFs are not comparable to options and cannot be used interchangeably.

SSFs are a delta one exchange traded equivalent to total return equity swaps ("TRS"), stock loan and equity repo transactions.[15] Delta one instruments are derivatives that have no optionality and move in sympathy with the underlying instrument as a substitute; accordingly for a given move in the underlying instrument there is an identical move in the derivative. Delta one instruments are used in financing transactions as follows: the TRS buyer/Single Stock Future ("SSF") buyer pays the other party a financing charge in exchange for synthetic exposure to the underlying equity stock. As a result, if the underlying stock price goes up, the TRS buyer/SSF buyer will receive payment equal to the price differential; if the underlying stock price goes down, the TRS buyer/SSF buyer will pay the price differential, as though it owns the stock which replicates the economics returns of owning the underlying stock. Therefore, the economics works like a financing transaction with the TRS/SSF buyer paying the financing charge (interest) to the TRS/SSF seller who passes on the Profit and Loss ("PnL") of owning the stock to the TRS/SSF buyer. Options are not delta one instruments which means that they are not equivalent to total return swaps and are not a financing transaction. There is additional risk attendant to the option position beyond a delta one relationship. The option buyer is not seeking to synthetically replicate the economics of owning the underlying equity stock. In fact, depending on the option strategy, an option buyer seeks to take a bullish or bearish view of the market and make profits based on the price movements vis-à-vis the strike price, which does not have a delta one relationship. SSFs are sought out due to their delta one nature, not as a substitute for options.

Plain vanilla single stock futures provide directional (i.e. long or short) exposure to the underlying issue. The theoretical price of a SSF is based on the underlying stock price, time until expiration and the interest rate which may be negative due to hard to borrow pressure.

Plain vanilla (long call, short call, long put, or short put) equity options provide risk managed (e.g. unlimited upside, limited downside) exposure to the underlying stock. The theoretical price of an option is based on the underlying stock price, the strike price, time until expiration, implied volatility, dividends and the interest rate which may be negative due to hard to borrow pressure. Option pricing is advanced match premised on the probability of the option expiring in the money. There are multiple option pricing formulas, for example, Black-Sholes, Barone-Adesi Whaley, Binomial, and Monte Carlo.

[15] The Options Clearing Corporation ("OCC"), the world's largest equity derivatives clearinghouse and a Systemically Importation Financial Market Utility, recognizes that SSF and TRS have the same risk profile and that options and SSF have different risk profiles. "A total return SB Swap based on a single underlying security of a large cap company poses even less risk management challenge than a put or call option on the same underlying security and is much the same as a security future on the same underlying. April 29, 2011 letter to Elizabeth Murphy, SEC from William Navin, OCC, S7-08-11 Clearing Agency Standards for Operations and Governance

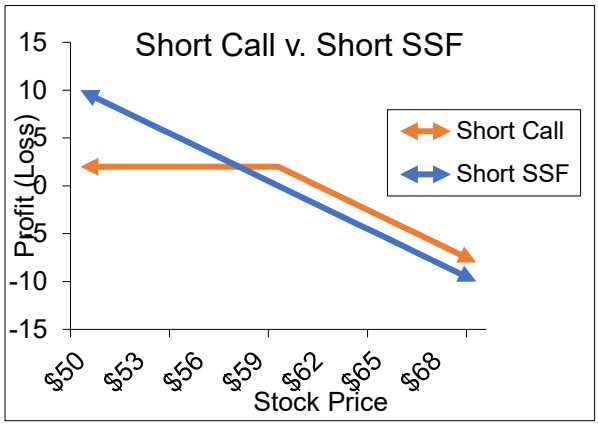
**Comparable Options?**

In the proposed rule, the Commissions primarily identify unhedged options as comparable to SSFs,[16] therefore, this discussion will focus first on short unhedged options. The Commissions further note that SSFs can be replicated by a synthetic long stock or short stock option position; consequently, those positions will also be examined.[17]

Profit and loss graphs[18] will be used to visualize the profitability of these strategies at different market levels absent commissions, fees and other trading costs. Profit (loss) graphs provide visuals on how a position will generally perform across a range of underlying prices and are useful in comparing potential profit and loss across different strategies/positions.

According to the Options Industry Council[19] ("OIC"), there are 45 options strategies[20] ranging from the simple long or short call or put to the complex positions with up to 4 components such Long Condor. For each of these 45 strategies, OIC publishes PnL graphs, example positions, maximum gain and loss information and comparable position. A summary of this information is attached as Appendix A. The PnL graphs published by OIC visualize the potential profit (loss) of each of these strategies.

For example, the below PnL graphs for a short call shows the maximum loss is unlimited while the maximum profit is limited to the premium received. As the Commissions have stated that a short option is comparable to a SSF, a short SSF position is presented on the same graph.

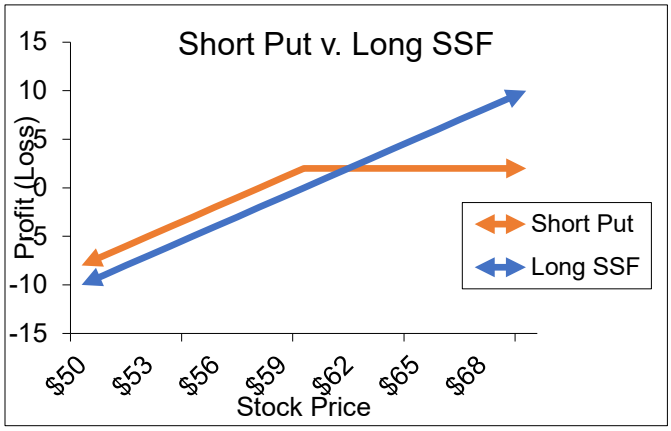



[16] Commodity Futures Trading Commission and Securities and Exchange Commission "Customer Margin Rules Relating to Security Futures". Release No. 34-086304; File No. S7-09-19. 84 FR 36439 "In this proposal, the Commissions seek to align the margin rate for security futures with the lower portfolio-based margin rate for exchange-traded options because the Commissions view exchange-traded options held in portfolio margin accounts as comparable to security futures that may be held alongside the exchange-traded options."
[17] Ibid 84 FR 36440, Footnote 62
[18] The Options Industry Council states "Profit and loss graphs help visualize how a certain options strategy may perform over a variety of prices. These graphs help us understand our gain or loss potential for a given strategy. Profit/loss graphs also help replicate various positions with options. For example, how to replicate the gain/loss profile for a long stock position with a particular option strategy (long call coupled with a short put)."
[19] The Options Industry Council, formed in 1992, is an industry resource funded by The Options Clearing Corporation dedicated to helping individuals, financial advisors and institutions understand the benefits and risks of exchange-listed options through unbiased educational content.
[20] See https://www.optionseducation.org/strategies/all-strategies-en

**Attachment B**

The PnL graph clearly shows that the short call has limited profit as the stock price decreases and unlimited losses as the stock prices increases. In contrast, the short SSF's profit is limited to the entire stock price while it also has unlimited losses as the stock price increases. While both market participants may be anticipating a market break, the option seller would not have the same returns as the SSF seller should the market break as they anticipated. Only if their market forecast was incorrect and the stock rose would the SSF and the short call have a similar profit. The OIC and CBOE both state that the only motive for selling an uncovered call is to earn income from selling premium. [21] There is no ability to earn income using SSF in the same way as there is no concept of premium in SSFs. Therefore, customers who wanted to earn income could not use SSFs to achieve their investment objective. SSF sellers' motive is to generate profits by a falling price in the underlying equity. A stagnant stock price does not generate return for the SSF seller as it does for the call seller. A customer who desired a short call but traded a short SSF would not find the product comparable given the difference in income generated and maximum transaction profit despite the similarities in maximum loss. Based on the foregoing, it is clear that a short call and a short SSF do not have similar risks/reward and therefore are not comparable or interchangeable.

A similar scenario occurs with a short put which has profit limited to premium received while the loss is limited to the entire stock price. In contrast, the long SSF's profit is unlimited while its maximum loss is the entire share price.




The PnL graph clearly shows that the two position's risk/reward diverge as the underlying stock price rises above the strike price. While both market participants may be anticipating a market rally, a market participant who sold a put would not have the same risk and returns as SSF buyer should the market rally as they anticipated. As with the short call, both the OIC and CBOE state that the only motive for selling an uncovered put is to earn income from selling premium. [22] Additionally, CBOE notes that put sellers can be motivated to acquire stock at a net cost below current market value due to the premium income.

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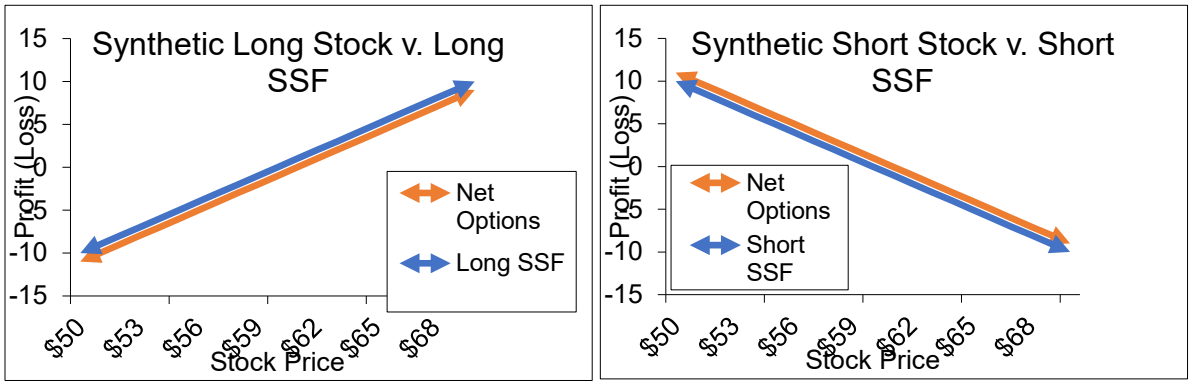
[21] "Naked Call (Uncovered Call, Short Call." The Options Industry Council, www.optionseducation.org/strategies/all-strategies/naked-call-uncovered-call-short-call?source=3127f1e6-8969-41c7-a0eb-50a711cc9195. Accessed 4 Apr 2020 and "Understanding Stock Options." Chicago Board Options Exchange, www.cboe.com/learncenter/pdf/understanding.pdf. Accessed 4 Apr 2020

[22] "Naked Put (Uncovered Put, Short Put." The Options Industry Council, www.optionseducation.org/strategies/all-strategies/naked-put-uncovered-put-short-put?source=3127f1e6-8969-41c7-a0eb-50a711cc9195. Accessed 4 Apr 2020 and "Understanding Stock Options." Chicago Board Options Exchange, www.cboe.com/learncenter/pdf/understanding.pdf. Accessed 4 Apr 2020

**Attachment B**

There is no ability using SSFs to earn income as there is no concept of premium in SSFs. SSFs on general collateral stocks will trade higher than the underlying stock and thus do not provide the opportunity to acquire stock at below current value. Therefore, customers who wanted to earn income could not use SSFs to achieve their investment objective. Customers who want a short SSF but traded a short put would not find the products comparable given the difference in income generated and maximum transaction profit despite the similarities in maximum loss. Based on the foregoing, it is clear that a short put and a long SSF do not have similar risks/reward and therefore are not comparable or interchangeable.

The synthetic long position created using options (long call, short put, same strike, same expiration) and the synthetic short position created using options (long put, short call, same strike, same expiration) most closely track the profit/loss of the corresponding single stock future position. However, the synthetic long or synthetic short option positions are subject to assignment risk,[23] pin risk,[24] and dividend risk.[25] Assignment risk increase when the short options is in the money and an upcoming dividend is greater than the time value left in the option. In that case, the long option holder will exercise to collect the dividend, leaving the option holder with an unwanted and expensive equity position. For instance, an investor who initiated a synthetic long stock position and was assigned on the short put is now long stock and long the call which is not the synthetic long position they initiated. Pin risk may result in the short position being assigned which creates a naked position in the underlying unless the participant exercises the long position. However, if the market participant exercises their long position and is not assigned on the short position, then they have a naked position in the underlying from their exercise.




**Dividend Risk**

Approximately 58% of U.S. listed non-exchange traded products currently pay dividends.[26] These products all have dividend risk which can negatively or positively impact their returns from the option

[23] Assignment risk materializes when the owner of the call or put option exercises the option prior to its expiration date and the option seller is a assigned a short or long position in the underlying stock.
[24] Pin risk arises when the market price of the underlying stock at the time of the put and call's expiration is close to the strike price. If this occurs, there is a risk that options may not be exercised and the customer is left with a large, undesired, and unhedged stock position.
[25] Dividend risk occurs when a dividend on the underlying stock is unexpectedly cancelled, raised, or lowered. Because the pricing of an option takes into account the anticipated dividend amount, any dividends paid that are different than this anticipated amount will change the profitability of the trade.
[26] Fidelity Investments stock screener

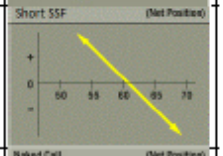
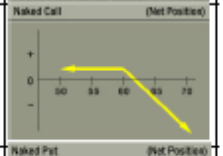
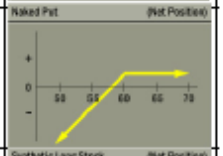
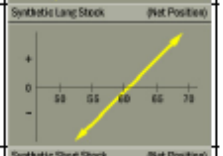
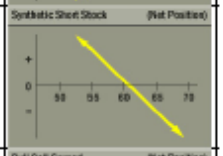
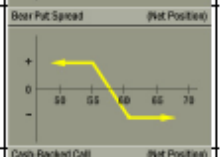
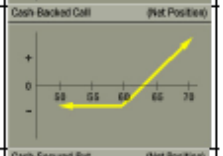
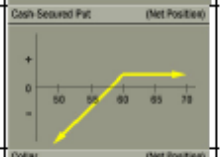
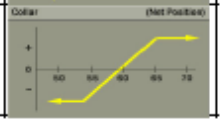
trade. For instance, for a stock priced at $39.34 paying an anticipated $0.30 dividend with an at the money option of 39.50, with 36 days left to expiration, a 20% reduction in the dividend causes a $0.032 reduction in the theoretical put price while a 20% increase in the dividend causes at similar increase in the theoretical put price. A market participant with $100 million put position (~25,000 contacts) would be impacted by $80,000 (0.032*25000*100) or 8 basis points of the notional value.[27] There is no impact from dividend changes to the holder of the OneChicago No Dividend Risk ("NDR") future as it is adjusted by the dividend amount on the ex-date.

**Summary**

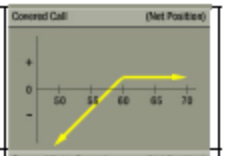
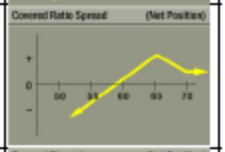
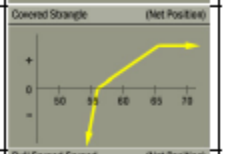
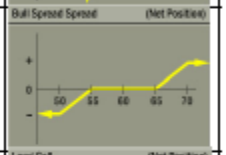
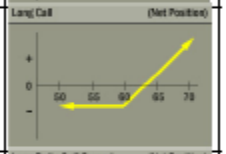
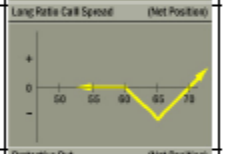
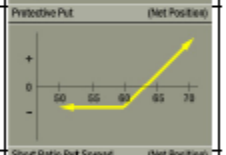
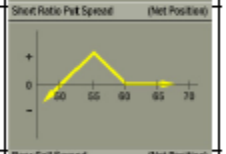
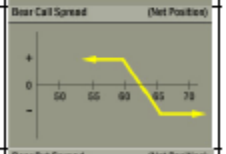
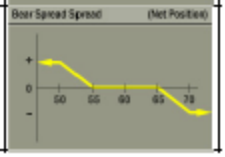
SSF holders and options holders have different objectives, different risks and different returns. Market participants with similar market forecasts who participate in SSF markets and naked short options have dissimilar outcomes due to the limited profit potential of option sellers or the limited loss of options buyers. SSF participants, as shown in the PnL graphs, do not have the ability for limited profit or loss strategies. While synthetic long or short positions created using options may have similar returns, they have assignment risk, dividend risk, and pin risk, none of which are present in the SSFs. **As such, the SSFs are not used by market participants as substitutes for or interchangeable with options.** Finally, critically important, SSFs are delta one exchanged traded equivalents to equity total return swaps and can be used in equity finance transactions such as equity repo and stock loan whereas options are not delta one transactions, not equivalent to equity total return swaps and cannot be used in equity finance transactions.

[27] See Appendix B

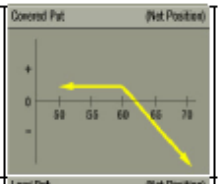
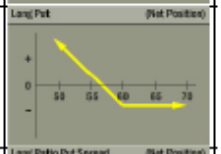
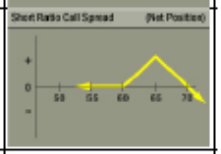
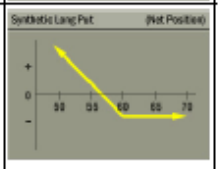
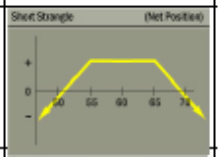
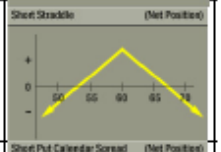
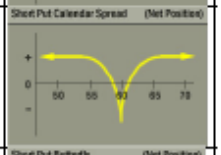
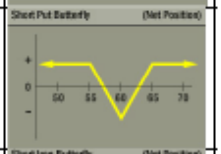
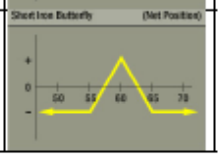
**Attachment B**
Appendix A
Option Strategies and Single Stock Futures

| Name | Description | Example | Maximum Profit | Maximum Loss | Comparable Position | Closest Similar Single Stock Future and Differences | Profit Loss Graph |
|---|---|---|---|---|---|---|---|
| Long SSF | Long SSF | Long ABC SSF | Unlimited | Entire Price | None | N/A |  |
| Short SSF | Short SSF | Short ABC SSF | Entire Price | Unlimited | None | N/A |  |
| Naked Short Call | Short Call | Short 60 Call | Premium Received | Unlimited | Covered Put | Short SSF - Differences are SSF has greater potential gain, no pin risk, no assignment risk and no dividend risk. |  |
| Naked Short Put | Short Put | Short 60 Put | Premium Received | Strike Price - Premium | Covered Call | Long SSF - Differences are SSF has greater potential gain, no pin risk, no assignment risk and no dividend risk. |  |
| Synthetic Long Stock | Long Call, Short Put, Same Expiration, Same Strike | Long 60 Call, Short 60 Put | Unlimited | Strike - Premium Paid | Long Stock | Long SSF - Differences are SSF has no pin risk, no assignment risk and no dividend risk. |  |
| Synthetic Short Stock | Short Call, Long Put, Same Strike, Same Expiration | Short 60 Call, Long 60 Put | Strike Price - Net Premium Received | Unlimited | Short Stock | Short SSF - Differences are SSF has no pin risk, no assignment risk and no dividend risk. |  |
| Bull Call Spread | Long Call, Short Call at Higher Strike, Same Expiration | Long 60 Call, Short 65 Call | High Strike - Low Strike - Net Premium Paid | Net Premium Paid | Bull Put Spread | None |  |
| Bull Put Spread | Short Put, Long Put at Lower Strike, Same Expiration | Long 60 Put, Short 55 Put | Net Premium Received | High Strike - Low Strike - Net Premium Received | Bull Call Spread | None |  |
| Cash-Backed Call (Cash-Secured Call) | Long Call, cash reserved to exercise | Long 60 Call, Long T - Bill | Unlimited | Premium Paid | Protective Put | None |  |
| Cash Secured Put | Short Put, cash reserved to purchase stock | Short 60 Put, Long T - Bill | Premium Received | Strike - Premium Received | Covered Call | Long SSF - Differences are SSF has greater potential gain and no dividend risk. |  |
| Protective Collar | Short Call, Long Lower Strike Put, Same Expiration, Long Stock at a Price between the Strikes | Short 65 Call, Long 55 Put, Long 100 Shares at 60 | Call Strike - Stock price - (+) net premium paid (received) | Stock Price - Put Strike - (+) net premium paid (received) | None | None |  |

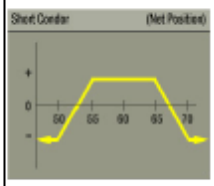
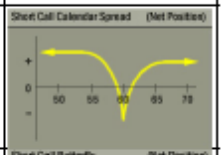
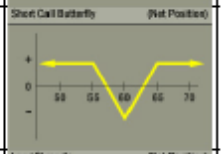
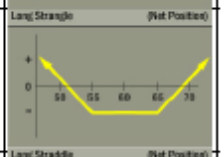
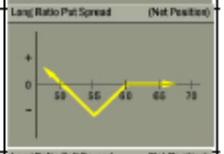
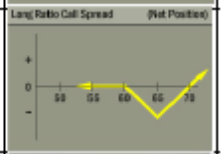
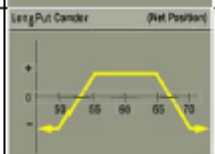
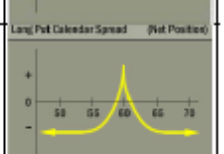
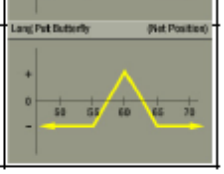
**Attachment B**
Appendix A
Option Strategies and Single Stock Futures

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Covered Call (Buy/Write | Short Call, Long Stock | Short 60 Call, Long Stock | Strike Price - Stock Price + Premium Received | Stock Price - Premium Received | Cash Secured Put | Long SSF - Differences are SSF has greater potential gain and no dividend risk. |  |
| Covered Ratio Spread | Long Stock, Short 2 Calls, Long Higher Strike Call, Same Expiration | Short 2 65 Calls, Long 1 70 Call, Long Stock | Lower Strike - Stock Purchase + Net Premium Received | Stock Price - Net Premium Received | None | None |  |
| Covered Strangle (Covered Combination) | Long Stock, Short Call, Short Lower Strike Put, cash reserved to cover assignment, Same Expiration | Short 65 Put, Short 55 Put, Long Stock, Long T - Bill | Call Strike - Stock Price + Net Premium Received | Stock Price + Put Strike -Net Premium Received | None | None |  |
| Double Bull Spread (Bull Spread Spread) | Long Call, Short Higher Strike Call, Short Put, Long Lower Strike Put. Call Strikes are above stock and Put Strikes are below. Difference between Call and Put | Short 70 Call, Long 65 Call, Short 55 Put, Long 50 Put | High Call Strike - Low Call Strike - Net Premium Paid | High Put Strike - Low Put Strike - Net Premium Paid | None | None |  |
| Long Call | Long Call | Long 60 Call | Unlimited | Premium Paid | Protective Put | Long SSF - Differences are SSF has greater potential loss and no dividend risk. |  |
| Long Ratio Call Spread | Short Call, Long 2 Calls at Higher Strike , Same Expiration | Short 60 Call, Long 2 65 Calls | Unlimited | High Strike - Low Strike - Net Premium Paid | None | None |  |
| Protective Put (Married Put) | Long Put, Investor was Already Long Stock | Long 60 Put, Long Stock | Unlimited | Stock Price - Strike Price - Premium Paid | Cash Backed Call | Long SSF - Differences are SSF has greater potential loss and no dividend risk. |  |
| Short Ratio Put Spread | Long ATM Put, Short 2 Puts at Lower Strike, Same Expiration | Long 1 60 Put, Short 2 55 Puts | High Strike - Low Strike - Net Premium Received | Low Strike - (High Strike - Low Strike) - Net Premium Received | Covered Ratio Spread | None |  |
| Bear Call Spread | Short Call, Long Call, Same Expiration, Short Call has Lower Strike Price | Short 60 Call, Long 65 Call | Net Premium Received | High Strike - Low Strike - Net Premium Received | Bear Put Spread | None |  |
| Bear Put Spread | Short Put, Long Put at Lower Strike, Same Expiration | Long 60 Put, Short 55 Put | High Strike Price - Low Strike Price - Net Premium Paid | Net Premium Paid | Bear Call Spread | None |  |
| Double Bear Spread (Bear Spread Spread) | Short call, Long Call at Higher Strike, Long Put and Short Put at Lower Strike | Long 70 Call, Short 65 Call, Long 55 Put, Short 50 Put | High Put Strike - Low Put Strike - Net Premium Paid | High Call Strike - Low Call Strike - Net Premium Paid | None | None |  |

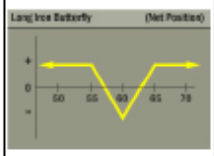
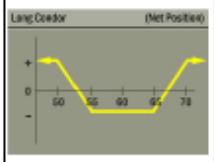
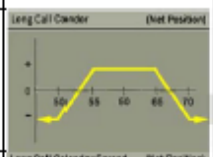
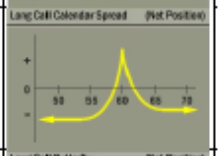
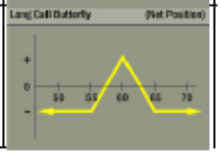
**Attachment B**
Appendix A
Option Strategies and Single Stock Futures

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Covered Put | Short Stock, Short Deep ITM Put | Short Stock, Short 60 Put | Short Stock Price - Strike Price + Premium Received + Interest on Premium | Unlimited | Naked Call | Short SSF - Differences are SSF has greater potential gain, no assignment risk, no pin risk, and no dividend risk. |  |
| Long Put | Long Put | Long 60 Put | Strike Price - Premium Paid | Premium Paid | Synthetic Long Put | Short SSF - Differences are SSF has greater potential loss and no dividend risk. |  |
| Long Ratio Put Spread | Short Put, Long 2 Puts with Lower Strikes, Same Expiration | Short 1 60 Put, Long 2 55 Puts | Low Strike - (High Strike - Low Strike) - Net Premium Paid | High Strike - Low Strike - Net Premium Paid | None | None |  |
| Short Ratio Call Spread | Long ATM Call, Short 2 Higher Strike Calls, Same Expiration | Long 60 Call, Short 2 65 Calls | High Strike - Low Strike - Premium Received | Unlimited | None | None |  |
| Synthetic Long Put | Long Call, Short Stock | Long 60 Call, Short Stock | Short Stock Price - Premium Paid | Strike Price - Short Stock Price | Long Put | Short SSF - Differences are SSF has greater potential loss and no dividend risk. |  |
| Short Strangle | Short Call, Short Put at lower strike, generally both OTM, Same Expiration | Short 1 65 Call, Short 55 Put | Net Premium Received | Unlimited | None | None |  |
| Short Straddle | Short Call, Short Put, Same Strike, Same Expiration | Short 1 60 Call, Short 1 60 Put | Premium Received | Unlimited | None | None |  |
| Short Put Calendar Spread (Short Put Time Spread) | Long Nearby Put, Short Deferred Put, Same Strike, Different Expiration | Long 1 Nearby 60 Put, Short 1 Deferred 60 Put | Net Premium Received | Strike - Net Premium Received | Short Call Calendar Spread | None |  |
| Short Put Butterfly | Short 1 High Strike Put, Long 2 Mid Strike Put and Short 1 Low Strike Put, Same Expiration | Short 1 65 Put, Long 2 60 Puts, Short 1 55 Put | Net Premium Received | High Strike - Middle Strike - Net Premium Received | Short Call Butterfly | None |  |
| Short Iron Butterfly | Long High Strike Call, Short Mid Strike Call, Short Mid Strike Put, Long Low Strike Put, Same Expiration | Long 1 65 Call, Short 1 60 Call, Short 1 60 Put, Long 1 55 Put | Net Premium Received | High Strike - Middle Strike - Net Premium Received | Long Call Butterfly | None |  |

**Attachment B**
Appendix A
Option Strategies and Single Stock Futures

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Short Condor (Iron Condor) | Long High Strike Call, Short Lower Strike Call, Short Even Lower Strike Put, Long Lowest Strike Put | Long 1 70 Call, Short 1 65 Call, Short 1 55 Put, Long 1 50 Put | Net Premium Received | High Call Strike - Low Call Strike -Net Premium Received OR High Put Strike - Low Put Strike - Net Premium Received | None | None |  |
| Short Call Calendar Spread (Short Call Time Spread) | Long Call, Short Call with Deferred Expiration, Same Strike | Long 1 Nearby 60 Call, Short 1 Deferred 60 Call | Net Premium Received | Unlimited | Short Put Calendar Spread | None |  |
| Short Call Butterfly | Short 1 High Strike Call, Long 2 Middle Strike Calls, Short 1 Low Strike Call, Same Expiration | Short 1 65 Call, Long 2 60 Calls, Short 1 55 Call | Net Premium Received | High Strike - Middle Strike - Net Premium Received | Short Put Butterfly | None |  |
| Long Strangle | Long OTM Call, Long OTM Lower Strike Put, Same Expiration | Long 65 Call, Long 55 Put | Unlimited | Net Premium Paid | None | None |  |
| Long Straddle | Long Call, Long Put, Same Strike, Same Expiration | Long 60 Call, Long 60 Put | Unlimited | Premium Paid | None | None |  |
| Long Ratio Put Spread | Short 1 Put, Long 2 Lower Strike Puts, Same Expiration | Short 1 60 Put, Long 2 55 Puts | Low Strike - (High Strike - Low Strike) - Net Premium Paid | High Strike - Low Strike - Net Premium Paid | None | None |  |
| Long Ratio Call Spread | Short 1 Call, Long 2 Higher Strike Calls, Same Expiration | Short 1 60 Call, Long 2 65 Calls | Unlimited | High Strike - Low Strike - Net Premium Paid | None | None |  |
| Long Put Condor | Long OTM Put, Short OTM Put at Higher Strike, Short 1 ITM Put at Even Higher Strike, Long DITM Put at Highest Strike, Same Expiration | Long 55 Put, Short 60 Put, Short 65 Put, Long 70 Put | (Highest Long Put Strike - Highest Short Put Strike) - Net Premium Paid | Net Premium Paid | Short Condor (Iron Condor) | None |  |
| Long Put Calendar (Horizontal) | Short Nearby Put, Long Deferred Put, Same Strike | Short Nearby 60 Put, Long Deferred 60 Put | Strike Price - Net Premium Paid | Net Premium Paid | None | None |  |
| Long Put Butterfly | Long High Strike Put, Short 2 Middle Strike Puts, Long Low Strike Put | Long 1 65 Put, Short 2 60 Puts, Long 1 55 Put | High Strike - Middle Strike - Net Premiums Paid | Net Premium Paid | Long Call Butterfly | None |  |

**Attachment B**
Appendix A
Option Strategies and Single Stock Futures

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Long Iron Butterfly | Short High Strike Call, Long Call Middle Strike, Long Put Middle Strike, Short Put Low Strike, Same Expiration, High and Low Strike are equidistant from Middle Strike | Short 65 Call, Long 60 Call, Long 60 Put, Short 55 Put | High Strike - Middle Strike - Net Premiums Paid | Net Premium Paid | Short Call Butterfly | None |  |
| Long Condor | Long Call, Short Call with Higher Strike, Long Put with Lower Strike, Short Put with Lowest Strike, Same Expiration | Long 65 Call, Short 70 Call, Long 55 Put, Short 50 Put | (High Call Strike - Low Call Strike) - Net Premium Paid OR (High Put Strike - Low Put Strike - Net Premium Paid | Net Premium Paid | None | None |  |
| Long Call Condor | Long ITM Call, Short Higher ITM Strike Call, Short Even Higher OTM Call, Long Highest Strike OTM Call | Long 55 Call, Short 60 Call, Short 65 Call, Long 70 Call | (Lowest Short Call Strike - Lowest Long Call Strike) - Net Premium Paid | Net Premium Paid | Short Condor (Iron Condor) | None |  |
| Long Call Calendar (Horizontal) | Short Nearby Call, Long Deferred Call, Same Strike, Different Expirations | Short Nearby 60 Call, Long Deferred 60 Call | Unlimited | Net Premium Paid | None | None |  |
| Long Call Butterfly | Long High Strike Call, Short 2 Middle Strike Calls, Long Lower Strike Call, Same Expiration, Wings Are Equidistant From Center | Long 1 65 Call, Short 2 60 Calls, Long 1 55 Call | High Strike - Middle Strike - Net Premium Paid | Net Premium Paid | Long Put Butterfly | None |  |

Source: Options Industry Council, All Strategies (https://www.optionseducation.org/strategies/all-strategies-en) for options information.

Attachment B
Appendix B
Theoritical Option Price Changes Due to Dividend Changes

## 20% lower dividend

For more information or help, please view our help files or contact our options professionals at 1-888-OPTIONS (1-888-678-4667)

Symbol: CF | Stock or Index Symbol | Option symbol | GO | Calculators Help

CF: NYSE - CF Industries Holdings Inc  Data as of: 02/13/2020  Today: 02/14/2020

| | |
|---|---|
| Style: | American |
| Price: | 39.34 |
| Strike: | 39.5 |
| Expiration Date: | Mar 20, 2020 |
| Days to Expiration: | 35 |
| Volatility %: | 29.62 |
| Interest Rate%: | 1.6585 |
| Dividends Date (mm/dd/yy): | 03/13/20 |
| Dividends Amount: | .24 |
| Dividends Frequency: | Quarterly |

Calculate

| | Call | Put |
|---|---|---|
| Option Value: | 1.3349 | 1.6148 |
| Delta: | 0.5053 | -0.5202 |
| Gamma: | 0.1167 | 0.1119 |
| Theta: | -0.0223 | -0.0195 |
| Vega: | 0.0479 | 0.0480 |
| Rho: | 0.0156 | -0.0190 |

Implied Volatility

| Option Price | Vola % |
|---|---|
| Call | 0.00 |

Calculate

## Baseline Dividend

# Basic Options Calculator - *Powered by IVolatility.com*

Our Basic Options Calculator, powered by IVolatility.com, provides fair values and Greeks of any option using our volatility data and previous trading day prices. You may customize all the input parameters (option style, price of the underlying instrument, strike, expiration, implied volatility, interest rate and dividends data) or enter a stock or options symbol and the database will populate all those fields for you! Note that the option's underlying price is the previous trading day's market closing price.

For more information or help, please view our help files or contact our options professionals at 1-888-OPTIONS (1-888-678-4667)

Symbol: CF | Stock or Index Symbol | Option symbol | GO | Calculators Help

CF: NYSE - CF Industries Holdings Inc  Data as of: 02/13/2020  Today: 02/14/2020

| | |
|---|---|
| Style: | American |
| Price: | 39.34 |
| Strike: | 39.5 |
| Expiration Date: | Mar 20, 2020 |
| Days to Expiration: | 35 |
| Volatility %: | 29.62 |
| Interest Rate%: | 1.6585 |
| Dividends Date (mm/dd/yy): | 03/13/20 |
| Dividends Amount: | .30 |
| Dividends Frequency: | Quarterly |

Calculate

| | Call | Put |
|---|---|---|
| Option Value: | 1.3262 | 1.6468 |
| Delta: | 0.5058 | -0.5268 |
| Gamma: | 0.1178 | 0.1119 |
| Theta: | -0.0224 | -0.0195 |
| Vega: | 0.0477 | 0.0480 |
| Rho: | 0.0154 | -0.0193 |

Implied Volatility

| Option Price | Vola % |
|---|---|
| Call | N/A |

Calculate

Attachment B
Appendix B
Theoritical Option Price Changes Due to Dividend Changes

**20% higher dividend**

## Basic Options Calculator - *Powered by IVolatility.com*

Our Basic Options Calculator, powered by IVolatility.com, provides fair values and Greeks of any option using our volatility data and previous trading day prices. You may customize all the input parameters (option style, price of the underlying instrument, strike, expiration, implied volatility, interest rate and dividends data) or enter a stock or options symbol and the database will populate all those fields for you! Note that the option's underlying price is the previous trading day's market closing price.

For more information or help, please view our help files or contact our options professionals at 1-888-OPTIONS (1-888-678-4667)

Symbol: CF (•) Stock or Index Symbol ( ) Option symbol GO Calculators Help

**CF: NYSE - CF Industries Holdings Inc Data as of: 02/13/2020 Today: 02/14/2020**

| | |
|---|---|
| Style: | American |
| Price: | 39.34 |
| Strike: | 39.5 |
| Expiration Date: | Mar 20, 2020 |
| Days to Expiration: | 35 |
| Volatility %: | 29.62 |
| Interest Rate%: | 1.6585 |
| Dividends Date (mm/dd/yy): | 03/13/20 |
| Dividends Amount: | .36 |
| Dividends Frequency: | Quarterly |

Calculate

| | Call | Put |
|---|---|---|
| Option Value: | 1.3185 | 1.6789 |
| Delta: | 0.5064 | -0.5335 |
| Gamma: | 0.1189 | 0.1119 |
| Theta: | -0.0226 | -0.0194 |
| Vega: | 0.0477 | 0.0480 |
| Rho: | 0.0153 | -0.0195 |

**Implied Volatility**

| | Option Price | Vola % |
|---|---|---|
| Call | | N/A |

Calculate