# Tactical Strategies for Conservative Investors

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**Abstract**

The initial goal of this research was to identify a strategy with a volatility comparable to that of the conservative buy and hold portfolio of 20% US stocks and 80% bonds, but with a lower drawdown and a consistently higher return. Maurer's S121 tactical strategy and the variations developed herein did not achieve this goal.

The revised goal is a strategy with a volatility comparable to that of the moderate portfolio of 60% US stocks and 40% bonds. Certain tactical strategies and the Swan active option strategy provide lower drawdowns than this benchmark and some provide consistently higher returns.

Passive option strategies and defined outcome ETFs were disappointing.

Tactical strategies control volatility by adjusting bond allocations. The presentation will speculate about performance in a low interest rate environment.

## Introduction and Summary

Most investors want a low-risk portfolio. Since low risk and high return tend to be mutually exclusive, investors generally settle for the lowest risk consistent with enough return to sustain the portfolio during retirement.

The usual investment advice is to invest broadly, because no one knows when a market sector will outperform, and to limit portfolio volatility with a fixed allocation to intermediate-term bonds. However, diversification has not always provided higher returns or lower volatility and a high fixed allocation to bonds can be problematic.

Increasing the bond allocation reduces risk statistics such as the standard deviation, Sharpe Ratio, maximum drawdown and Ulcer Performance Index but increasing the bond allocation also increases the risk of outliving the portfolio.

Tactical strategies differ from buy and hold in that they adjust the portfolio composition in response to current or anticipated market conditions. The Silicon Valley Computerized Investing Group has examined many variations of many strategies looking for better risk statistics, better longevity statistics and better ease of use.

In its most sophisticated form, tactical volatility control means choosing next month's portfolio composition based on the trailing returns, volatilities and covariances of the portfolio elements.

Maurer developed strategy 121 (S121 hereafter) in response to an investor who wished a sophisticated investment strategy which provided at least a 5% annualized return and a drawdown of no more than 5% annually.[1]

S121 is a relatively complex strategy for a beginner. I prefer simpler strategies and results can be as attractive. For example, S121 has performed about as well over the past twenty-one years as the simpler strategy of holding a portfolio of 80% intermediate term government bonds and 20% large cap US stocks. Indeed, I was unable to identify any strategy which provided significantly better results than the 20:80 portfolio.

My reference shifted to strategies with higher but still moderate volatilities. The goal was a strategy with a standard deviation of about 2.5% per month, which is the historical volatility of the 60:40 buy and hold portfolio over the past twenty-one years, but with better risk statistics.

One attractive possibility is to control the monthly volatility of QQQ, an exchange traded fund which tracks the NADSAQ 100 index, by adding intermediate bonds. Three ways of doing this are discussed. One approach is simple enough to be implemented using a spreadsheet. It could even be implemented using pencil and paper but that would be tedious.

Swan Global Investments has employed an active option strategy based on large cap US stocks since 1997. The standard deviation is about the same as that of the 60:40 portfolio but the maximum drawdown has been about half that of the 60:40 portfolio. The strategy cannot be recommended at present because it is providing lower returns than the 60:40 portfolio.

Cboe has developed and backtested a variety of passive option strategies. Buying and holding a zero-cost put spread (ticker CLLZ) has been disappointing.

Defined outcome strategies also employ passive option strategies, but these reset annually rather than monthly. Defined outcome ETFs are available from Innovator, TrueShares, FirstTrust and Allianz with a variety of reconstitution dates, downside protections and upside limitations.

Defined outcome funds moderate drawdowns but returns are disappointing.

This article describes the inner workings of S121 and of defined outcome ETFs and presents results for the strategies described above. Reliability metrics are used to test whether outperformance is the result of a lucky interval or is consistent across the backtest period.

All results are from backtesting. Since few securities have an adequate history for backtesting, various techniques are used to create the necessary prehistory,

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[1] Don Maurer, AAII Silicon Valley Computerized Investing SIG, February 6, 2020.

Archived at https://1drv.ms/u/s!ArVYry6KpqBthckzBCrT3KTt8xgovQ?e=Qb9vym

which is part of the art of backtesting. The prehistories which I use are described in CuratedData.xlsx at www.lingane.com/qi.

To ease understanding, the strategies are described using the securities with which they would be implemented. The backtesting generally used different securities.

This article is organized as follows.

## PART I. LOW VOLATILITY PORTFOLIOS

The traditional way to reduce portfolio volatility has been to add a fixed allocation to bonds. Not only do bonds tend to be less volatile than stocks but they have, in the past, tended to increase in value during times of market stress. The increase in bond values in times of stress has somewhat offset the decline in stock values.

The majority of the bond return over the past four decades has been a capital return arising from the long-term decline in interest rates. Bond yields are currently near zero and further capital returns seem unlikely in the intermediate future. Indeed, the present risk is that bond prices might depreciate and produce negative returns as yields rise. This happened to a modest degree during the first quarter of the current year.

My conclusion is that the returns of portfolios with high fixed bond allocations may be lower than in the past.

Increasing the bond allocation improves traditional risk statistics such as standard deviation, Sharpe Ratio, drawdown and Ulcer Performance Index but increasing the bond allocation also increases the risk of outliving the portfolio.

This is illustrated by the statistics in Table 1. The portfolios with an 80% allocation to fixed income were less volatile, as measured by the realized daily standard deviations (dSD), and have better Sharpe Ratios, maximum drawdowns and Ulcer Performance Indices than the 60:40 portfolios. However, the Probability of Ruin (POR) statistic[2], which estimates the risk of running out of money before death, increases as the bond allocation increases.

Table1 also shows that the risk of running out of money before death is higher with lower yielding bonds. Compare, for example the increase in POR on shifting from a portfolio of stocks and intermediate bonds to a portfolio of stocks and Tbills.

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[2] Equation 9.4 in "The Calculus of Retirement Income" by Moshe A. Milevsky, Cambridge University Press, 2006.

The POR statistic depends on the average annualized inflation adjusted return and on the standard deviation of the inflation-adjusted annualized returns. The standard deviation of the annualized returns is determined from the standard deviation of the monthly returns using the Levy-Gunthorpe (1993) method.

The POR values reported here are much higher than the failure rates reported from historical Monte Carlo simulations. There are two reasons for this. Failure rates are higher because POR measures the risk of failure over an infinite time horizon whereas the Monte Carlo simulations tend to be limited to intervals of thirty or forty years. Second, I have increased the annual withdrawal rate from the 4% typical of Monte Carlo simulations to 6% in order to accentuate differences among strategies.

POR should be used as a measure of relative performance and should not be used as a measure ff how long your personal pot of gold will last.

**Table 1. Monthly Statistics for Portfolios with a Fixed Allocation to Bonds, 2000 – 2020.** . Performance statistics are defined at www.lingane.com/qi. Source: EF Direct Performance.xlsx.

| **Risky Asset** | LrgCapUS | LrgCapUS | 40 LrgCapUS 40 Foreign 20 USREIT | QQQ | LrgCapUS | LrgCapUS | LrgCapUS | 40 LrgCapUS 40 Foreign 20 USREIT | QQQ | LrgCapUS |
|---|---|---|---|---|---|---|---|---|---|---|
| **Risk-Free Asset** | 70 VFITX 30 VUSTX | IGBond | IGBond | IGBond | 1-moTbills | 70 VFITX 30 VUSTX | IGBond | IGBond | IGBond | 1-moTbills |
| **CAGR** | 0.0562 | 0.0513 | 0.0511 | 0.0549 | 0.0269 | 0.0631 | 0.0606 | 0.0596 | 0.0667 | 0.0478 |
| **Realized dSD**[3] | 0.0025 | 0.0021 | 0.0022 | 0.0029 | 0.0019 | 0.0055 | 0.0055 | 0.0056 | 0.0087 | 0.0057 |
| **Sharpe** | 1.02 | 1.08 | 1.01 | 0.85 | 0.39 | 0.57 | 0.54 | 0.52 | 0.43 | 0.39 |
| **MaxDD** | 0.07 | 0.06 | 0.08 | 0.11 | 0.11 | 0.30 | 0.30 | 0.34 | 0.56 | 0.34 |
| **UPI** | 3.00 | 3.21 | 2.48 | 1.26 | 0.45 | 0.59 | 0.54 | 0.59 | 0.21 | 0.31 |
| **Risky Asset Allocation** | 20% | 20% | 20% | 20% | 20% | 60% | 60% | 20% | 60% | 60% |
| **Bond Allocation** | 80% | 80% | 80% | 80% | 80% | 40% | 40% | 80% | 40% | 40% |
| **Annualized Mean** | 0.0354 | 0.0304 | 0.0302 | 0.0344 | 0.0063 | 0.0453 | 0.0427 | 0.0421 | 0.0548 | 0.0305 |
| **Annualized SD** | 0.0447 | 0.0377 | 0.0396 | 0.0498 | 0.0325 | 0.0923 | 0.0915 | 0.0939 | 0.1451 | 0.0942 |
| **Probability of Ruin @ 6% w/d** | 28% | 32% | 33% | 29% | 60% | 25% | 27% | 28% | 27% | 38% |

[3] Tactical methods to control volatility control the daily standard deviation (dSD). Volatility goals are expressed in terms of daily standard deviations.

The standard deviation which is measured from the monthly equity curve is a monthly standard deviation (mSD). Solely for comparison to the dSD goal, realized dSD is realized mSD divided by the square root of 21.

If bonds provide lower returns in the immediate future than in the past, some buy and hold investors will be forced to increase fixed income allocations with their attendant higher volatilities in order to maintain current spending without increasing the risk of running out of money.

Tactical strategies differ from buy and hold in that they adjust the portfolio composition in response to current or anticipated market conditions. This allows for low allocations when the market is rising – thereby increasing return - and high allocations when the market is falling – and protection is more important than return.

This article tests low volatility tactical strategies and identifies some which have outperformed a fixed allocation to bonds.

**Controlling Volatility (Standard Deviation) by Dilution with a Security of Lower Volatility**

It is often possible to control the portfolio standard deviation at a particular value by diluting the stock portfolio with a lower-risk asset like Treasury bills (Tbills) or intermediate term bonds. Allocations need to be updated periodically to ensure that the standard deviation of the portfolio remains at the desired value as market conditions change. Monthly updates are employed in this article.

When a risky (volatile) security is diluted with a lower risk (less volatile) security, the return for portfolios containing the two securities is

$$Return_{portfolio} = W_{risky\ asset} * Return_{risky\ asset} + (1 - W_{risky\ asset}) * Return_{lower\ risk\ asset}$$

where $W_{risky\ asset}$ is the weight of and allocation to the risky security.

The allocation to the lower-risk security is $1 - W_{risky\ asset}$.

When the volatility of the lower risk security is low and/or the covariance (correlation) between the returns of the risky and lower risk securities is small, the lower risk asset is considered "risk-free" and the standard deviation of the portfolio containing a risky and a risk-free security can be approximated as

$$SD_{portfolio} = W_{risky\ asset} * SD_{risky\ asset}$$

*When the volatility and/or covariance of the lower risk securities is not small, there is a quadratic relationship among the volatilities. See Appendix A. We make no distinction between lower risk and risk-free securities in the remainder of this article but be aware that it is generally necessary to solve the quadratic relationship when using bonds as the risk-free asset/security.*

Maurer used these concepts when he developed the S121 strategy. His risky asset was the portfolio constructed from SPY, QQQ and IEF. Three-month Tbills served as Maurer's risk-free asset.

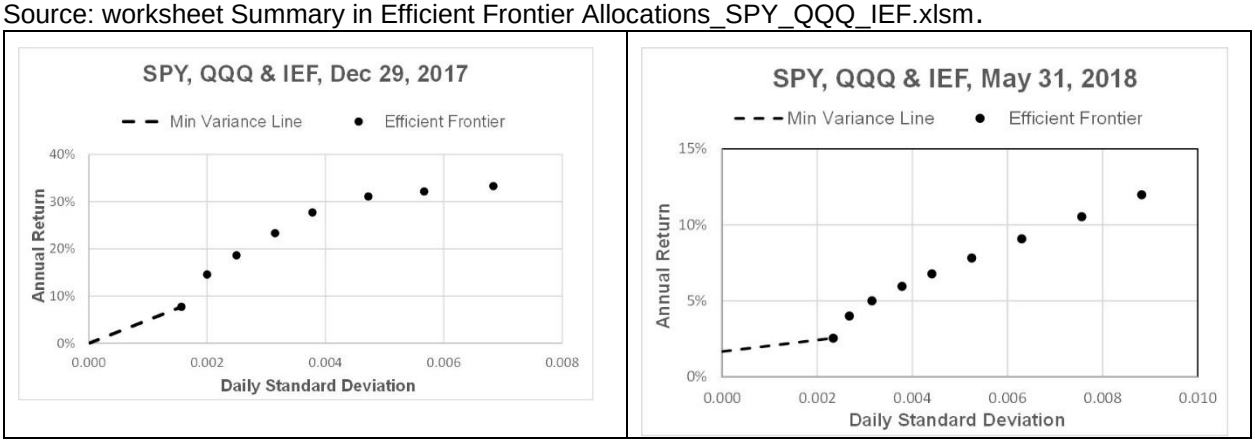
Maurer's "Efficient Frontier" method determines the composition of the risky portfolio which produces a specified daily standard deviation. The goal is usually a standard deviation of 0.2% per day or about 3.2% annually[4]. The procedure is described in Appendix A.

Fundamentally, the efficient frontier method determines the allocations among SPY, QQQ and IEF which produce the highest return for the specified standard deviation using daily variances, covariances and average returns over the recent past, 105 days for variances and covariances and 65 days for the average returns.

If this proves to be impossible because all combinations of the risky securities produce a standard deviation which is above the goal, as it would have at month end May 2018 (see Figure 1), the composition of the risky portfolio with the smallest standard deviation is determined. The portfolio with the smallest standard deviation is called the "minimum variance" (MinVar) portfolio.

**Figure 1. Efficient Frontiers for SPY, QQQ and IEF as of Two Different Dates.** The minimum standard deviation on the efficient frontier as of December 29, 2017 is below the 0.2% daily standard deviation goal. The minimum standard deviation on the efficient frontier as of May 31, 2019 is above the 0.2% goal.

Source: worksheet Summary in Efficient Frontier Allocations_SPY_QQQ_IEF.xlsm.




When the standard deviations of all combinations of the risky securities are too high, the efficient frontier method adds Tbills to the minimum variance portfolio to reduce the standard deviation to specified goal.

It is possible that the standard deviations of all combinations of the risky portfolio are less than the goal. In this case it is necessary to use leverage to achieve the goal. Leverage is not employed in this article.

This article adopts the same lookback interval for variances, covariances and returns. It differs from the efficient frontier approach in that the initial allocations are for the minimum variance *or the maximum Sharpe* portfolio.

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[4] In this article, standard deviations are scaled from daily to monthly or annual values by multiplying by the square root of time ratio. This is an approximation. Scaling is for presentation purposes only and does not affect the simulation results.

Initial allocations are diluted with Tbills *or other risk-free asset (RFA)* when the initial standard deviation is above the goal. However, when the standard deviation at the initial portfolio optimization is less than the goal, the composition is not adjusted to achieve the goal.

The direct solution method determines the allocations which meet the specified goal for the portfolio plus the risk-free asset. This method is more computationally demanding because the order of the matrix calculations is increased but it avoids the need to test both MinVar and MaxSharpe as the initial allocations. The MinVar standard deviation is often higher than a low SD goal when the risk-free asset is more volatile than Tbills. In this situation, Tbills is added as an additional component.

A comparison of the three approaches is as follows.

| Efficient Frontier | Initial Optimization as MinVar or MaxSharpe | Direct Solution |
|---|---|---|
| Determine the standard deviation of the portfolio's MinVar composition. For S121, this involves a 3x3 covariance matrix. | Determine the standard deviation of the portfolio's MinVar or Max Sharpe compositions. For S121, this involves a 3x3 covariance matrix. | Determine allocations at the SD goal for the portfolio plus Tbills. For S121, this involves a 4x4 covariance matrix. |
| If SD exceeds the SD goal, dilute with the MinVar composition with Tbills. | If SD exceeds the SD goal, dilute with the MinVar or MaxSharpe composition with Tbills or other RFA. | When the 4x4 Direct Solution fails to achieve a solution for a low SD Goal, add Tbills and solve the 5x5 covariance matrix. |
| If SD is less than the SD goal, determine allocations at SD goal. | Record "SD Below Goal" but take no further action. | Not Required |

**Bonds for the Risky Portfolio**

The S121 simulation began at the end of 1999.

There are curated daily data for IGBond from 1992[5]. Other bond funds with long histories include VFISX (1991), VFITX (1991), VUSTX (1986), VBMFX (1986) and PTTRX (1987).

Maurer chose IEF for his risky portfolio. The history for IEF does not begin until July 26, 2002 and Maurer extended the equity curve for IEF backwards by regressing the IEF price against the price of VFITX.

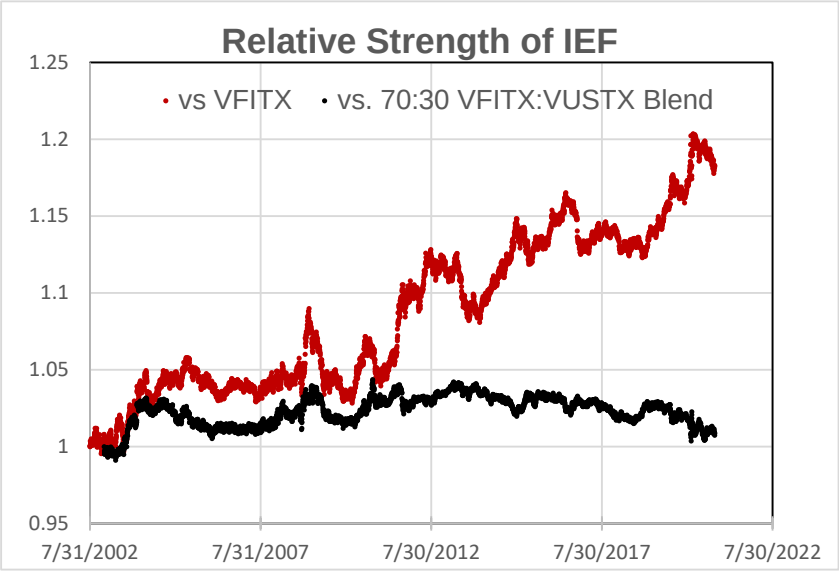
[5] Curated Data.xlsx at www.lingane.com/qi. Curated data for LrgCapUS, Foreign, USREIY and 1moTbills are also at this site.

Figure 2 illustrates the relative strength of IEF versus VFITX. If VFITX were a good surrogate for IEF, the relative strength would be flat in the post 2002 region where both funds have history.

What we find is that the relative strength rises, meaning that VFITX is not a good surrogate for IEF.

The reason that VFITX is not a good surrogate is probably because the duration of IEF is longer than the duration of VFITX. In support of this hypothesis, the relative strength is constant if VUSTX, a long maturity Treasury bond fund, is blended with VFITX using monthly rebalancing. See Figure 2.

**Figure 2. Relative Strength of EIF versus VFITX and versus the 70:30 Blend of VFITX and VUSTX.**




Source: Workbook "IEF Analysis" in Maurer S121 Strategy.xlsx

The minimum variance portfolio is the leftmost point on the efficient frontier of the risky portfolio. See Figure 3. The maximum Sharpe (MaxSharpe) portfolio is another identifiable point on the efficient frontier. The identification of the composition of the maximum Sharpe portfolio is described in Appendix A.

As seen in Figure 3, the return of the maximum Sharpe portfolio is higher than that of the minimum variance portfolio and the MaxSharpe line lies above the MinVar line. This suggests that MaxSharpe optimization might lead to higher returns than MinVar optimization

**Figure 3. Efficient Frontier for SPY, QQQ and IEF. This chart is specific to the date shown.**

Source: worksheet Summary in Efficient Frontier Allocations_SPY_QQQ_IEF.xlsm

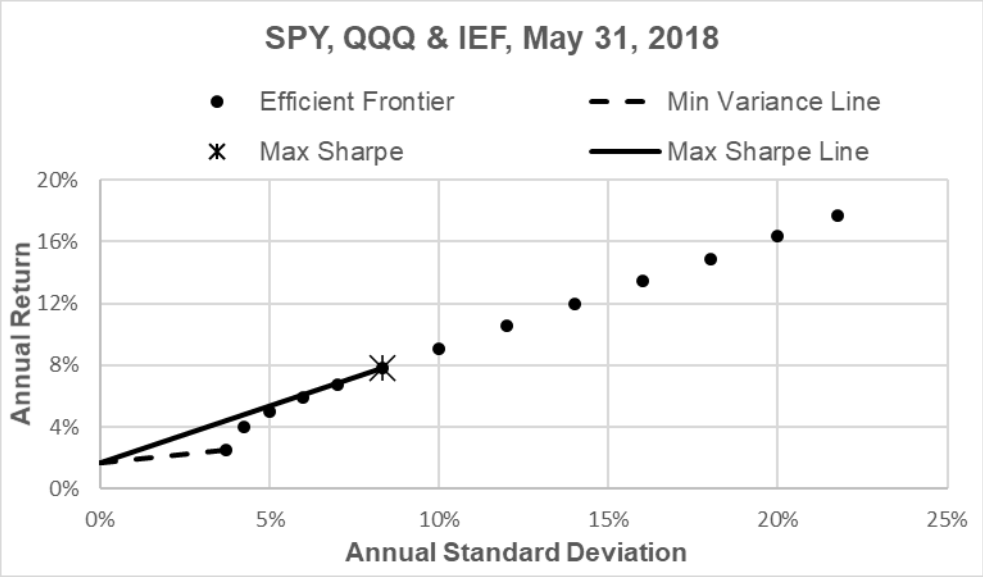



Table 2 provides statistics for variations of the S121 portfolio. The observations from Tables 1 and 2 are

- The source of the equity prices and the duration of the Treasury bills have only small effects on performance.

  The primary reason that the return for Case 17 is less than for S121 is because the composition of the risky portfolio was not adjusted in those months when the standard deviation of the minimum variance portfolio was less than the goal.

- Substituting the 70:30 blend for IEI reduces the return and substituting with IGBond reduces the return further.

  Since the portfolio compositions are dominated by bonds, portfolio returns would be expected to decrease when substituting a bond series with a lower annualized return. The returns and standard deviations of the bond series are shown here.

| 2000 - 2020 | Annual CAGR | Annual Standard Deviation |
|---|---|---|
| **IEF series** | 6.30% | 6.4% |
| **70:30 Blend** | 5.89% | 6.2% |
| **IGBond** | 4.50% | 3.5% |
| **VFISX** | | |
| **1-month Tbills** | 1.52% | 0.5% |

- MaxSharpe optimization did not provide the expected performance improvement as compared to MinVar optimization for this portfolio. MaxSharpe tended to outperform MinVar when the volatility goal was increased, as shown by later tables.
- Part of the decreased return associated with the use of IGBond is associated with the frequency that the standard deviation of the minimum variance portfolio lies below the goal. The efficient frontier approach would probably have provided higher returns.
- "WINS36" measures the frequency with which the return of a strategy exceeds the return of the reference portfolio over a 36-month rolling interval.

  The reference portfolios for this table contain 20% LrgCapUS and 80% bonds. The statistics for several reference portfolios are in Table 1. Note the changes in realized standard deviation among the reference portfolios.

  Because of the outsized influence of the nature of the bond series on performance, the bond type in the reference portfolio should be chosen with consideration of the bond type in the risky portfolio.
- Since optimizing the risky portfolio and then diluting with the risk-free asset is more complex than a fixed allocation to bonds, the efficient frontier strategies need to provide higher returns and/or lower drawdowns to replace the 20:80 portfolio in the toolkit of a conservative investor.

  Some of the alternatives provide slightly higher returns, but not consistently so (WINS36). None of the alternatives provide lower drawdowns.

These observations prompted a broadening of the search for alternative low volatility portfolios.

**Table 2A. Monthly Statistics for SPY, QQQ and Bonds as the Risky Portfolio, 2000 – 2020.** "Allocation" refers to the average allocation after dilution by Tbills. WINS36 is measured with respect to 20% LrgCapUS stocks and 80% IGBond.

| Case #, Workbook | Reference | 13 | 14 MinVar 0.002 Exact | 15 MinVar 0.002 FastTrack | 16 MinVar 0.002 1moTbills | 17 MinVar 0.002 | Direct Solution SPY, QQQ & Bonds 0.002 |
|---|---|---|---|---|---|---|---|
| **Optimization** | | S121 | MinVar | MinVar | MinVar | MinVar | Direct |
| **Bonds Prices** | | Maurer | Maurer | Maurer | Maurer | Maurer | Maurer |
| **Equity Prices** | LrgCapUS | Yahoo | Yahoo | FastTrack | Yahoo | FastTrack | Yahoo |
| **Risk-Free Asset** | IGBond | 3moTbills | 3moTbills | 3moTbills | 1moTbills | 1moTbills | 3moTbills |
| **SD Goal, daily** | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 |
| **CAGR** | 5.02% | 5.41% | 5.11% | 5.20% | 5.18% | 5.20% | 5.16% |
| **Realized SD** | 0.00206 | 0.00215 | 0.00208 | 0.00207 | 0.00207 | 0.00207 | 0.0201 |
| **Sharpe** | 1.05 | 1.13 | 1.08 | 1.11 | 1.11 | 1.11 | 1.12 |
| **MaxDD** | 0.064 | 0.044 | 0.043 | 0.043 | 0.043 | 0.043 | 0.047 |
| **UPI** | 3.09 | 3.36 | 2.98 | 3.17 | 3.16 | 3.16 | 2.96 |
| **SPY Allocation** | 20% | 14.5% | 14.1% | 14.2% | 14.1% | 14.2% | 9.4% |
| **QQQ Allocation** | | 1.4% | 1.0% | 1.0% | 1.0% | 1.0% | 7.5% |
| **Bond Allocation** | | 55.3% | 55.9% | 55.6% | 55.8% | 55.9% | 32.5% |
| **RFA Allocation** | 80% | 28.9% | 28.9% | 29.1% | 29.0% | 29.1% | 50.6% |
| **SD Below Goal** | | 0% | 9% | 9% | 9% | 9% | 0% |
| **SD Above Goal** | | 0% | 0% | 0% | 0% | 0% | 0% |
| **WINS36** | Reference | 59% | 51% | 53% | 53% | 53% | 57% |
| **POR @ 6% w/d** | 32% | 30% | 32% | 32% | 32% | 32% | 32% |

Source: EF Performance.xlsx and EF Table 1.xlsm

**Table 2B. Monthly Statistics for SPY, QQQ and Bonds as the Risky Portfolio, 2000 – 2020.** "Allocation" refers to the average allocation after dilution by RFA. WINS36 is measured with respect to 20% LrgCapUS stocks and 80% IGBond.

| Case #, Workbook | | 18 MinVar Blend 0.002 | 19 MaxSharpe Blend 0.002 | 17 (Direct) SPY, QQQ, Blend &Tbills 0.002 | 20 MinVar IGBond 0.002 | 21 MaxSharpe IGBond 0.002 | 18 (Direct) SPY, QQQ, IGBond & Tbills 0.002 | 19 (Direct) SPY, QQQ, IGBond & Tbills 0.005 |
|---|---|---|---|---|---|---|---|---|
| **Optimization** | | MinVar | MaxSharpe | Direct 4x4 | MinVar | MaxSharpe | Direct 4x4 | Direct 4x4 |
| **Bonds Prices** | | 70:30 | 70:30 | 70:30 | IGBond | IGBond | IGBond | IGBond |
| **Equity Prices** | LrgCapUS | FastTrack | FastTrack | FastTrack | FastTrack | FastTrack | FastTrack | FastTrack |
| **Risk-Free Asset** | IGBond | 1moTbills | 1moTbills | 1moTbills | 1moTbills | 1moTbills | 1moTbills | 1moTbills |
| **SD Goal, daily** | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0050 |
| **CAGR** | 5.02% | 5.14% | 5.12% | 4.95% | 4.54% | 4.89% | 5.45% | 7.30% |
| **Realized SD** | 0.0021 | 0.0021 | 0.0021 | 0.0020 | 0.0017 | 0.0019 | 0.0019 | 0.0045 |
| **Sharpe** | 1.05 | 1.08 | 1.06 | 1.05 | 1.15 | 1.09 | 1.27 | 0.80 |
| **MaxDD** | 0.06 | 0.04 | 0.05 | 0.05 | 0.03 | 0.05 | 0.05 | 0.158 |
| **UPI** | 3.09 | 3.07 | 2.81 | 2.69 | 3.55 | 2.66 | 3.61 | 1.29 |
| **SPY Allocation** | 20% | 13.9% | 8.8% | 9.0% | 8.4% | 8.0% | 9.1% | 25.5% |
| **QQQ Allocation** | | 1.2% | 7.5% | 7.4% | 1.1% | 7.4% | 9.0% | 25.7% |
| **Bond Allocation** | | 55.0% | 34.2% | 34.1% | 84.2% | 52.1% | 49.7% | 36.1% |
| **RFA Allocation** | 80% | 30.0% | 49.3% | 49.6% | 6.3% | 32.5% | 32.2% | 12.6% |
| **SD Below Goal** | | 6% | 1% | 0% | 63% | 30% | 0.4% | 0% |
| **SD Above Goal** | | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **WINS36** | Reference | 51% | 51% | 50% | 18% | 40% | 68% | 81% |
| **POR @ 6% w/d** | | 32% | 32% | 34% | 38% | 35% | 29% | 17% |

A more diversified risky portfolio might perform better than the SPY/QQQ/IEF portfolio and returns might also be improved by diluting the risky portfolio with bonds rather than Tbills. The following strategies were investigated.

- LargeCapUS and Foreign stocks and IGBond diluted with Tbills or bonds.
- LargeCapUS, Foreign and REIT stocks diluted with Tbills or bonds.
- LrgCapUS stocks diluted with bonds.
- QQQ, Foreign and REIT stocks diluted with Tbills or bonds. These components have the lowest correlations; see Table 2.

**Table 3. Correlation Among Possible Components of the Risky Portfolio.**
Correlation of average 63-day trailing returns was calculated in EXCEL using the CORREL function. NEED TO UPDATE PAST DECEMBER 24.

| 2000 - 2020 | SPY | LrgCap US | QQQ | Foreign | USREIT | IEF | IGBond | Blend |
|---|---|---|---|---|---|---|---|---|
| SPY | 1.00 | 1.00 | 0.83 | 0.88 | 0.70 | (0.46) | (0.52) | (0.43) |
| LrgCapUS | | 1.00 | 0.83 | 0.88 | 0.70 | (0.46) | (0.52) | (0.43) |
| QQQ | | | 1.00 | **0.70** | **0.45** | (0.43) | (0.48) | (0.36) |
| Foreign | | | | 1.00 | 0.66 | (0.42) | (0.47) | (0.41) |
| USREIT | | | | | 1.00 | (0.12) | (0.21) | (0.10) |
| IEF | | | | | | 1.00 | 0.96 | 0.98 |
| IGBond | | | | | | | 1.00 | 0.93 |
| Blend | | | | | | | | 1.00 |

Source: Correlation Matrix.xlsx

The following tables summarize the results. The conclusions are that

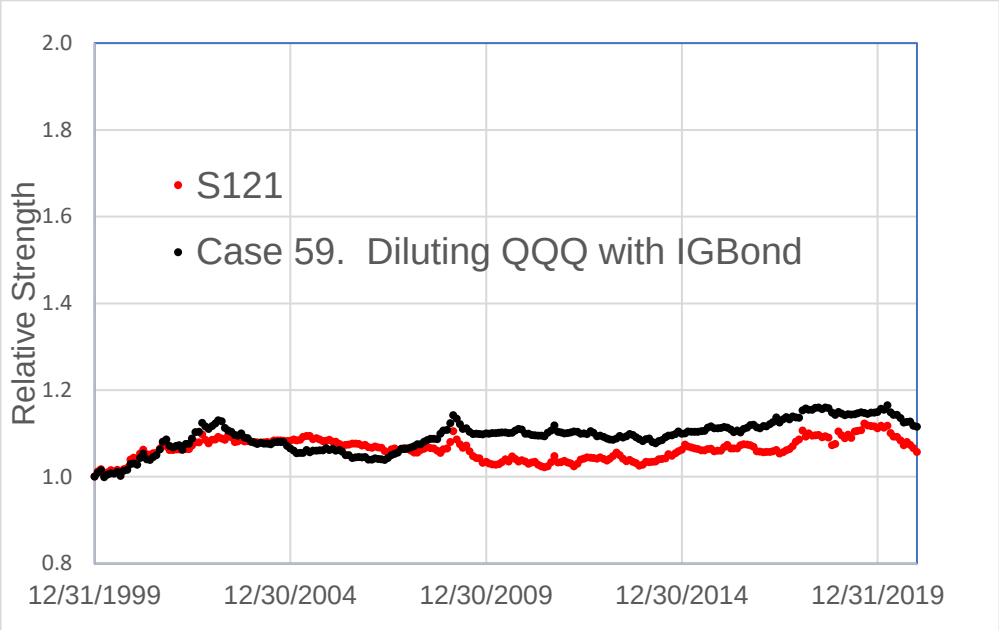
- Substituting LrgCapUS and Foreign stocks for SPY and QQQ in the risky portfolio does not provide a material improvement (Table 3). The previously observed effects on substituting for IEF are confirmed.
- Substituting the 70:30 blend or IGBond for Tbills as the risk-free asset increases returns but it is often difficult to achieve the 0.002 standard deviation goal. "SD Above Goal" measures the frequency with which the risk-free asset was unable to reduce the portfolio standard deviation to the goal. In some cases, SD Above Goal is so high as to increase the realized standard deviation which renders the simulation unsatisfactory.
- "SD Below Goal" measures the frequency with which the final portfolio standard deviation was less than the goal. Similarly, simulations should be considered unsatisfactory when SD Below Goal is so large as to reduce the realized standard deviation which renders the simulation unsatisfactory.

- Substituting LargeCapUS, Foreign and USREIT or QQQ, Foreign and USREIT as the risky portfolio increased CAGR in some instances but not consistently so (WINS36). See Tables X and Y.
- Table 7A provides statistics for strategies in which a risky portfolio is diluted with the risk-free asset[6]. There is no optimization. While this approach is simpler than other low volatility strategies and about as effective, there are no meaningful improvements over the 20:80 benchmark.

The statistics for some of the better low volatility strategies have been assembled in Table 10. The risk of running out of money before death is but slightly reduced as compared to the 20:80 benchmark

Figure 4 provides no evidence that the low volatility strategies assembled in Table 8 have consistently outperformed the easier to implement 20:80 benchmark.

**Figure 4. Relative Strength vs. 20% LrgCapUS and 80% IGBond Benchmark.**




The conclusion is that we have failed to identify a low volatility strategy which is materially better than the conservative portfolio of 20% US stocks and 80% intermediate bonds.

There is no reason for the conservative investor to employ a more sophisticated strategy.

[6] "Dilution" is almost the same as the approach of Macquarie Capital Markets Canada who recommended the use of the 63-day standard deviation of SPX (^GSPC) to control the volatility of the risky asset. The original publication is no longer available on the world wide web. The small difference is that "dilution", as used here, controls volatility based on the 63-day standard deviation of the risky asset itself.

**Table 4. Effects of Bond Type, 2000 – 2020.** "SD Above or Below Goal" measures the frequency with which the risk-free asset was unable to reduce the portfolio standard deviation to the goal. WINS36 is referenced to a portfolio of 20% LrgCapUS and 80% of the indicated bond series. Source: EF Performance.xlsx and EF Table 3.xlsm

| Case # | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|
| **Optimization** | MinVar | MaxSharpe | MinVar | MaxSharpe | MinVar | MaxSharpe | MaxSharpe | MaxSharpe | MaxSharpe |
| **Risky Asset** | LrgCapUS Foreign Blend | LrgCapUS Foreign Blend | LrgCapUS Foreign IGBond | LrgCapUS Foreign IGBond | LrgCapUS Foreign IGBond | LrgCapUS Foreign IGBond | LrgCapUS Foreign IGBond | LrgCapUS Foreign Blend | LrgCapUS Foreign Blend |
| **Risk-Free Asset** | 1moTbills | 1moTbills | 1moTbills | 1moTbills | IGBond | IGBond | Blend | IGBond | Blend |
| **SD Goal, daily** | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.002 |
| **CAGR** | 4.80% | 5.03% | 4.30% | 4.81% | 4.52% | 5.19% | 6.11% | 5.74% | 6.58% |
| **Realized SD** | 0.0021 | 0.0021 | 0.0017 | 0.0019 | 0.0018 | 0.0021 | 0.0026 | 0.0023 | 0.00329 |
| **Sharpe** | 0.96 | 1.06 | 1.05 | 1.10 | 1.02 | 1.07 | 1.10 | 1.13 | 0.96 |
| **MaxDD** | 0.045 | 0.041 | 0.029 | 0.041 | 0.037 | 0.042 | 0.079 | 0.044 | 0.064 |
| **UPI** | 2.42 | 2.64 | 3.04 | 2.93 | 2.96 | 2.80 | 2.46 | 2.91 | 2.41 |
| **US Allocation** | 12.5% | 10.6% | 8.3% | 9.7% | 8.9% | 9.1% | 10.2% | 7.5% | 9.7% |
| **For. Allocation** | 3.8% | 7.4% | 1.9% | 7.4% | 2.0% | 5.6% | 7.5% | 4.6% | 7.25 |
| **Bond Allocation** | 54.6% | 32.9% | 83.7% | 50.4% | 89.1% | 28.7% | 39.8% | 12.8% | 16.7% |
| **RFA Allocation** | 29.1% | 49.1% | 6.1% | 32.5% | 0.0% | 56.7% | 42.6% | 75.1% | 66.4% |
| **SD Below Goal** | 7% | 2% | 64% | 28% | 63% | 14% | 15% | 1% | 0% |
| **SD Above Goal** | 0% | 0% | 0% | 0% | 36% | 41% | 72% | 49% | 95% |
| **WINS36** IGBond | 48% | 60% | 18% | 49% | 24% | 56% | 73% | 56% | 87% |

**Table 5A. Large Cap US Stocks, Foreign Stocks and Real Estate as the Risky Portfolio, 2000 – 2020.** It is often impossible to achieve a 0.002 daily standard deviation with IGBond as the risk-free asset. WIN36 is with respect to a benchmark of 20% LrgCapUS and 80% IGBond. "dSD Above or Below Goal" is the frequency with which the dSD difference in a particular month exceeds 0.00002. "Failed Solution" is the frequency with which EXCEL's Solver function failed to find a solution.

Sources: EF Performance.xlsx and EF Table 4.xlsm; EF Direct Performance.xlsx

| Case # | 39 | 40 | 41 | 42 | 20 (Direct) | 32 (Direct) |
|---|---|---|---|---|---|---|
| **Optimization** | MinVar | MaxSharpe | MinVar | MaxSharpe | Direct 4x4 | Direct 5x5 |
| **Risky Asset** | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT IGBond | LrgCapUS Foreign USREIT IGBond 1moTbills |
| **Risk-Free Asset** | 1moTbills | 1moTbills | IGBond | IGBond | | |
| **dSD Goal** | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 |
| **CAGR** | 3.33% | 3.53% | 5.39% | 5.63% | 5.38% | 5.12% |
| **Realized dSD** | 0.0022 | 0.0021 | 0.0022 | 0.0022 | 0.0022 | 0.0022 |
| **Sharpe** | 0.53 | 0.61 | 1.09 | 1.14 | 1.10 | 1.04 |
| **MaxDD** | 0.084 | 0.052 | 0.046 | 0.042 | 0.042 | 0.049 |
| **UPI** | 0.61 | 1.11 | 2.71 | 2.74 | 2.72 | 2.39 |
| **US Allocation** | 10.6% | 6.2% | 8.1% | 4.9% | 9.3% | 7.4% |
| **For. Allocation** | 8.3% | 6.9% | 6.6% | 4.5% | 4.4% | 6.3% |
| **REIT Allocation** | 8.6% | 10.7% | 5.9% | 6.5% | 5.4% | 7.3% |
| **Bond Allocation** | 72.5% | 76.2% | 79.5% | 84.0% | 80.9% | 79.0% |
| **dSD Below Goal** | 0% | 0% | 0% | 0% | 0% | 0% |
| **dSD Above Goal** | 0% | 0% | 38% | 43% | 28% | 0% |
| **Failed Solution** | | | | | 36% | 0% |
| **WINS36** | 32% | 27% | 59% | 54% | 57% | 50% |
| **Annualized Mean** | 0.0128 | 0.0147 | 0.0330 | 0.0354 | 0.0329 | 0.0303 |
| **Annualized SD** | 0.0372 | 0.0359 | 0.0401 | 0.0406 | 0.0313 | 0.0386 |
| **Probability of Ruin @ 6% w/d** | 52% | 50% | 30% | 28% | 30% | 32% |

**Table 5B. Large Cap US Stocks, Foreign Stocks and Real Estate as the Risky Portfolio, 2000 – 2020.** WIN36 is with respect to a benchmark of 60% LrgCapUS and 40% IGBond. "dSD Above or Below Goal" is the frequency with which the dSD difference in a particular month exceeds 0.00002. "Failed Solution" is the frequency with which EXCEL's Solver function failed to find a solution.

Source: EF Performance.xlsx and EF Table 4.xlsm; EF Direct Performance.xlsx

| Case # | 43 | 44 | 45 | 46 | 21 (Direct) |
|---|---|---|---|---|---|
| **Optimization** | MinVar | MaxSharpe | MinVar | MaxSharpe | Direct 4x4 |
| **Risky Asset** | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT | LrgCapUS Foreign USREIT IGBond |
| **Risk-Free Asset** | 1moTbills | 1moTbills | IGBond | IGBond | |
| **dSD Goal** | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| **CAGR** | 6.55% | 4.47% | 7.72% | 8.03% | 7.36% |
| **Realized dSD** | 0.0052 | 0.0048 | 0.0052 | 0.0053 | 0.0053 |
| **Sharpe** | 0.63 | 0.41 | 0.76 | 0.79 | 0.70 |
| **MaxDD** | 0.178 | 0.227 | 0.169 | 0.138 | 0.158 |
| **UPI** | 0.78 | 0.35 | 1.18 | 1.41 | 1.10 |
| **US Allocation** | 25.8% | 10.1% | 26.5% | 14.9% | 13.4% |
| **For. Allocation** | 20.1% | 41.3% | 20.5% | 17.6% | 17.7% |
| **REIT Allocation** | 21.3% | 7.0% | 21.6% | 26.8% | 28.5% |
| **Bond Allocation** | 32.8% | 41.6% | 31.3% | 40.7% | 40.5% |
| **dSD Below Goal** | 8% | 6% | 8% | 3% | 0.8% |
| **dSD Above Goal** | 0% | 0% | 0% | 0% | 0% |
| **Failed Solution** | | | | | 0.8% |
| **WINS36** | 67% | 49% | 76% | 69% | 56% |
| **Annualized Mean** | 0.0472 | 0.0262 | 0.0588 | 0.0619 | 0.0554 |
| **Annualized SD** | 0.0871 | 0.0789 | 0.0893 | 0.0903 | 0.0909 |
| **Probability of Ruin @ 6% w/d** | 23% | 41% | 15% | 14% | 18% |

**Table 6A. QQQ, Foreign Stocks and USREIT as the Risky Portfolio, 2000 – 2020.** WINS36 is measured with respect to a portfolio of 20% LrgCapUS plus 80% IGBond. With QQQ, Foreign and USREIT as the risky asset and the 70:30 Blend as the risk-free asset, the simulations failed to achieve the Goal 98-99% of the time.

Source: EF Performance.xlsx and EF Table 5.xlsm

| Case # | 47 | 48 | 51 | 52 | 27 (Direct) | 28 (Direct) |
|---|---|---|---|---|---|---|
| **Optimization** | MinVar | MaxSharpe | MinVar | MaxSharpe | Direct 4x4 | Direct 5x5 |
| **Risky Asset** | QQQ Foreign USREIT | QQQ Foreign USREIT | QQQ Foreign USREIT | QQQ Foreign USREIT | QQQ Foreign USREIT IGBond | QQQ Foreign USREIT IGBond 1moTbills |
| **Risk-Free Asset** | 1moTbills | 1moTbills | IGBond | IGBond | | |
| **dSD Goal** | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 |
| **CAGR** | 2.90% | 3.59% | 4.54% | 5.69% | 5.77% | 5.54% |
| **Realized dSD** | 0.0028 | 0.0020 | 0.0029 | 0.0022 | 0.0022 | 0.0022 |
| **Sharpe** | 0.33 | 0.67 | 0.67 | 1.18 | 1.22 | 1.17 |
| **MaxDD** | 0.175 | 0.045 | 0.159 | 0.042 | 0.044 | 0.053 |
| **UPI** | 0.50 | 1.30 | 1.38 | 3.00 | 3.45 | 2.93 |
| **QQQ Allocation** | 4.8% | 6.7% | 3.7% | 4.8% | 6.7% | 7.1% |
| **Foreign Allocation** | 11.5% | 5.9% | 8.5% | 4.2% | 5.1% | 5.7% |
| **USREIT Allocation** | 10.2% | 10.1% | 6.9% | 6.0% | 5.6% | 7.1% |
| **IGBond Allocation** | | | 80.8% | 84.9% | 82.6% | 48.1% |
| **Tbill Allocation** | 73.4% | 77.4% | | | | 32.0% |
| **dSD Below Goal** | 0% | 0% | 0% | 0% | 0% | 0% |
| **dSD Above Goal** | 0% | 0% | 39% | 42% | 30% | 0% |
| **Failed to Solve** | | | | | 35% | 0% |
| **WINS36** | 35% | 30% | 60% | 61% | 73% | 65% |
| **Annualized Mean** | 0.0089 | 0.0151 | 0.0251 | 0.0360 | 0.0367 | 0.0344 |
| **Annualized SD** | 0.458 | 0.0342 | 0.0496 | 0.0401 | 0.0392 | 0.0384 |
| **Probability of Ruin @ 6% w/d** | 58% | 49% | 39% | 27% | 26% | 28% |

**Table 6B. QQQ, Foreign Stocks and USREIT as the Risky Portfolio, 2000 – 2020.**
WINS36 is measured with respect to a portfolio of 60% LrgCapUS plus 40% IGBond.

Source: EF Performance.xlsx and EF Table 5.xlsm or EF 4x4 Performance.xlsx and EF 4x4 Table 1.xlsm

| Case # | | 55 | 53 | 54 | 26 Direct | 29 Direct |
|---|---|---|---|---|---|---|
| **Optimization** | | MaxSharpe | MinVar | MaxSharpe | Direct 4x4 | Direct 5x5 |
| **Risky Asset** | LrgCapUS | QQQ Foreign USREIT | QQQ Foreign USREIT | QQQ Foreign USREIT | QQQ Foreign USREIT IGBond | QQQ Foreign USREIT IGBond 1moTbills |
| **Risk-Free Asset** | IGBond | 1moTbills | IGBond | IGBond | | |
| **dSD Goal** | | 0.0050 | 0.0050 | 0.0050 | 0.0050 | 0.0050 |
| **CAGR** | | 6.52% | 5.60% | 8.16% | 9.23% | 8.93% |
| **Realized dSD** | | 0.0049 | 0.0069 | 0.0049 | 0.0052 | 0.0052 |
| **Sharpe** | | 0.66 | 0.42 | 0.86 | 0.93 | 0.90 |
| **MaxDD** | | 0.119 | 0.409 | 0.118 | 0.128 | 0.131 |
| **UPI** | | 1.11 | 0.69 | 1.84 | 1.82 | 1.69 |
| **US Allocation** | 60% | 16.6% | 12.4% | 16.8% | 18.5% | 18.7% |
| **Foreign Allocation** | | 34.5% | 28.4% | 14.7% | 13.4% | 13.3% |
| **USREIT Allocation** | | 25.2% | 25.6% | 25.2% | 25.0% | 24.6% |
| **IGBond Allocation** | 40% | | 33.4% | 43.3% | 43.1% | 34.1% |
| **Tbills Allocation** | | | | | | 9.3% |
| **dSD Below Goal** | | 3% | 6% | 3% | 0% | 0% |
| **dSD Above Goal** | | 0% | 0% | 0% | 0% | 0% |
| **Failed to Solve** | | | | | 0% | 0% |
| **WINS36** | Reference | 64% | 75% | 72% | 80% | 79% |
| **Annualized Mean** | | 0.0465 | 0.0413 | 0.0626 | 0.0737 | 0.0707 |
| **Annualized SD** | | 0.0815 | 0.1149 | 0.0835 | 0.0902 | 0.0896 |
| **Probability of Ruin @ 6% w/d** | | 22% | 32% | 13% | 9% | 10% |

**Table 7A. Stocks plus Sufficient Bonds, adjusted monthly, to Dilute the Standard Deviation to the Indicated Goal, 2000 – 2020.** WINS36 is measured with respect to a portfolio of 20% LrgCapUS stocks and 80% of the indicated fixed income series.

Sources: EF Performance.xlsx and EF Table 6.xlsm; EF Direct Performance.xlsx

| Case # | 57 | 56 | 58 | 59 | 30 (Direct) | 31 (Direct) |
|---|---|---|---|---|---|---|
| **Optimization** | Dilution | Dilution | Dilution | Dilution | Direct 3x3 | Direct 3x3 |
| **SD Cap, daily** | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| **Risky Asset** | LrgCapUS | QQQ | LrgCapUS | QQQ | LrgCapUS<br>IGBond<br>1moTbills | QQQ<br>IGBond<br>1moTbills |
| **Risk-Free Asset** | 1moTbills | 1moTbills | IGBond | IGBond | | |
| **CAGR** | 2.83% | 3.27% | 5.18% | 5.68% | 5.13% | 5.52% |
| **Realized SD** | 0.0018 | 0.0018 | 0.0020 | 0.0020 | 0.0019 | 0.0019 |
| **Sharpe** | 0.46 | 0.60 | 1.13 | 1.26 | 1.18 | 1.30 |
| **MaxDD** | 0.058 | 0.058 | 0.035 | 0.028 | 0.040 | 0.036 |
| **UPI** | 0.66 | 1.06 | 3.21 | 4.47 | 3.33 | 4.20 |
| **Equity Allocation** | 22.4% | 16.9% | 18.5% | 13.6% | 19.5% | 15.1% |
| **Bond Allocation** | 77.6% | 83.1% | 81.5% | 86.4% | 80.5% | 84.9% |
| **SD Below Goal** | 0% | 0% | 0% | 0% | 0.4% | 0% |
| **SD Above Goal** | 0% | 0% | 37% | 38% | 0% | 0% |
| **Failed to Solve** | | | | | 1.6% | 0.4% |
| **WINS36**<br>Tbills<br>IGBond | <br>82%<br>26% | <br>74%<br>27% | <br>88%<br>56% | <br>88%<br>63% | <br>86%<br>51% | <br>86%<br>62% |
| **Annualized Mean** | 0.0077 | 0.0120 | 0.0308 | 0.0358 | 0.0303 | 0.0341 |
| **Annualized SD** | 0.0312 | 0.0315 | 0.0368 | 0.0375 | 0.0348 | 0.0349 |
| **POR @ 6% w/d, 20-yr Life** | 58% | 53% | 32% | 27% | 32% | 28% |

"SD Above Goal" measures the frequency with which the monthly simulations failed to achieve the standard deviation. The simulations failed because the volatility of the equity securities were too high in certain months. This was resolved in the Direct 3x3 results which add Tbills to the portfolio.

**Table 7B. Stocks plus Sufficient Bonds, adjusted monthly, to Dilute the Standard Deviation to the Indicated Goal, 2000 – 2020.** No optimization. WINS36 is measured with respect to a portfolio of 20% LrgCapUS stocks and 80% of the indicated fixed income series.

Source: EF Performance.xlsx and EF Table 6.xlsm

| Case # | 60 | 61 | 62 | 63 | 64 | 65 | 66 |
|---|---|---|---|---|---|---|---|
| **dSD Goal** | 0.005 | 0.0055 | 0.006 | 0.006 | 0.0055 | 0.006 | 0.006 |
| **Risky Asset** | LrgCapUS | LrgCapUS | LrgCapUS | LrgCapUS | QQQ | QQQ | QQQ |
| **Risk-Free Asset** | IGBond | IGBond | IGBond | 1moTbills | IGBond | IGBond | 1moTbills |
| **CAGR** | 6.34% | 6.45% | 6.56% | 5.07% | 8.42% | 8.72% | 6.59% |
| **Realized dSD** | 0.0044 | 0.0048 | 0.0052 | 0.0052 | 0.0049 | 0.0054 | 0.0055 |
| **Sharpe** | 0.70 | 0.66 | 0.63 | 0.46 | 0.88 | 0.84 | 0.60 |
| **MaxDD** | 0.136 | 0.156 | 0.176 | 0.207 | 0.144 | 0.165 | 0.198 |
| **UPI** | 1.08 | 0.92 | 0.80 | 0.42 | 1.65 | 1.46 | 0.66 |
| **Risky Allocation** | 57.3% | 62.2% | 66.9% | 65.0% | 48.0% | 52.2% | 50.5% |
| **Risk-Free Allocation** | 42.7% | 37.8% | 33.1% | 35.0% | 52.0% | 47.8% | 49.5% |
| **SD Below Goal** | 6% | 6% | 9% | 9% | 1% | 1% | 0% |
| **SD Above Goal** | 0% | 0% | 0% | 0% | 0% | 0% | 1% |
| **WINS36**<br>Tbills<br>IGBond | <br>81%<br>75% | <br>89%<br>81% | <br>90%<br>82% | <br>83%<br>55% | <br>88%<br>78% | <br>89%<br>81% | <br>75%<br>63% |
| **Annualized Mean** | 0.0442 | 0.0458 | 0.0473 | 0.0327 | 0.0653 | 0.0688 | 0.0479 |
| **Annualized SD** | 0.0747 | 0.0812 | 0.0877 | 0.0862 | 0.0847 | 0.0924 | 0.0913 |
| **POR @ 6% w/d** | 23% | 23% | 23% | 35% | 12% | 11% | 23% |

"SD Above Goal" in Table 7B measures the frequency with which the monthly simulations failed to achieve the standard deviation goal. This is not a flow but a reflection of the fact that there were periods, all of 2016 for example, during which the volatility of large cap US stocks was less than 0.5%.

The Dilution strategy (cases 64 and 65 in Table 7B) resembles the Macquarie and SPVOL market timing strategies[7].

**Macquarie** determines the equity allocation as the standard deviation goal divided by the 63-day standard deviation of a risk index.

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[7] For a discussion of these and other timing algorithms, with attributions, see "Definition of Timing and Allocation Algorithms" at www.liingane.com/qi.

Adaptive Asset Allocation: A Primer, Adam Butler, Michael Philbrick, Rodrigo Gordillo and David Varadi, September 2013. papers.ssrn.com/sol3/papers.cfm?abstract_id=2328254. An earlier version of this manuscript was published in 2012. Butler, Philbrick and Godrigo were associated with Macquarie Private Wealth in Toranto, Canada.

**SPVOL**, Standard & Poors' Dynamic Rebalancing Risk Control Indicator, determines the equity allocation as the standard deviation goal divided by the square root of the exponential moving average (EMA) of the current standard deviation of a risk index.

Conservative investors should cap equity allocations at 100% with both timers.

The important difference from the Dilution strategy is that the Dilution strategy estimates the market volatility from the characteristics of the portfolio whereas Macquarie and SPVOL determine the market volatility from the volatility of an index such as the S&P 500 Composite without dividends.

Simulations were performed to characterize how well the Macquarie and SPVOL indicators perform as compared to the Dilution strategy. The results are in Table 8.

Both the Macquarie and SPVOL strategies improve performance over that of the 60:40 portfolio so long as the volatility of the risk index is at least as volatile as the equity security being timed. For example, SPX, the S&P Index without dividends does not control the volatility of QQQ as well as NDX, the NASDAQ 100 Index.

Table 8 includes the statistics for a composite timer (equal weighting of the 5AbsMom + DR*VOL + IUC timers) which controls the equity allocation at 0, 33.3. 66.7 or 100%.

A word on nomenclature. The market timers are identified by risk index (SPX or NDX), standard deviation goal (0.005 to 0.11 per day) and type (Macquarie or SPVOL). The Macquarie timers are also identified by the lookback interval over which the volatility is measured.

> Macquarie Nomenclature: dSD Goal followed by the risk index followed by the lookback interval. E.g., 0.005SPX63d.
>
> SPVOL Nomenclature: dSD Goal followed by SPVol followed by the risk index. E.g., 0.005SPVOLSPX.

The composite timer provides good statistics with both LrgCapUS stocks and QQQ. Neither volatility timer provides good statistics for LrgCapUS stocks.

Lower volatility targets produce lower drawdowns, and returns, and higher risks of ruin. The lower volatility portfolios are clearly higher risk.

We begin our analysis of Table 8 by focusing on the strategies which realized a daily standard deviation near the 0.5% goal. After eliminating the low volatility strategies with high drawdowns, the six remaining strategies exhibit good volatilities, drawdowns, risks of failure and Sharpe and UPI statistics.

| | |
|---|---|
| 005NDX63 | 005SPVolNDX |
| 006NDX63 | 006SPVolNDX |
| 005NDX105 | |
| 006NDX105 | |

**Table 8. Market Timing Alternatives to the QQQ Dilution Strategy.** The bond security is IGBond. Milevsky's Risk of Ruin omits mortality and is therefore 2-3 times higher than in other tables. Volatility timing of large cap US stocks was less satisfactory, as it was in Table 7B. *Table should be sorted by increasing dSD*

| **2000 - 2020** | Timer | CAGR | mSD | Sharpe | UPI | maxDD | Annualized Mean | Annualized SD | POR @ 6% w/d, 20 yr |
|---|---|---|---|---|---|---|---|---|---|
| LrgCapUS & IGBond | 5AbsMom+DR*VOL +IUC | 0.0995 | 0.028 | 0.87 | 2.22 | 0.15 | 0.0820 | 0.1061 | 7% |
| QQQ & IGBond | 0.005SPX63d | 0.0635 | 0.030 | 0.50 | 0.31 | 0.41 | 0.0473 | 0.1088 | 26% |
| QQQ & IGBond | 0.006SPX63d | 0.0640 | 0.035 | 0.45 | 0.24 | 0.49 | 0.0501 | 0.1289 | 27% |
| QQQ & IGBond | 0.011SPX63d | 0.0515 | 0.055 | 0.28 | 0.08 | 0.76 | 0.0496 | 0.2025 | 43% |
| QQQ & IGBond | 0.005SPX105d | 0.0655 | 0.029 | 0.53 | 0.41 | 0.35 | 0.0488 | 0.1051 | 24% |
| QQQ & IGBond | 0.006SPX105d | 0.0661 | 0.034 | 0.47 | 0.30 | 0.45 | 0.0516 | 0.1255 | 25% |
| QQQ & IGBond | 0.011SPX105d | 0.0493 | 0.055 | 0.27 | 0.08 | 0.75 | 0.0475 | 0.2026 | 44% |
| QQQ & IGBond | 0.005SPVolSPX | 0.0663 | 0.028 | 0.55 | 0.35 | 0.39 | 0.0495 | 0.1041 | 23% |
| QQQ & IGBond | 0.006SPVolSPX | 0.0671 | 0.033 | 0.49 | 0.27 | 0.48 | 0.0525 | 0.1234 | 26% |
| QQQ & IGBond | 0.011SPVolSPX | 0.0544 | 0.054 | 0.30 | 0.09 | 0.76 | 0.0516 | 0.1983 | 40% |
| QQQ & IGBond | 0.005NDX63d | 0.0779 | 0.020 | 0.90 | 2.51 | 0.07 | 0.0584 | 0.0747 | 14% |
| QQQ & IGBond | 0.006NDX63d | 0.0835 | 0.024 | 0.82 | 1.78 | 0.11 | 0.0650 | 0.0899 | 12% |
| QQQ & IGBond | 0.011NDX63d | 0.0993 | 0.040 | 0.64 | 0.75 | 0.34 | 0.0871 | 0.1509 | 11% |
| QQQ & IGBond | 0.005NDX105d | 0.0770 | 0.019 | 0.92 | 2.57 | 0.09 | 0.0573 | 0.0718 | 14% |
| QQQ & IGBond | 0.006NDX105d | 0.0829 | 0.023 | 0.85 | 1.91 | 0.12 | 0.0641 | 0.0860 | 12% |
| QQQ & IGBond | 0.011NDX105d | 0.0955 | 0.040 | 0.62 | 0.74 | 0.31 | 0.0832 | 0.1488 | 12% |
| QQQ & IGBond | 0.005SPVolNDX | 0.0802 | 0.019 | 0.98 | 3.01 | 0.07 | 0.0604 | 0.0714 | 13% |
| QQQ & IGBond | 0.006SPVolNDX | 0.0859 | 0.023 | 0.89 | 2.03 | 0.10 | 0.0670 | 0.0857 | 11% |
| QQQ & IGBond | 0.011SPVolNDX | 0.1020 | 0.039 | 0.68 | 0.83 | 0.32 | 0.0892 | 0.1472 | 9% |
| QQQ & IGBond | 5AbsMom+DR*VOL +IUC | 0.1096 | 0.039 | 0.73 | 1.00 | 0.27 | 0.0967 | 0.1476 | 7% |
| QQQ & IGBond | 60% Equity | 0.0610 | 0.039 | 0.39 | 0.19 | 0.56 | 0.0487 | 0.1418 | 30% |

Source: MomSim Daily Timing 02032021.cs, SmlOutput02052021 and Stats As Appendix C.xlsm – sources no longer exist!.

**Table 9. Selected Low Volatility Strategies, 2000 – 2020.** Equity and bond allocations are average values over 21 years.

| **Source** | Table 1A | Table 2A S121 (13) | Table 5A (32 Direct) | Table 6A (28 Direct) | Table 7A (30 Direct) | Table 7A (31 Direct) |
|---|---|---|---|---|---|---|
| **Optimization** | Fixed Allocation | MinVar | Direct 5x5 | Direct 5x5 | Direct 3x3 | Direct 3x3 |
| **Risky Asset** | USLrgCap | SPY<br>QQQ<br>IEF | LrgCapUS<br>Foreign<br>USREIT<br>IGBond<br>1moTbills | QQQ<br>Foreign<br>USREIT<br>IGBond<br>1moTbills | LrgCapUS<br>IGBond<br>1moTbills | QQQ<br>IGBond<br>1moTbills |
| **Risk-Free Asset** | IGBond | Tbills | | | IGBond | IGBond |
| **SD Goal, daily** | n/a | 0.0020 | 0.0020 | 0.0020 | 0.0020 | 0.0020 |
| **CAGR** | 5.13% | 5.41% | 5.12% | 5.54% | 5.13% | 5.52% |
| **Realized SD** | 0.0021 | 0.0021 | 0.0022 | 0.0022 | 0.0019 | 0.0019 |
| **Sharpe** | 1.08 | 1.13 | 1.04 | 1.17 | 1.18 | 1.30 |
| **MaxDD** | 0.064 | 0.044 | 0.049 | 0.053 | 0.040 | 0.036 |
| **UPI** | 3.21 | 3.36 | 2.39 | 2.93 | 3.33 | 4.20 |
| **Sum of Equity Allocations** | 20% | 15.9% | 21% | 20% | 19.5% | 15% |
| **Sum of Bond Allocations** | 80% | 84.1% | 79% | 80% | 80.5% | 85% |
| **SD Below Goal** | | 0% | 0% | 0% | 0.4% | 0% |
| **SD Above Goal** | | 0% | 0% | 0% | 0% | 0% |
| **WINS36** | Reference | 59% | 50% | 73% | 51% | 62% |
| **Probability of Ruin @ 6% w/d** | 32% | 30% | 32% | 26% | 32% | 28% |

## PART 2. MODERATE VOLATILITY STRATEGIES

This section tests the performance of strategies with a 0.5% goal for the daily standard deviation. Tactical strategies provide better performance at this higher volatility. Adjusting bond allocations monthly at this higher volatility is more effective than a fixed allocation.

Table 10 shows that controlling the standard deviation provides a similar volatility but better returns, drawdowns, Sharpe ratios and UPIs than the 60:40 portfolio.

WINS36 values are good, meaning that the higher tactical returns are moderately consistent over rolling 36-month intervals. POR, the risk of exhausting the portfolio before death, is more than halved as compared to the benchmark.

Since performance of the Dilution, efficient frontier and market timing strategies is similar, the Dilution and market timing strategies are superior since they are easier to explain and implement.

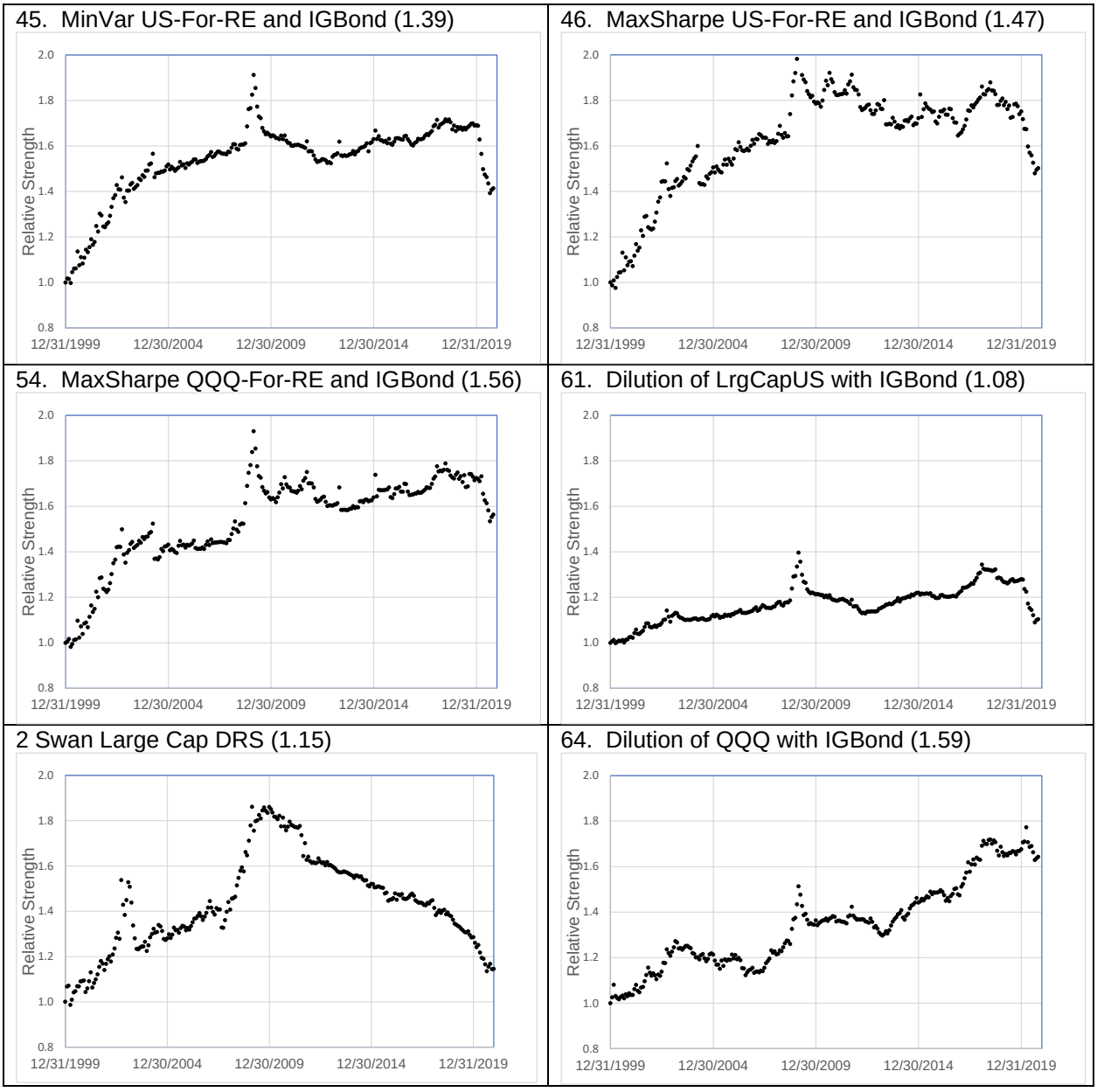
The relative strengths versus the 60:40 benchmark of some of the strategies of Table 10 plus the Swan DRS strategy (described in a later section) are shown in Figure 5.

**Table 10. Tactical Strategies of Moderate Volatility, 2000 – 2020.**

| **Source** | Table 1 | Table 5B (21 Direct) | Table 6B (26 Direct) | Table 7B (61) | Table 7B (64) | Table 7B (65) | Table 7B (66) | Table 8 0005NDX105 | Table 8 006SPVolNDX |
|---|---|---|---|---|---|---|---|---|---|
| **Optimization** | 60:40 | Direct 4x4 | Direct 4x4 | Dilution | Dilution | Dilution | Dilution | MarketTiming | MarketTiming |
| **Risky Asset** | LrgCapUS | LrgCapUS Foreign USREIT IGBond | QQQ Foreign USREIT IGBond | LrgCapUS | QQQ | QQQ | QQQ | QQQ | QQQ |
| **Risk-Free Asset** | IGBond | | | IGBond | IGBond | IGBond | Tbills | IGBond | IGBond |
| **dSD Goal** | | 0.0050 | 0.0050 | 0.0055 | 0.0055 | 0.0060 | 0.0050 | 0.0050 | 0.0060 |
| **CAGR** | 6.06% | 7.36% | 9.23% | 6.45% | 8.42% | 8.72% | 6.59% | 7.70 | 8.59 |
| **Realized dSD** | 0.0054 | 0.0053 | 0.0052 | 0.0048 | 0.0049 | 0.0054 | 0.0055 | 0.0041 | 0.0050 |
| **Sharpe** | 0.50 | 0.70 | 0.93 | 0.66 | 0.88 | 0.84 | 0.60 | 0.92 | 0.89 |
| **MaxDD** | 0.304 | 0.158 | 0.128 | 0.156 | 0.144 | 0.165 | 0.198 | 0.09 | 0.10 |
| **UPI** | 0.54 | 1.01 | 1.82 | 0.92 | 1.65 | 1.46 | 0.66 | 2.57 | 2.03 |
| **Equity Allocation** | 60% | 59% | 57% | 62% | 48% | 52% | 51% | | |
| **Bond Allocation** | 40% | 41% | 43% | 38% | 52% | 48% | 49% | | |
| **WINS36** | Reference | 56% | 80% | 81% | 78% | 81% | 63% | | |
| **Complexity** | Low | High | High | Moderate | Moderate | Moderate | Moderate | Low | Low, if SS is available |
| **POR @ 6% w/d & 20 yr Life** | 27% | 18% | 9% | 23% | 12% | 11% | 23% | 14% | 11% |

## Figure 5. Relative Strength vs. 60% LrgCapUS 40% IGBond Benchmark.

*Source: generated within EF Performance.xlsx.*



## PART 3. OPTION BASED STRATEGIES

Institutions have, for many years, purchased put options to limit downside price movements. The cost associated with option purchases inevitably limits the upside potential.

We begin with a discussion of the Chicago Board Option Exchange (Cboe) zero cost put spread collar index (CLLZ) with history from 1986. We then discuss the use of options by Swan Global Investment with history from June 20, 1998. "Defined outcome" exchange traded funds bring these concepts to the retail marketplace.

### Cboe S&P 500 Zero-Cost Put Spread Collar Index (CLLZ)

On the third Friday of each month, the investor

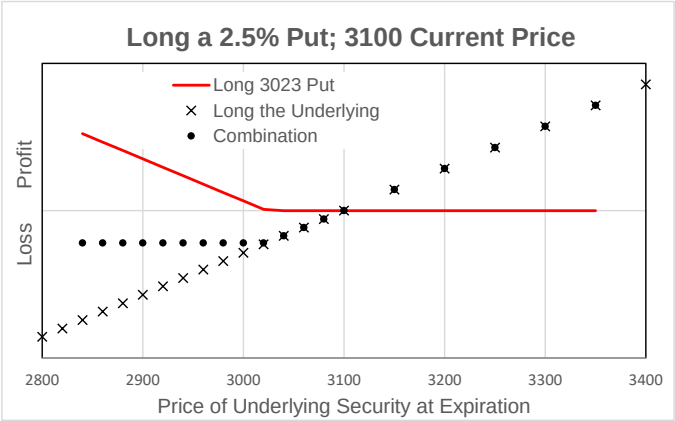
- Creates synthetic position linked to SPX, the S&P 500 composite without dividends, by buying an at the money SPX call and selling an at the money SPX put;
- Buys a put on the SPX index at a strike price equal to 97.5% of the current price;
- Sells a put on the SPX index at 95% of the current price; and
- Sells out-of-the-money SPX calls at the strike price which covers the net cost of the puts.

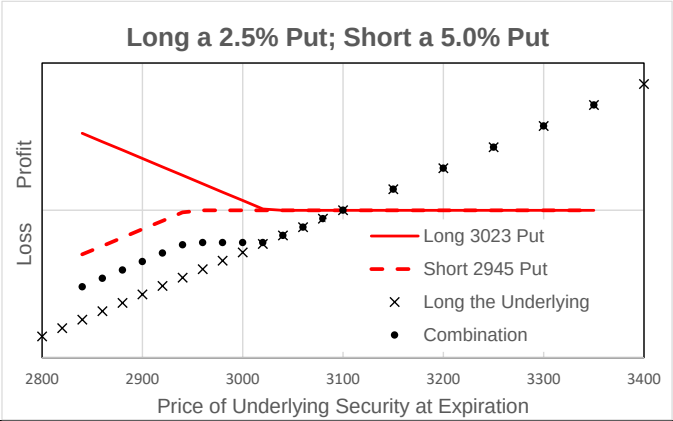
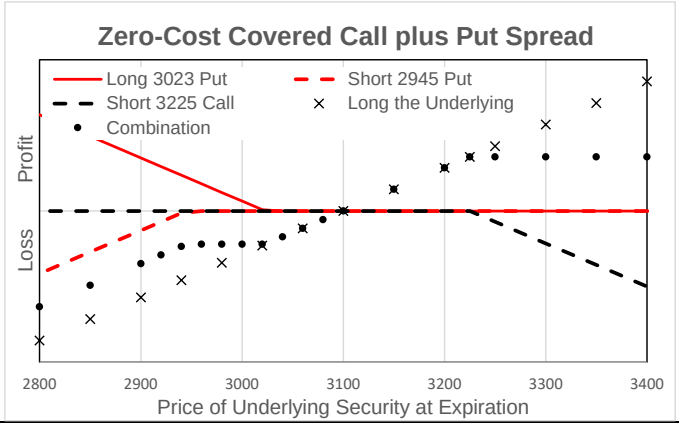
The profit and loss profile at expiration is created by adding the profit and loss profiles for each step of the transaction. Transaction costs were neglected in constructing these diagrams.

The synthetic SPX position shows a profit if the SPX price at expiration is above the current price and loses value if the price at expiration is below the current price.

The 97.5% put increases in value after the market declines 2.5%.

The combination tracks SPX on the upside and protects against declines of more than 2.5%.



| | |
|---|---|
| Selling a put at a lower strike price crates a "put spread." Losses are unlimited below the lower strike price, but the investor is protected from loss between the strike prices. |  |
| Selling an SPX call generates revenue to offset the net cost of the puts but caps the upside. |  |

The investor is liable for the first 2.5% decline each month but is protected from further declines unless the monthly decline exceeds 5.0%. This strategy has slightly reduced drawdown but at the expense of large reductions in return, Sharpe ratio and UPI. (Table 9).

Monthly option strategies have disadvantages because it is expensive, perhaps prohibitively, expensive to roll the put position forward in a falling market. Protection is also limited; the CLLZ strategy reduced losses by 2.5% a month during 2008 but this was of limited value because markets were falling 10% a month.

Options which expire a year or more into the future are more practical.

- Long-term equity anticipation securities (LEAPS) are publicly traded option contracts with expiration dates longer than one year.
- Flexible exchange options (FLEX options) allow the buyer and seller to negotiate terms. The exercise style, strike price and expiration date (any business day up to fifteen years) are all negotiable.

  FLEX options do not have continuous quote streams but publish quotes only by request.

Cboe created FLEX options in 1993 with the goal of eliminating the counter party risk associated with options which are not-exchange traded options.

Exchange traded options, including FLEX options, are guaranteed by the Options Clearing Corporation.

Defined outcome funds use European-style FLEX options which cannot be exercised before the expiration date.

Swan Global Investments' Select Composite defined risk strategy (DRS) typically buys 2-year puts at the money. It costs approximately 10% of the value of the portfolio to purchase enough puts to hedge the entire portfolio[8]. The starting value of the portfolio is therefore about 90% stock (such as SPY) and 10% puts.

If the market rises, the puts expire worthless and the portfolio captures most of the upside. If the market declines, the puts rise in value and reduce losses.

**Table 9. Moderate Volatility Tactical and Option Strategies, 2000 – 2020.** SDRIX was substituted for the Swan Select Composite after November 2020.

| **Source** | | Table 6 Case 64 | Swan Select, net of expenses | CLLZ, net of 0.75% expenses |
|---|---|---|---|---|
| **Optimization** | Fixed Allocation | Dilution | Active Option | Passive Option |
| **Risky Asset** | LrgCapUS | QQQ | Large US | SPX |
| **Risk-Free Asset** | IGBond | IGBond | options | options |
| **CAGR** | 6.06% | 8.42% | 6.74% | 3.09% |
| **Realized SD** | 0.0054 | 0.0049 | 0.0052 | 0.0075 |
| **Sharpe** | 0.50 | 0.88 | 0.65 | 0.19 |
| **MaxDD** | 0.304 | 0.144 | 0.136 | 0.436 |
| **UPI** | 0.54 | 1.65 | 1.13 | 0.12 |
| **RA Allocation** | 60% | 48% | | |
| **RFA Allocation** | 40% | 52% | | |
| **WINS36** | reference | 78% | 44% | 3% |
| **Complexity** | | Moderate | Low since purchased | High, unless purchased |

Swan's is an active strategy. For example, puts are typically rolled to new ATM puts at the end of each calendar year. This typically reduces the cost of the hedge by not suffering all of the time value decline.

Puts are also sold if the market declines, buying at the money puts at the lower price and investing the gain in additional shares of stock. When the market recovers, the upside potential is increased because of the additional shares purchased at the lower price.

[8] "Investing Redefined" by Randy Swan, River Grove Books, Austin, TX, 2019. p.123

Swan also tries to generate profits by trading market neutral, short term option positions.

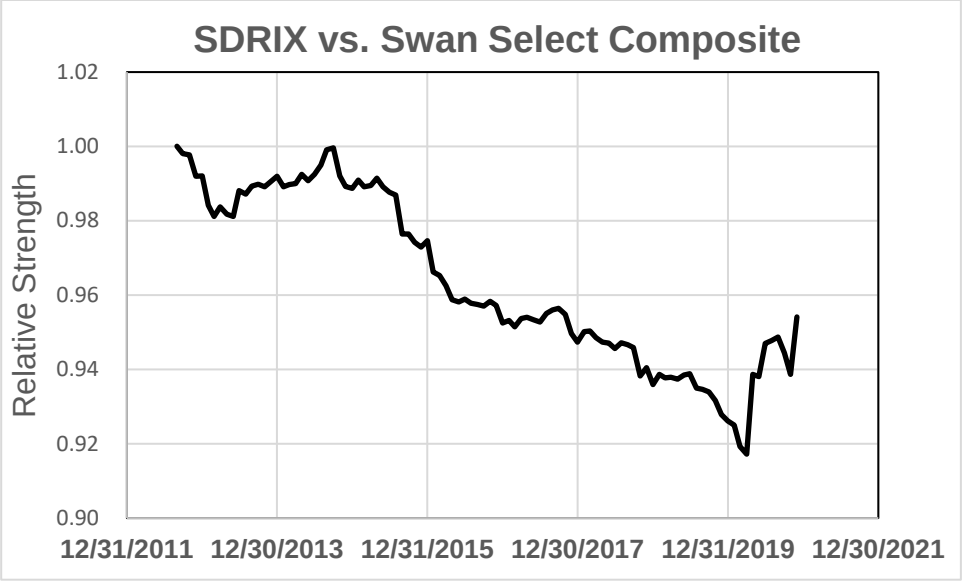
Swan's large cap US defined risk strategy has realized a volatility of about the same as the volatility of the 60:40 portfolio. However, Swan realized a higher return net of fees and limited the maximum drawdown to half that of the 60:40 portfolio. See Table 9.

Investors can access the Swan strategy through a mutual fund (SDRIX, inception July 30, 2012, 1.3% expense ratio, $100,000 minimum at Fidelity), through a separately managed Swan account or through an ETF, HEDG which came to market in December 2020 with 0.9% expenses.

While HEDG follows the general Swan strategy, I am told that it would be a mistake to assume that the historical performance of the Swan SMA is representative of their new exchange traded fund.

The Swan mutual fund has provided about 1 percent per year less return than that of the separately managed account; see Figure 6. Morningstar is ambivalent about the mutual fund[9].

**Figure 6. Relative Strength of SDRIX versus the Swan DRS Strategy.**




Source: Cboe data and analysis.xlsx

The relative strength of the Swan DRS strategy versus the 60:40 benchmark is a cause for concern. As shown in Figure 5, the DRS strategy strongly outperformed the benchmark through about 2009 but has strongly underperformed since. I am told that the underperformance since 2010 is due to a value tile introduced to the equity portfolio at about this time; cap weighting of S&P sectors was changed to equal weighting.

[9] "A number of concerns hold this strategy back" by Erol Alitovski, Morningstar, Inc., September 3, 2020.

In addition, market cycles seem to have shorted over the past decade which is challenging for option strategies such as the sale of short puts. It is hoped that the return to equal weighting of market sectors an as more opportunistic approach to the sale of puts will allow the strategy to again outperform the 60:40 portfolio. Steve Begasian, marketing representative, March 4, 2021.

The SMA is a hedged equity strategy that had strong outperformance during the 2000-2003 Tech crash and during the 2008-2009 Financial Crisis in a decade where stocks were basically flat. However, in the last decade bonds and stocks and a 60/40 portfolio have been quite strong, especially equities. While this particular SMA DRS did ok the last ten years, there were a few factors that led to the noticeable underperformance vs a 60/40. First off, a hedged equity strategy, one that always owns put options, we expect to underperform stocks when they are strong/moving up/during a bull market (such as the strong one from 2009 to 2020). This is the nature of a hedged strategy, which looks to outperform during bear markets to help provide a lower vol investment vehicle over a full market cycle.

However, there were also a few other factors. The SMA switched to an equal weight S&P 500 approach in taxable accounts in 2012 that caused some underperformance especially from 2014-2019 before the strategy started to move back to cap weight in 2020 and earlier this year and is now cap weight again. The basis risk of having a hedge on something different than the underlying exposure was something that was not worth doing in a hedged strategy. In addition, 2015, 2018, and 2020 were challenging years for this SMA in another of its components given a market shift in the last 5 years seeing much more frequent quick volatility spikes, which hindered the hedge against the hedge component (shorter-term selling of puts and calls against the rest of the portfolio). Given the change in the market environment, likely from tech, increase of HFT trading, Fed intervention, major addition of option expirations, and other factors that we've analyzed, we have made some improvements and adjustments to this component to better handle the current market environment. Personal communication from Micah Wakefield, Portfolio Manager, March 4, 2021.

**The first defined outcome ETFs** were issued in 2018. However, the option strategies on which they are based have decades of history.

Defined outcome ETFs use passive option strategies. The profit and loss diagram is defined at the time of purchase *assuming that the investment is held to the end of the 1-year outcome interval*.

First Trust[10], Innovator and True Shares and are the primary players with Innovator having the most offerings[11]. Allianz Investment Management is a newer entry, seeking to leverage their long experience with buffered annuities.

Defined outcome strategies produce one of two return profiles. The profit and loss profile of the First Trust and Innovator strategies is shown schematically on the right side of Figure 7. This profile is similar to that of the Cboe CLLZ

[10] United States Patent US2014/0122371 A1, Inventor Karen Sood.

[11] Innovator Capital Management has more than four dozen ETFs as of late 2020 based on the N100, R2000 MSCI EM or SPX price indices, multiple buffer and cap choices and monthly or quarterly reconstitution dates.

index. Both First Trust and Innovator use put options to control the downside and both offset the cost of the puts by selling calls, which limits the upside.

First Trust buys and sells options on a stock, such as SPY, while Innovator buys and sells options on an index, such as SPX. First Trust says that their approach is more conservative from an income tax perspective; see Appendix C.

The profit and loss profile on the left side of Figure 4 is characteristic of the Swan and True Shares strategies. There is no cap, but the rate of upside appreciation is less than the rate of market appreciation.

True Shares sells an out of the money put and buys an at the money call. Since the cost of the call exceeds the revenue from the sale of the put plus the interest on the fund's collateral, the number of call contracts must be less than the number of put contracts if the net cost is to be zero. Consequently, the value of their strategy does not increase on the upside as fast as the stock price.

*Explanation of True Shares strategy. Day one – We have $10 million in the fund. We sell puts and use the proceeds to buy calls. How many puts due we sell? If the SPY is at 300, then we are selling puts at 270 (down 10%). We want 1:1 exposure for the fund from that point. So, the puts we sell are based on the full exposure of $10 million at 270. That is calculated as…*

*$10 Million / ($270 price * 100 shares in a contract)*

*Note that we are essentially putting the $10 million to work at 270. We then use the proceeds to buy Call options. How many options? That is…*

*Proceeds/ (Option price *100 in a contract)*

*We are buying the SPY at the current price of $300 in this example. The fact that we are selling and buying at a 10% difference means that you cannot use the Put/Call ratio to determine the upside participation. For the DOWNSIDE from 270 on down, we have puts equal to the value of the fund at 270 which would be $10 million. For the upside, we do not have Calls that are equal to the value of the fund. The call notional value is 83% of the fund.*

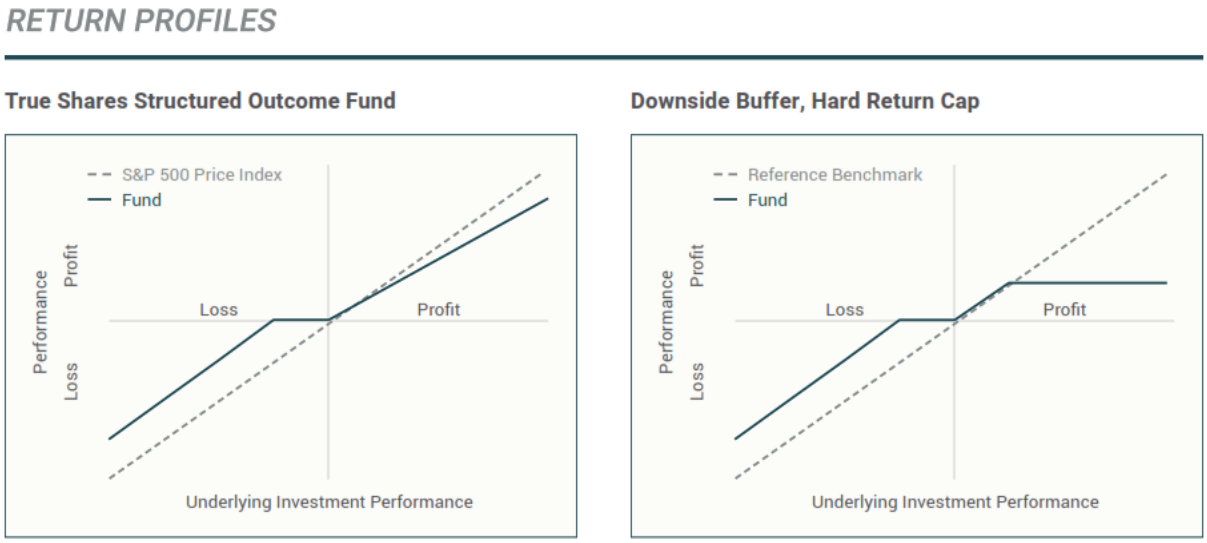
*In the end, because the notional value of the puts strikes are at a lower value, you have MORE puts relative to the value you would get at the money where the calls are. So, the # of puts is higher which makes the call:put ratio LOWER relative to the upside capture. – Dave Donnelly via email, July 20, 2020.*

Another difference among the option strategies is that Swab Global Investments purchases the underlying security and adds options. The defined outcome ETFs use options to construct synthetic securities and do not purchase the security itself. I was told that the synthetic approach pays the estimated value of future dividends upfront and that upfront payment allows for higher caps or additional call contracts.

This article addresses products which are designed to move up and down in concert with the market. There are also products which are designed to provide twice or three times the upside potential.

There is additional discussion of strategy construction in Appendix C.

**Figure 7. Profit and Loss Profiles of Define Outcome Strategies**. Source: TrueShares.com, July 3, 2020.




Defined outcome funds roll the basket of options forward when they expire at the end of the 1- year outcome period. Since options will be priced differently when the funds are reconstituted, the upside cap and participation ratio during the subsequent year are not known until the funds are reconstituted.

| | Swan | True Shares | First Trust | Innovator |
|---|---|---|---|---|
| Collateral | Sector funds | Buy Tbills, ATM call; sell 90% put | Buy calls at near zero strike price | Box-Spread.<br>9 options total |
| Protection | ATM put | No loss until market is down more than 10% | OTM put or put spread | OTM put or put spread |
| Upside | Limited by cost of puts; participation ratio is about 90% | Limited by cost of puts; participation ratio is 70 - 85% | Capped by OTM Call | Capped by OTM Call |
| Style and Interval | Active, plus opportunistic | Passive, annually reconstituted | Passive, reconstituted | Passive; reconstituted |

| | trading of s/t options | during first trading day of month | annually on 3rd Friday | annually at month-end |
|---|---|---|---|---|
| Investment Vehicle | SMA, mutual fund | ETFs | ETFs | ETFs |
| Tax Efficiency | Might be low | High | High | High |
| "History" | | None is available | SPRO (10%), SPRF (15%) | SRPF (15%), SPRS (5-35%) |

Caps and buffers are gross of fees. Since the expense ratios of defined outcome funds are about 0.8%,

- *A "9% buffer" means that the investment does not lose money, if held to the end of the outcome period, unless the underlying security declines more than about 8.2% (9% buffer less the expense ratio.)*
- *A "30% buffer" means that the investor is liable for the first 5.8% of loss (5% plus the expense ratio) but is hedged against losses in the range 5.8 – 35.8%.*
- *A "12% cap" means that the maximum upside is about 11.2% (the cap minus the expense ratio.)*

Caps and dividends are net of dividends. Since dividends are about 2% on the SPX index, a 12% cap, which is really 11.2% net of expenses, corresponds to a 14% or greater rise in SPY.

A 9% buffer, which protects against a SPX decline of about 8.2%, protects against about a 6.2% decline in SPY.

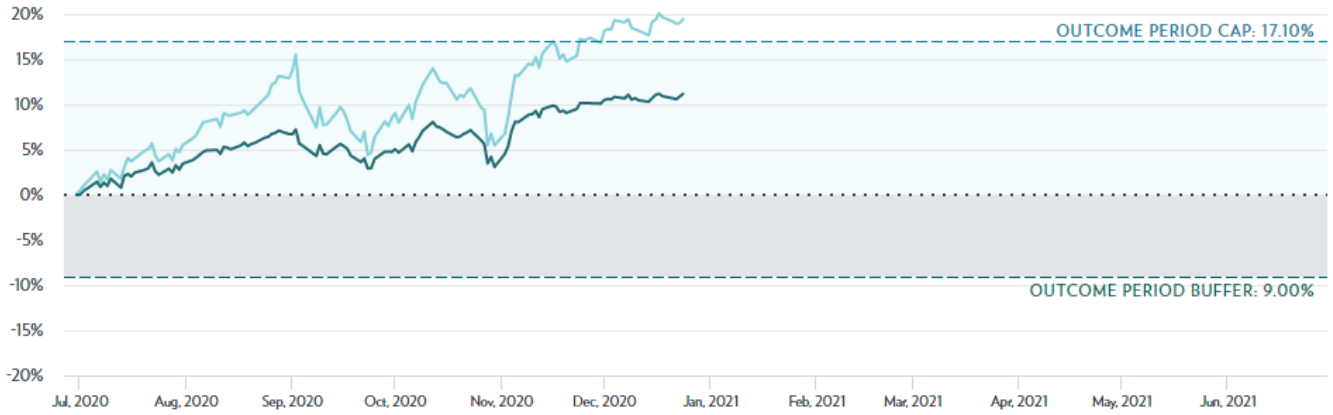
**Option Time Value**

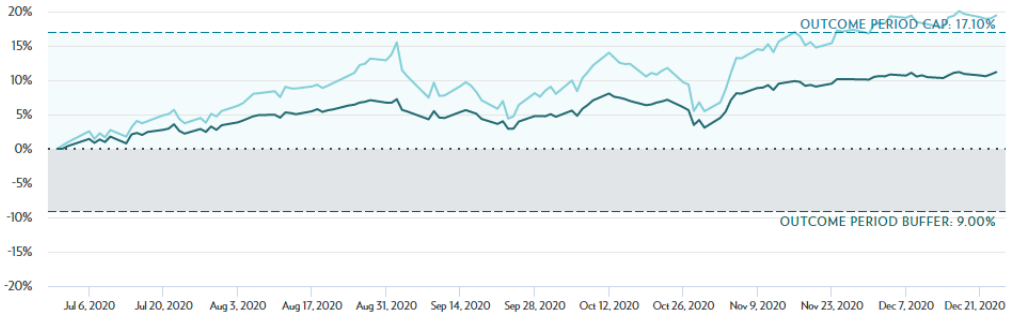
The examples discussed to this point implicitly assume that the defined outcome ETF is held until the reconstitution date. The price of the ETF departs significantly from the price of the underlying security before the reconstitution date due to "time value" of the underlying option contracts.

Equity curves for a defined outcome fund based on the SPX index and for the index are shown in Figure 8. The price of SPX rose in the latter part of 2020, following the reconstitution of the fund on June 30, 2020. The index pieced the cap in mid-November and is up 19% as of December 24. BJUL lagged the rise of SPX and is up 11%, about two thirds as much.

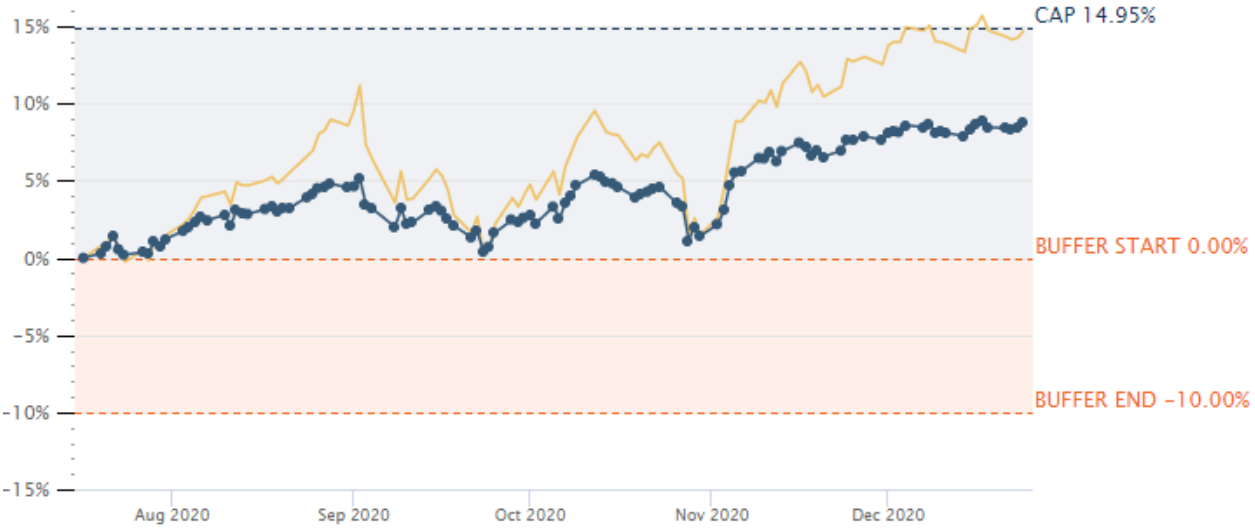
BJUL will rise a further 5.2% (17.1% Cap minus 0.75% expense ratio minus the 11.18% current appreciation) by the end of the outcome interval if the price of SPX is above the cap at the end of the outcome interval.

**Figure 8. Performance Between Reconstitution Dates in a Rising Market.** BJUL. Source: InnovatorETFs.com, December 24, 2020. Charts such as this are available daily for Innovator funds and First Trust families.



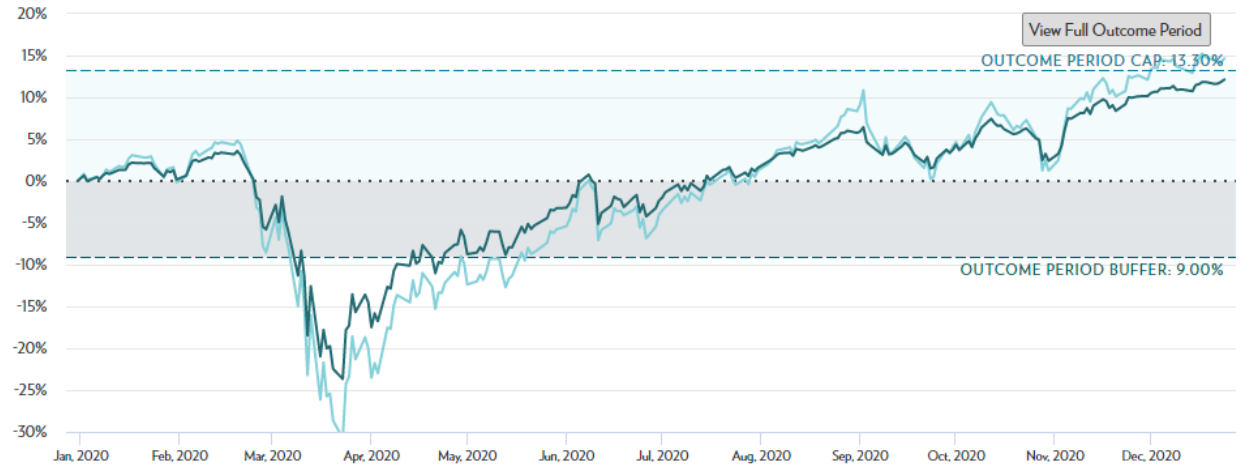




JULZ, a TrueShares offering, was up 15.48% over the same interval. FJUL a First Trust offering was up 8.75% over the slightly shorter interval from July 20.

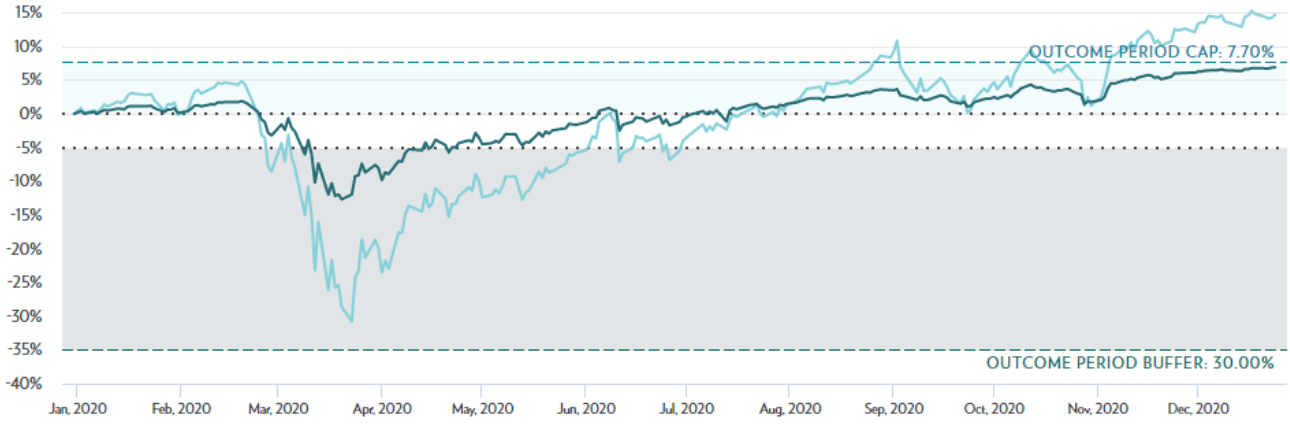



There is a similar lag when the market moves down; the defined outcome fund does not fall as fast as the market. The following chart shows BJAN on

December 24, 2020, seven days from the end of its outcome interval. Note the piercing of the buffer in the March-April timeframe.




Compare the performance of BJAN with almost sedate performance of UJAN in the same time frame. (The U-series provides a 5-35% buffer and a smaller cap.)



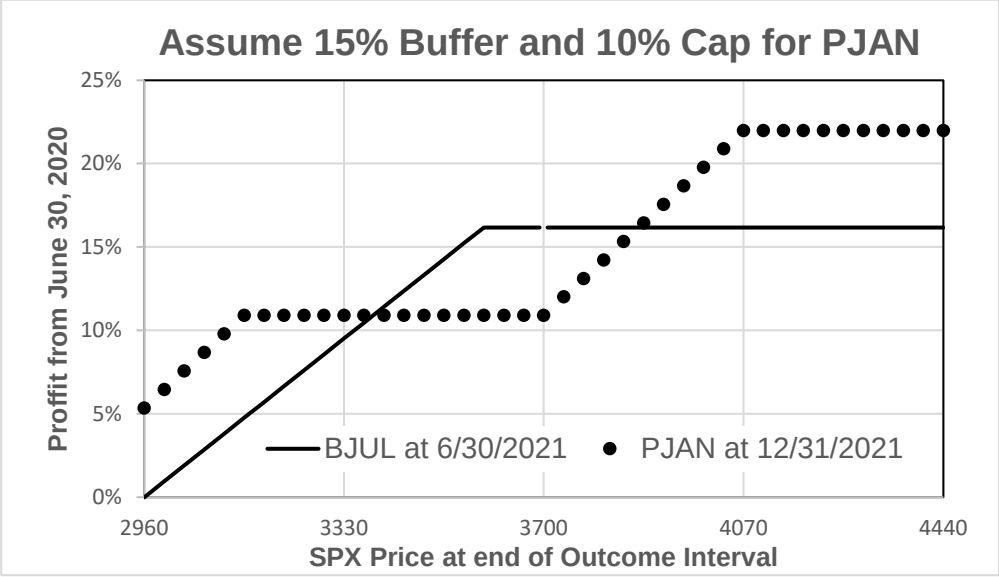

**Opportunistic Trading of Defined Outcome Funds.**

BJUL is up 10.9% as of December 18 per InnovatorETFs.com. The cap is 17.1%, or about 16.7% net of the remaining six months of expenses. The maximum appreciation of BJUL over the next six months is therefore about 6.2%.

If SPX is up 17.1% or more on June 30, 2021, BJUL will close at the cap. SPX is up 19.7% as of December 18. The closing price of BJUL on June 30 is unaffected should SPX decline as much as 2.6% from the current price.

If SPX declines between 2.6 and 19.7% from the current price, BJUL will track the decline. If SPX declines more than about 17T, the buffer will be activated and the decline of BJUL will be arrested.

This discussion is summarized in the following figure.




PJAN was reconstituted at the end of December 2020 with a 15% buffer. A few days before reconstitution, the cap was estimated to be 10%.

The profit and loss diagram for PJAN is shown by the dotted line in the figure. PJAN is protected from a 15% decline in SPX whereas BJUL is only protected from a 2.6% loss. PJAN has the potential to gain about 9% (10% cap less expenses) over the next year while BUL is limited to about 6% over the next six months.

If the market is unchanged over the next six months BJUL gains about 6% and PJAN declines by six months of fund expenses.

I am told that many advisers would move to PJAN under these conditions to lock in the gain. Had the market moved down, there would be an incentive to roll to a new fund to increase the buffer.

These ideas lead to the concept of rolling a fund forward periodically. Quarterly rotations were tested (at the suggestion of Wes Matthews, Milliman) and found to provide value for the 15% buffer but not for the 30% buffer. See Table 10.

**Table 10. Defined Outcome Strategies, 2006 – 2020.** When index equity curves were adjusted for estimated expenses, each monthly return was reduced by the factor 2 - (1.0079)^0.08333.

| **Source** | | Table 6 | Swan Select Composite | SPRO01, 10% Buffer gross of expense | SPFR01 15% Buffer, net of expense | 15% Buffer, Quarterly Rotation, net of expense | 15% Buffer, Monthly Momentum, net of expense | SPRS01 30% Buffer, net of expense | 30% Buffer, Quarterly Rotation, net of expense | 30% Buffer, Monthly Momentum, net of expense |
|---|---|---|---|---|---|---|---|---|---|---|
| **Case #** | 1 | 64 | 2 | 4 | 5 | 7 | 8 | 9 | 11 | 12 |
| **Optimization** | Fixed Allocation | Dilution | | | | Quarterly Rotation | Momentum | | Quarterly Rotation | Momentum |
| **Risky Asset** | LrgCapUS | QQQ | US stocks | SPX | SPX | SPX | SPX | SPX | SPX | SPX |
| **Risk-Free Asset** | IGBond | IGBond | Active options | Passive options | Passive options | Passive options | Passive options | Passive options | Passive options | Passive options |
| **CAGR** | 7.73% | 9.79% | 6.68% | 7.00% | 4.97% | 5.67% | 4.38% | 4.68% | 4.45% | 4.02% |
| **Realized SD** | 0.0055 | 0.0051 | 0.0051 | 0.0066 | 0.0053 | 0.0051 | 0.0052 | 0.0041 | 0.0038 | 0.0043 |
| **Sharpe** | 0.78 | 1.07 | 0.71 | 0.60 | 0.49 | 0.59 | 0.43 | 0.58 | 0.58 | 0.46 |
| **MaxDD** | 0.304 | 0.144 | 0.136 | 0.399 | 0.353 | 0.295 | 0.323 | 0.198 | 0.217 | 0.241 |
| **UPI** | 0.89 | 1.96 | 1.22 | 0.57 | 0.43 | 0.65 | 0.42 | 0.70 | 0.63 | 0.43 |
| **RA Allocation** | 60% | 62% | | | | | | | | |
| **RFA Allocation** | 40% | 38% | | | | | | | | |
| **WINS36** | Reference | 83% | 23% | 28% | 1% | 0% | 0% | 23% | 14% | 16% |

Source: EF Performance.xlsx

## PART IV. RELATIVE PERFORMANCE IN A LOW INTEREST RATE ENVIRONMENT

**The following discussion is speculative! Input is invited.**

The compositions of the low and moderate volatility portfolios are dominated by bonds. It is reasonable therefore to consider that the future performance of these portfolios will be dominated by the future performance of bonds.

The US Federal Reserve has indicated that short term interest rates will remain low for the next year or two, which is likely to mean that all interest rates will remain below historical averages. While the decline in interest rates over the past three or four decades has boosted bond returns, this boost has run its course. Indeed, bond total returns are likely to decline over the intermediate future as interest rates begin to renormalize.

Tbills were substituted for bonds to assess how strategies might perform in a low interest rate environment.

| **2000 – 2020** | | Table 6, #57 | Table 6, #56 | | Table 6, #63 | Table 6, #66 |
|---|---|---|---|---|---|---|
| **Optimization** | Fixed Allocation | Dilution | Dilution | Fixed Allocation | Dilution | Dilution |
| **Risky Asset** | LrgCapUS | LrgCapUS | QQQ | LrgCapUS | LrgCapUS | QQQ |
| **Risk-Free Asset** | 1moTbills | 1moTbills | 1moTbills | 1moTbills | 1moTbills | 1moTbills |
| **CAGR** | 2.69% | 2.83% | 3.27% | 4.78% | 5.07% | 6.59% |
| **Realized SD** | 0.0019 | 0.0018 | 0.0018 | 0.0057 | 0.0052 | 0.0055 |
| **Sharpe** | 0.39 | 0.46 | 0.60 | 0.39 | 0.58 | 0.60 |
| **MaxDD** | 0.114 | 0.058 | 0.058 | 0.336 | 0.207 | 0.198 |
| **UPI** | 0.45 | 0.66 | 1.06 | 0.31 | 0.42 | 0.66 |
| **Tbills Allocation** | 80% | 78% | 83% | 40% | 35% | 50% |
| **WINS36** | Reference | 82% | 74% | Reference | 83% | 75% |

Maximum drawdowns increased on switching from IGBond to Tbills. Active management of volatility (Dilution) continued to provide consistently higher returns than a fixed allocation to bonds.

# Appendix A. Efficient Frontier.

**Describing the Efficient Frontier in EXCEL**. The example is for month-end 12/31/2019. The "risky portfolio" contains three securities: SPY, QQQ and IEF; 1-month treasury bills ("Tbills") is the "risk-free" asset.

1. Calculate returns for each security and the variance-covariance matrix for all of the securities at the end of each month.

   THIS SECTION USES DATA FOR SPY, QQQ and IEF

   The daily return of a particular security is taken to be the average of its daily returns over the prior 63 days, including the month-end date. Do not annualize the returns.

| SPY | QQQ | IEF | Tbills |
|---|---|---|---|
| 0.1573% | 0.2073% | -0.0311% | 0.0060% |

   The variance-covariance matrix is determined from the daily returns over the prior 105 days, including the month-end date, using EXCEL's VAR.S and COVARIANCE.S functions.

   The entries shown below have been annualized by multiplying by 252 trading days in a typical year. (Annualization is not necessary.)

| | SPY | QQQ | IEF | 1-mo Tbills |
|---|---|---|---|---|
| SPY | 1.722E-2 | 2.017E-2 | -4.700E-3 | 2.34E-6 |
| QQQ | | 2.533E-2 | -5.548E-3 | 1.91E-6 |
| IEF | | | 5.103E-3 | 1.24E-6 |
| Tbills | | | | 6.29E-8 |

2. The efficient frontier is the locus of returns where the allocations within the risky portfolio have been chosen to maximize the portfolio return for a given standard deviation. The frontier stretches along the standard deviation axis from the standard deviation of the portfolio with minimum variance to the standard deviation of the portfolio with maximum return.

   The minimum variance portfolio can be identified by using EXCEL's SOLVER function to determine the weights of the securities in the risky portfolio (SPY, QQQ and IEF in this example) which minimize the variance of the risky portfolio, subject to the constraints that the weights cannot be negative and that the sum of the weights equals one.

   The maximum return portfolio can be identified by using EXCEL's SOLVER function to determine the weights of the securities in the risky portfolio which maximize the return of the risky portfolio subject to the constraints that the weights cannot be negative and that the sum of the weights equals one.

   The intermediate points on the efficient frontier can be identified by using EXCEL's SOLVER function to determine the weights of the securities in the risky portfolio which maximize the return of the risky portfolio subject to the constraints that the

weights are positive or zero, that the sum of the weights equals one AND that the variance (or standard deviation) is fixed at a value between the standard deviation of the minimum variance and maximum return portfolios.

3. The variance of the risky portfolio can be determined using EXCEL's matrix formulas. Matrix multiplication requires that the number of rows in the first matrix must equal the number of columns in the second. That is,

| | | | |
|---|---|---|---|
| X X X | times X X X is valid but X X X times | X X X | Is not. |
| X X X | | X X X | |
| X X X | | X X X | |

| | | | |
|---|---|---|---|
| X X | times X X is valid but X X times | X X | Is not. |
| X X | | X X | |

The variance covariance portfolio in this example has three rows and three columns.

If the weights are in a row, the variance of the risky portfolio is

MMULT(weights, MMULT(Var-Covar Matrix, TRANSPOSE(weights)))

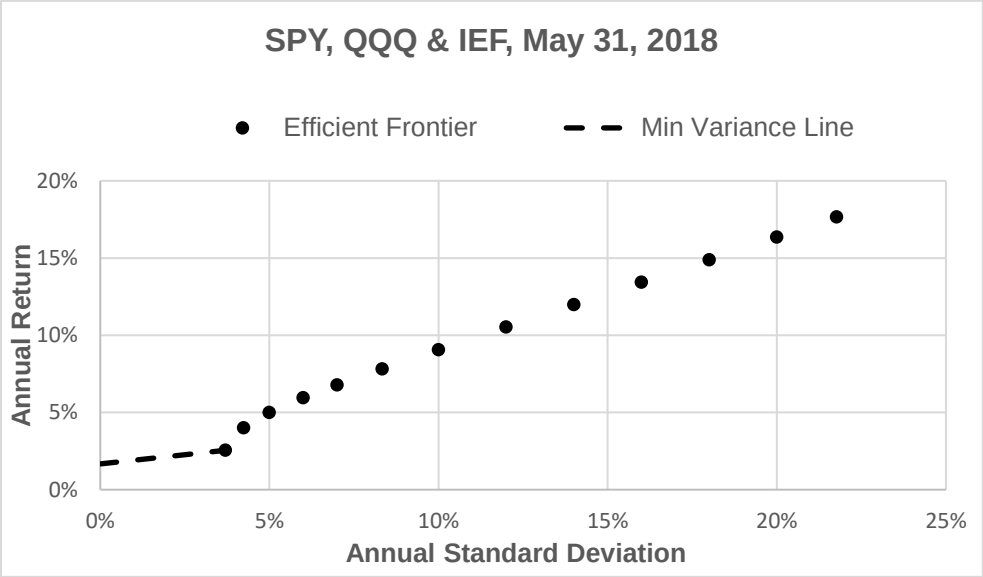
If the weights are in a column, the variance of the risky portfolio is

MMULT(TRANSPOSE(weights), MMULT(Var-Covar Matrix, weights))

4. The daily return of the risky portfolio is $\Sigma W_i R_i$ where $W_i$ and $R_i$ are the weights of the individual securities and their average daily returns respectively.

   The annual return of the risky portfolio is (1 + daily return) ^ 252.

The efficient frontier for the SPY, QQQ, IEF portfolio as of a specific date is reproduced below.




**Determining Allocations for a Blended Portfolio of Specified Standard Deviation.**

The variance of a portfolio formed by blending two portfolios is determined from the variances and covariance of the two portfolios as follows.

$$VAR_{blend} = W_1\text{^}2*VAR_1 + (1-W_1)\text{^}2*VAR_2 + 2*W_1*(1-W_1)*COVAR_{12}$$

This formula can be simplified when Tbills is the second portfolio because the variance of Tbills is small and the covariance with the risky portfolio is also small.

$$SD_{blend} = SQRT(VAR_{blend}) = Weight_{risky\ asset} * SD_{risky\ asset}$$

When blending the risky portfolio with bonds, it is generally necessary to solve the quadratic formula because the variance of bonds and the covariance with bonds are no small. Alternatively, the variance of the blended portfolio can be determined using matrix formulas. The variance covariance matrix is a 4x4 matrix in this example.

The return of a blended portfolio comprising Tbills and this risky asset (portfolio) varies linearly between the return of Tbills and the return of the risky portfolio. This is the dashed black line in the prior figure.

$$Return_{blend} = Weight_{risky\ asset} * (R_{risky\ asset} - R_{tbills}) + R_{tbills}$$

If the desired standard deviation of the blended portfolio is 0.2% daily (about 0.2% * sqrt(252) = 3.2% annually), the weight of the risky asset (portfolio) to achieve the desired standard deviation is 0.002 divided by the daily standard deviation of the risky asset. The balance of the blended portfolio would be Tbills.

*Assume that the optimized weights in the risky portfolio are {0.3, 0.3, 0.4} and that the weight of the risky portfolio to achieve the standard deviation goal is 40%. The weights in the blended portfolio, risky portfolio plus Tbills, are {0.12, 0.12, 0.16, 0.60}.*

When the standard deviation goal exceeds the standard deviation of the risky portfolio, these formulas lead to the shorting of Tbills and more than 100% allocations to the risky securities. There is no shorting of Tbills in the simulations described here. That is the desired standard deviation was treated as a cap.

**Determining the Maximum Sharpe Portfolio**.

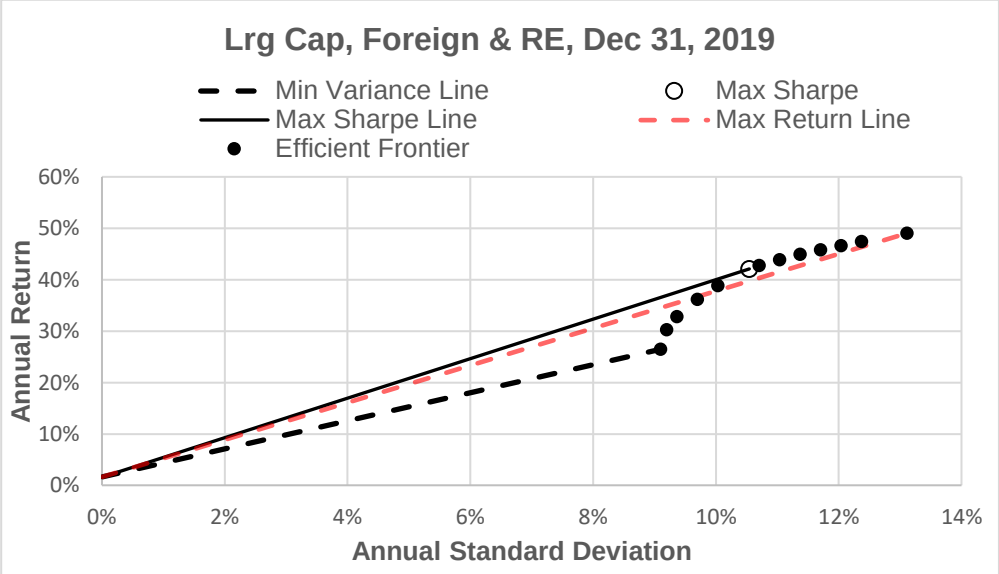
Use EXCEL's solver function to determine the weights which maximize the Sharpe Ratio of the risky portfolio subject to the constraints that the weights cannot be negative and that the sum of the weights equals one.

Sharpe adjusted each return by subtracting the return of the risk-free asset, Tbills in this context. He defined his ratio as the average of the adjusted returns divided by the standard deviation of the adjusted returns.

For simplicity, we define the Sharpe ratio in this application as the average of the daily returns of the risky portfolio minus the average of the daily returns of Tbills all divided by the standard deviation of the daily returns of the risky portfolio.

The standard deviation of the risky portfolio is the square root of the variance of the risky portfolio, whose calculation was illustrated previously. The weights which maximize the Sharpe Ratio do not depend on whether the variance is expressed daily or annually.

The following chart illustrates the Efficient Frontier with the location of the Sharpe Ratio indicated by the open circle.



## Appendix B. Profit and Loss Profiles for Option Contracts

Defined outcome funds buy baskets of stock options with a common expiration date, usually one year hence. The options are "European style" with no possibility of assignment before expiration.

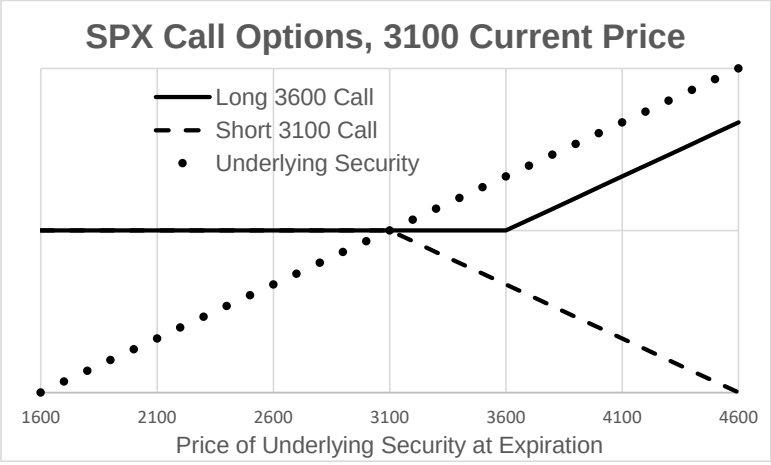
We value options here as a function of the price of the underlying stock at expiration. This is known as the "intrinsic value". We neglect the "time value" of the option, which is an important determinator of the value before expiration.

We also neglect the premium received or paid.

**A CALL option** is the right to purchase, or the obligation to sell, the underlying stock at a specific price, known as the "strike price." If you buy or "are long" a call, there is no incentive to exercise the call unless the value of the underlying security is above the strike price. Above the strike price, the option gains value from the perception of the buyer.

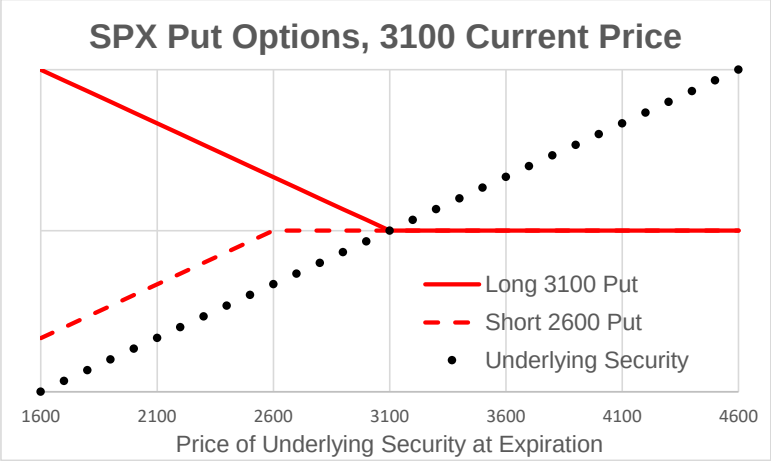
If you sell or "are short" a call, there is no incentive for the buyer to exercise until the price of the underlying security moves above the strike price. Consequently, a short call does not change in value until the price of the underlying security is above the strike price. Above the strike price, the option loses money from the perception of the seller.

**Figure B-1. Value of Long Call and Short Call Contracts at Expiration**. The strike price of the long call happens to be different from the strike price of the short call in this example.



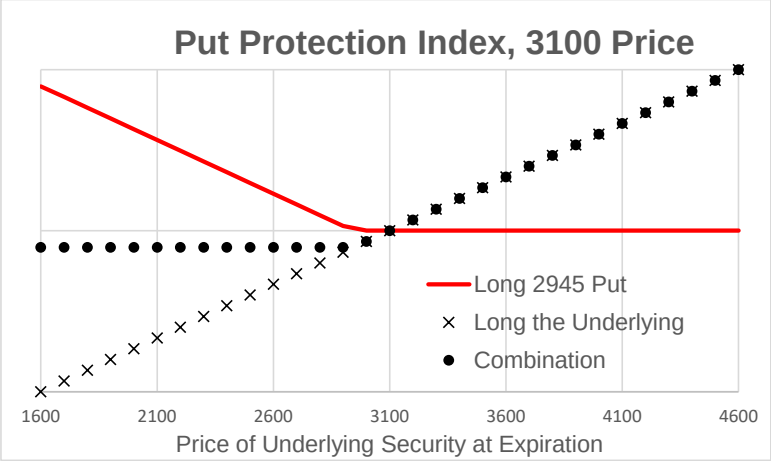

**A PUT option** is the right to sell, or the obligation to purchase, a stock at a predetermined "strike" price. There is no incentive for the buyer to exercise the option if the price of the underlying security at expiration is more than the strike price. Consequently, the value of a long put does not increase until the price of the underlying security is less than the strike price. The value of a short put at maturity does not decline unless the price of the underlying security is less than the strike price.

**Figure B-2. Value of Long Put and Short Put Contracts at Expiration**. The strike prices of the long and short puts happen to be different in this example.




**The Cboe S&P 500 5% Put Protection Index (PPUT)** holds a long position indexed to the S&P 500 Index (without dividends) and buys 1-month SPX puts with a strike price equal to 95% of the current price. There are data from 1988.

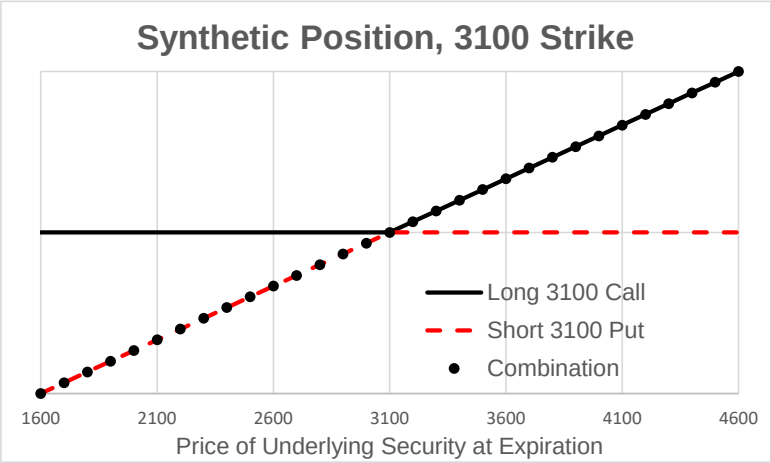
**Figure B-3. Value of 1-month Cboe Put Protection Index at Expiration**. The maximum monthly loss is 5%, plus the cost of the put option.




*The next examples are combinations of calls and puts. The figures were constructed in EXCEL as the sum of the appropriate call and put profiles. The costs to buy or sell the options have been omitted for clarity.*

**A SYNTHETIC POSITION** is a portfolio of options which, taken together, emulates a position in a security. For example, a synthetic long position in the underlying security is established by buying a call and selling a put at the same strike price. The strike price is often the current market price, in which case the options are said to be "at the money" (ATM).

**Figure B-4. Value of a Synthetic Long Position at Expiration**. The net premium is generally not zero and thus the net value of the two options is usually slightly offset from the price profile of the underlying security. ADD UNDERLYING TO THIS FIGURE




Another approach to a synthetic long position is to buy a way in the money call. For example, buying a SPX call at 100 when SPX is trading at 3100. First Trust does this when constructing its defined outcome strategies. The option premium is large for a call so deep in the money and thus this approach creates significant collateral, whereas the combination of a long call and a short put does not create collateral.

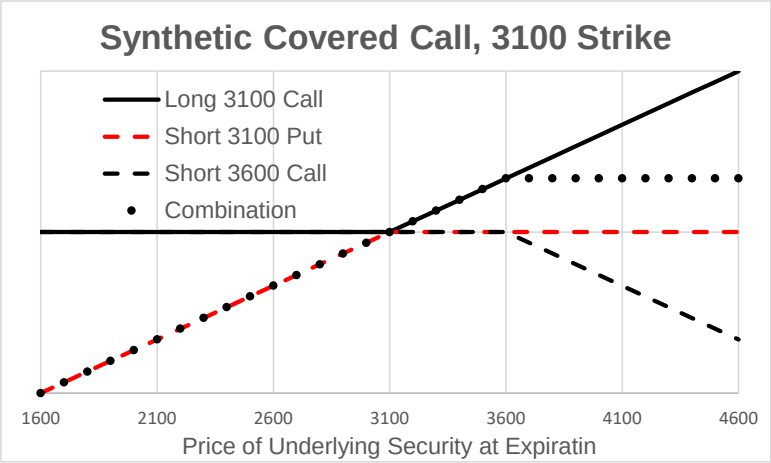
Synthetic positions do not accrue dividends and thus they cost less than buying the underlying security. The lower cost of the synthetic position increases the upside potential of defined outcome strategies.

**A COVERED CALL** is the sale of a call option when you own the underlying security (or are long a synthetic stock position).

**The Cboe S&P 500 BuyWrite** Index (BXM) buys the stocks in the SPX index (e.g., VOO), and sells (writes) 1-month ATM SPX call options. The maximum monthly upside is the revenue from the call and the downside is unlimited. There are data from 1988 and there is a Cboe video describing the strategy.

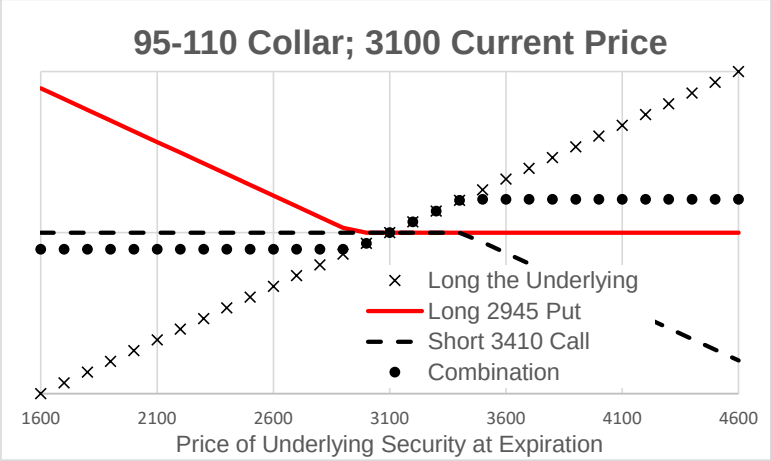
Defined outcome strategies use SYNTHETIC COVERED CALLS. This requires three options, the purchase of a call and the sale of a put with the same strike price to establish the synthetic long position and the sale of a call at a higher strike price.

**Figure B-5. Value of a Synthetic Covered Call at Expiration**. This example shows the purchase of an ATM call, the sale of an ATM put and the purchase of an "out of the money" (OTM) call. The maximum upside is the net of the option premiums plus the strike price of the call minus the current price; the downside is unlimited.




**The Cboe S&P 500 95-110 Collar Index (CLL)** combines aspects of the covered call and the protective put. The CLL strategy purchases the stocks in the S&P 500 Index (e.g., VOO), sells, each month, SPX calls at 110% of the index value and, each quarter, purchases SPX put options at 95% of the index value.

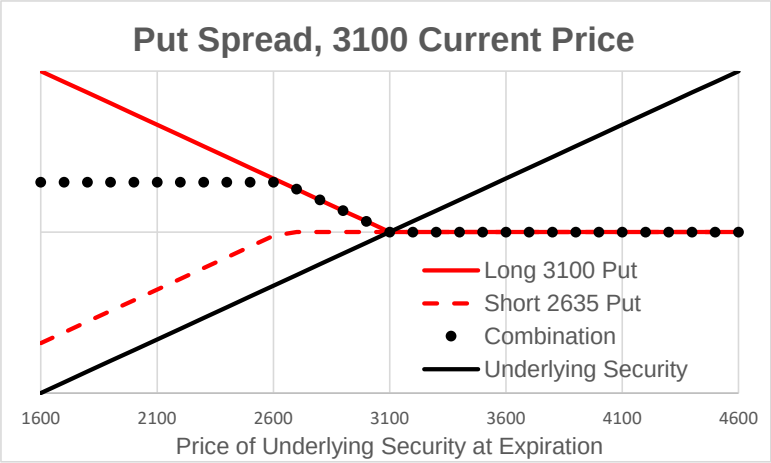
**Figure B-6. Value of Cboe Collar Index at Expiration**. This example shows the purchase of the underlying security, the quarterly purchase of a 5% OTM put and the monthly sale of a 10% OTM call. The maximum monthly upside is 10% minus the net option premium; the maximum quarterly downside is 5% plus the net option premium.




**A PUT SPREAD** is the sale of an OTM put and the purchase of another put at a higher strike price. The purchased put is often at the money but, in certain defined outcome strategies, the purchased put has a strike price which is 5.0% below the current price.

**Figure B-7. Value of a Put Spread at Expiration**. In this illustration, the purchased put is at the money and the short put is at 2635, which creates a 15% downside buffer.

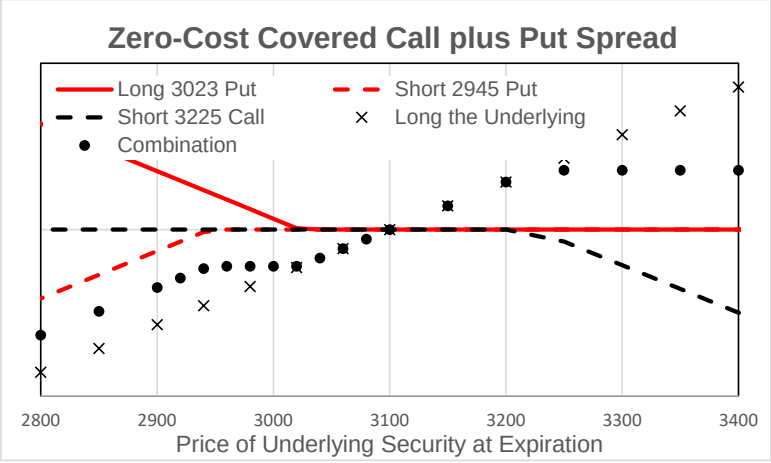
This figure is not correct. The combo should be flat from 0 to minus 15% and the underlying should be shown as X.




**The Cboe S&P 500 Zero-Cost Put Spread Collar** Index (CLLZ) combines a covered call and a put spread. The strategy holds a long position indexed to the S&P 500 Index (without dividends), buys a 95% SPX put and sells a 97.5% SPX put each month basis and sells monthly out-of-the-money SPX calls at whatever strike price covers the cost of the put spread.

The strategy provides a 2.5% per month downside buffer after a 2.5% decline.

**Figure B-7. Value of the Cboe S&P 500 Zero-Cost Put Spread Collar Index (CLLZ) at Expiration**. The call in this illustration has a strike price of 3225. In reality, the strike price of the call would not be known until after the put spread has been established because the call premium must offset the cost of the put spread.



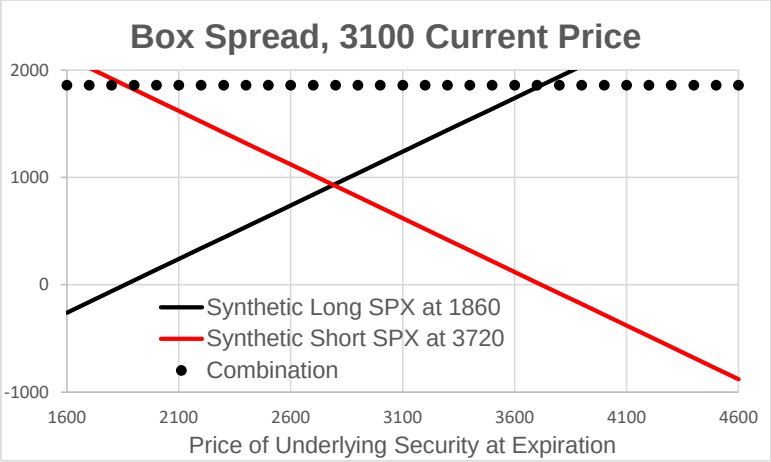

**A BOX SPREAD** requires four options. The strategy is equivalent to buying stock at one price and selling the stock short at another. The payoff is independent of the price at expiration and equals the difference in strike prices less the net cost to acquire the options. The payoff is usually *de minimis*.

The box spreads used in the Innovator defined outcome strategies employ a long call and a short put with strike prices equal to 60% of the current price and a long put and a short call with strike prices equal to 120% of the current

price. This is equivalent to being long SPX at 60% of the current price and short SPX at 120% of its current price.

With SPX trading at 3100, the value/cost of Innovator's box spread would be $186,000 per contract, neglecting the option premiums. A box spread therefore requires significant collateral, akin to buying T-bills.

**Figure B-6. Value of Innovator Box Spread at Expiration**. Two options create a synthetic long position, and two other options create a synthetic short position. The combined value of the four options equals the difference in strike prices and is independent of the price of the underlying security at expiration.

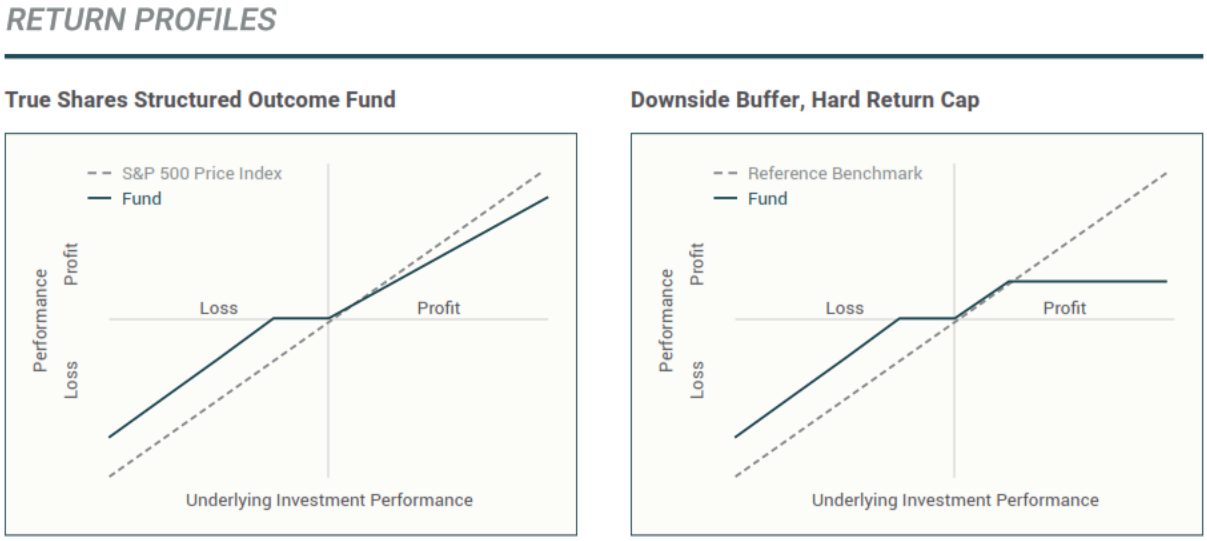


## Appendix C. Defined Outcome Funds

Defined outcome funds hold a basket of exchange-traded FLEX options with varying strike prices but the same, one-year, expiration date. FLEX options allow great flexibility as to strike price and expiration date. Defined outcome funds do not use leverage.

Existing defined outcome strategies produce one of two return profiles. Both profiles limit or "buffer" some of the downside risk. The strategy on the right allows appreciation up to a predefined market cap. The strategy on the left has no cap but the rate of appreciation is less than the rate of market appreciation. Both profiles decline below the buffer region in line with the decline in the price of the underlying security.

**Figure C-1. Alternate Return Profiles of Define Outcome Strategies**. Source: TrueShares.com, July 3, 2020.




**TRUE-SHARES DEFINED OUTCOME ETFs** are examples of the left profile. The strategies are constructed by selling out of the money puts and buying at the money calls.

The cost of an ATM call contract generally exceeds the revenue from the sale of an OTM put contract plus the interest on the fund's collateral. If the net cost is to be zero, the strategy must buy fewer call contracts than the number of put contracts sold. Consequently, the strategy value does not increase on the upside as fast as the value declines on the downside.

The "participation ratio" is the ratio of the notional value of the calls divided by the notional value of the puts on the reconstitution date. The notional value of an option is the number of contracts times the strike price.

The participation ratio is determined by the costs of the options and by the difference in the strike prices. The participation ratio is typically 70 – 85%[12].

*Example. The fund buys 37 put contracts on SPX with a strike price of 2700. The notional value is 37 * 100 shares per contract * 2700 = $9,990,000. The cost of the purchase less the interest on the fund's collateral is offset by the revenue from the sale of 28 calls at 3000. The notional value of the calls is 28 * 100 shares per contract * 3000 = $8,400,000. The participation ratio is 84.1%.*

The INNOVATOR defined outcome funds are examples of the right-hand strategy profile. Innovator Capital Management offers ETFs based on the NASDAQ100, Russell2000 MSCI EM and SPX price indices with three buffer sizes and monthly or quarterly reconstitution dates. More variations are on the way.

Innovator's basic strategy is to own a synthetic covered call and a put spread. Three options are needed for the synthetic covered call.

Long an ATM call
Short an ATM put
Long an OTM call

An additional two options are needed for the put spread.

Short an ATM put or short a 5% OTM put.
Long an OTM put.

The maximum return cap is determined by the strike price of the OTM call, which is determined in turn by the net revenue after buying and selling the other options.

Innovator adds a four-option box spread. This is said to increase net revenue, which allows for a higher strike price for the OTM call and a higher cap.

*For Innovator's BJUL, reconstituted 30 Jun 2020 when the price of SPX was 3100, the box spread is long SPX 1860 calls, short SPX 3720 calls, short SPX 1860 puts and long SPX 3720 puts. This is equivalent to being long SPX at 1860 and short SPX at 3720.*

Innovator creates a synthetic index rather than purchasing a low-cost ETF based on the index. I was told that the synthetic approach pays the estimated value of future dividends upfront and that upfront payment allows for a higher cap.

FIRST TRUST ETFs also provide the right-hand return profile. The First Trust ETFs are based on the price return of SPY (which approximates SPX) with multiple buffer sizes and reconstitution dates[13]. Whereas Innovator

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[12] 15 July 2020 TrueShares webinar.

[13] I am told that the tax treatment of option on a fund like SPY is well understood whereas the tax treatment of option on an index like SPX has not been litigated. First Trust considers it important that the

reconstitutes its ETFs at the close on the last day of the months, First Trust reconstitutes its funds at the close on the third Friday option expiration date.

The First Trust strategy starts with the purchase of a call at 10% of the current SPY price. This call is nearly as expensive as buying SPY; it is, in effect, a synthetic position and it serves as collateral.

First Trust's second step is to establish a put spread on SPY analogous to the put spreads that Innovator establishes on SPX. The long put is at the money and the short put is 10% below the current price, which establishes a 10% buffer. Alternatively, the long put is 5% below the current price and the short put is 30% below the current price which establishes a 25% buffer (-5 to -30%).

The final step is to sell calls to establish the upside cap.

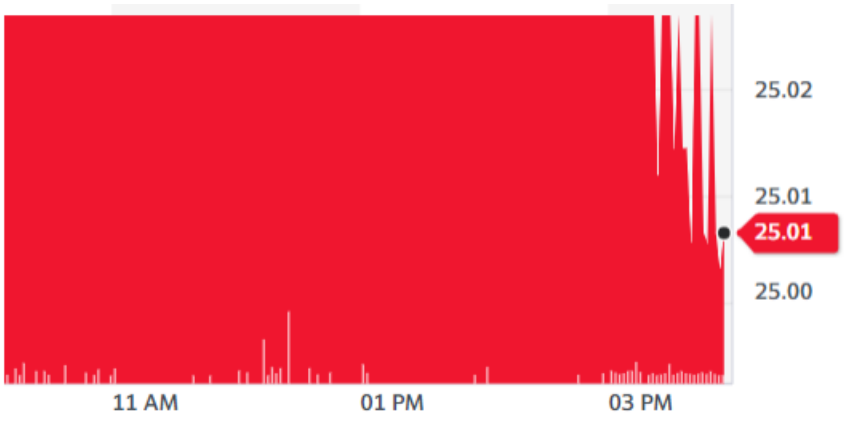
*TrueShares buys an ATM call; Innovator and First Trust sell OTM calls.*

Defined outcome funds roll the basket of options forward when they expire at the end of the "outcome period." Since options are priced differently when the funds are reconstituted, the upside cap and the participation ratio during the subsequent year are not known until the funds are reconstituted

*Innovator's BJUL is based on the S&P500 price composite with a 9% downside buffer. BJUL had a 14.0% cap when BJUL reconstituted July 1, 2019 and a 17.1% cap when BJUL reconstituted July 1, 2020.*

True Shares does not immediately re-invest the proceeds from expiring options. Rather the proceeds, and any new money less any redemptions, are re-invested near the close of the first trading day of the new outcome interval. If an investor wishes to purchase a True Shares fund on the reconstitution date, he or she should purchase the fund during the middle of the day on the reconstitution date.

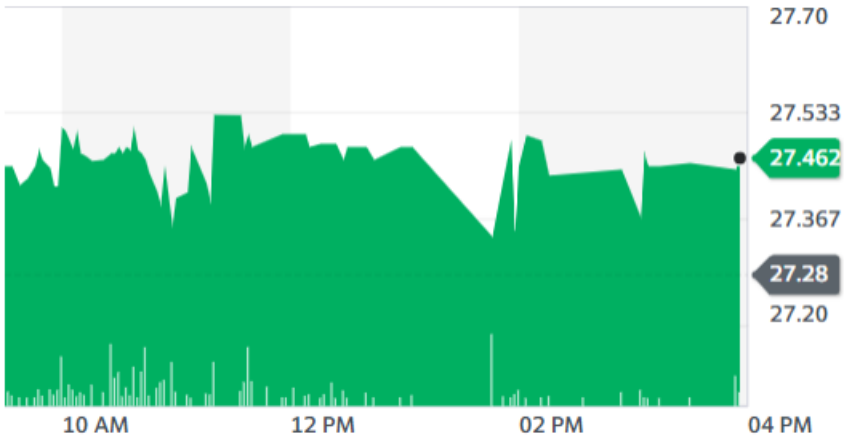
Figure C-2. Market Price of TrueShares AUGZ on the 3 Aug 2020 reconstitution date. The fund did not begin trading until after 3 pm. Chart from finance.yahoo.com




options should be based on a fund rather than an index; Innovator does not. The design decisions by innovator and First Trust may be meant to avoid conflict with licensing arrangements.

Innovator and First Trust re-invest the proceeds of expiring options at the close on their respective expiration dates. If an investor wants to purchase a newly reconstituted Innovator or First Trust fund, he or she should purchase the expiring fund before the close on the reconstitution date.

**Figure C-3. Price of Innovator's BAUG on 3 Aug 2020, the day after reconstitution; the price closed at 27.28 on the reconstitution date. Chart from finance.yahoo.com.**




**Buffers and Caps are Complicated by Dividends and Expenses.**

Expenses and dividends were not considered in the construction of the return profiles shown above. Downside protection is limited to the buffer size less the fund's expense ratio and, consequently, downside protection and upside caps are smaller than they appear.

*Expenses are 0.79% for the True-Shares funds, and for most of the Innovator funds, and 0.85% for the First Trust ETFs. Consequently, a ten percent buffer protects against about 9.2% in losses.*

*A 17% cap limits the upside to about 16.2%.*

*A twenty percent market rise with an 80% participation ratio represents a 15.2% gain (20% * 80% - expenses) for the investor.*

Dividends are another complication. If VOO[14] is down ten percent over a year, the composite without dividends (SPX) will be down about 12% since annual dividends on the S&P 500® Composite are about 2%.

The following examples assume purchase of the defined outcome fund on the 30 June 2020 reconstitution date. See also Table 1.

[14] VOO is a Vanguard ETF which tracks the S&P 500® Total Return Index. Expenses are 0.03%. SPY, the SPDR S&P500 Trust ETF, tracks the same index but with higher expenses.

1. VOO declines 30% by the 30 Jun 2021 reconstitution date. SPX declines about 32% and the strategies decline 22, 23 and 5% respectively. Because of expenses, an investor loses 22.8, 23.8 and 5.8% respectively.

   The 60:40 portfolio declines about 18%. (Expenses for VOO are so low that they are being neglected.)

2. VOO declines 10% by the reconstitution date, SPX declines about 12% and the strategies declined 2, 3 and 5% respectively. Because of expenses, an investor loses 2.8, 3.8 and 5.8% respectively.

   The 60:40 portfolio declines about 6.0%.

3. VOO is unchanged on the reconstitution date. SPX declines about 2% but the strategies are unchanged, and an investor loses of 0.8%.

   The 60:40 portfolio is unchanged.

4. VOO is up 10% on the reconstitution date, SPX is up about 8% and the strategies are up 6.6, 8.0 and 7.3%. An investor has gains of 5.8, 7.2 and 6.5%

   The 60:40 portfolio is up about 6.0%.

5. VOO is up thirty percent on the reconstitution date, SPX is up about 28% and the strategies are up 23.1, 17.1 and 7.3%. An investor experiences gains of 22.3, 16.3 and 6.5%.

6. The 60:40 portfolio would be up about 18.0%.

**Table C-1. Investor Gains and Losses at End of 1-year Outcome Period.** The buffers and upside limits are specific to JULZ, BJUL and UJUL reconstituted 1 Jul 2020. The buffers for First Trust's DJUL and FJUL, reconstituted 17 Jul 2020, are 10 and 25% (5-30%), the upside caps are 8.40 and 14.95% and expenses are 0.85%.

| | 60% VOO, 40% zero yield MMF | True Shares | Innovator and First Trust | Innovator and First Trust |
|---|---|---|---|---|
| Buffer | | 10% | 9% | 5 – 35% |
| Upside | | 82.4% capture | 17.1% cap | 7.3% cap |
| Expenses | 0.03% | 0.79% | 0.79% | 0.79% |
| **Example 1** | | | | |
| VOO, net | -30% | -30% | -30% | -30% |
| SPX | -32% | -32% | -32% | -32% |
| Strategy | -18% | -22% | -23% | -5% |
| ETF Return | -18% | -22.8% | -23.8% | -5.8% |
| **Example 2** | | | | |
| VOO, net | -10% | -10% | -10% | -10% |
| SPX | -12% | -12% | -12% | -12% |
| Strategy | -6% | -2% | -3% | -5% |
| ETF Return | -6.0% | -2.8% | -3.8% | -3.8% |
| **Example 3** | | | | |
| VOO, net | Unchanged | Unchanged | Unchanged | Unchanged |
| SPX | -2% | -2% | -2% | -2% |
| Strategy | Unchanged | Unchanged | Unchanged | Unchanged |
| ETF Return | 0.0% | -0.8% | -0.8% | -0.8% |
| **Example 4** | | | | |
| VOO, net | 10% | 10% | 10% | 10% |
| SPX | 8% | 8% | 8% | 8% |
| Strategy | 6% | 6.6% | 8.0% | 7.3% |
| ETF Return | 6.0% | 5.8% | 7.2% | 6.5% |
| **Example 5** | | | | |
| VOO, net | 30% | 30% | 30% | 30% |
| SPX | 28% | 28% | 28% | 28% |
| Strategy | 18% | 23.1% | 17.1% | 7.3% |
| ETF Return | 18.0% | 22.3% | 16.3% | 6.5% |

**These examples are only accurate if the fund is purchased on the reconstitution date and held to the end of the outcome period.** Because of option time value, there are significant deviations from these results between reconstitution dates.

When a defined outcome ETF is purchased between reconstitution dates, the downside buffer and cap are different from what they were on the reconstitution date because of changes in option prices[15].

[15] Innovator and First Trust provide tools on their websites which provide a daily update of buffer and cap.

Equity curves for a defined outcome fund and for SPX are shown in Figure 8. The price of the S&P Composite rose rapidly in the early months of 2019, piercing the cap in April. The value of the ETF did not track the value of the Composite, rising only 7 or 8% by April. By the end of the year, the ETF has appreciated to the value of the cap less the expense ratio.

**Figure C-4. Performance Between Reconstitution Dates in a Rising Market.** Innovator's PJAN was reconstituted in January 2019 with a 15% downside buffer and a 13.9% cap. Source: Innovator February 2020 webinar.


The is also a lag when the market moves down[16]. If the buffer were 15% and the market is down 15% six months after reconstitution, a defined outcome fund might be down 6 - 8%. If the market were unchanged at the next reconstitution date, the fund would have appreciated as option time value decays to zero and the fund would only be down by the amount of the expense ratio.

**Other Considerations.** Defined outcome strategies are said to work best in highly valued markets (where the risk of a decline is high) and/or in volatile markets. They are designed to appeal to conservative investors who is willing to forego some upside for less downside risk.

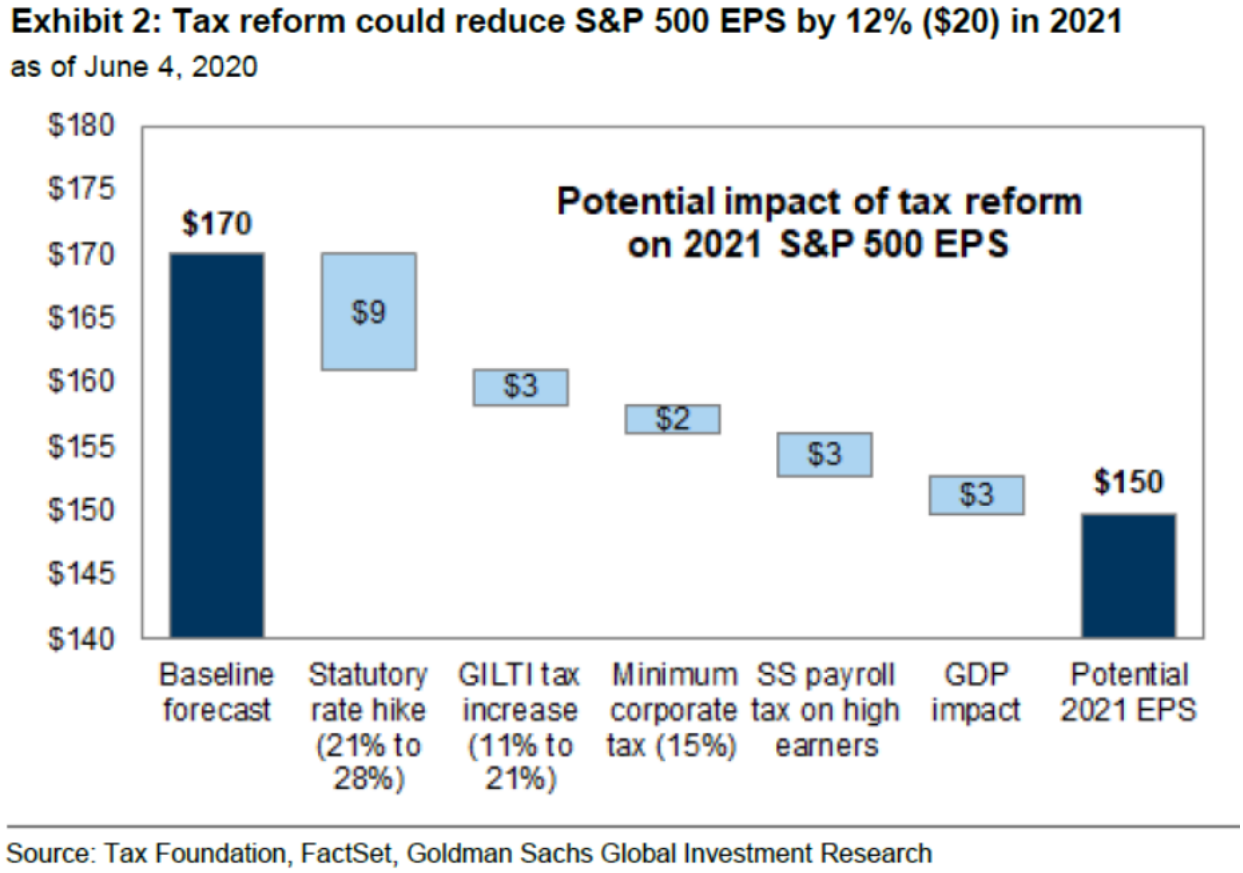
An example was given in the February webinar of an investor with 50% in stocks and 50% in fixed income. Replacing part of the equity and fixed income

[16] This hypothetical example is from the Q&A during Innovator's February 2020 webinar.

allocations with 30% of a defined outcome fund was said to provide more upside potential with less downside risk.

"Exhibit 2" below appeared at Bloomberg.com on June 8, 2020[17]. If Biden were elected and the Senate were controlled by Democrats, there would be a good likelihood of some of Biden's tax ideas being enacted. If EPS decline 12% in 2021, the market should also decline[18]. Purchasing a defined outcome fund with a 10 or 15% buffer in the October timeframe might be a prudent tactical move.

Figure C-5.




Although these products reduce downside risk, some brokerage firms treat them as high risk. Investors at Fidelity, for example, need to certify that they are not relying upon Fidelity for advice, that they could afford to lose their investment and that the portfolio objective is maximum aggressive.

**Liquidity and Tax Treatment.**

The liquidity of exchange traded funds depends on the liquidity of the underlying securities. Daily trading volumes of index options on the Cboe are

[17] I am indebted to Daniel xxxxxxxx for bringing this chart to my attention.

[18] A 21% decline if the market trades at 17 times $150 earnings per share (upfina.com, 9 Jun 2020).

about twice that of options on exchange traded products. This might lead one to conclude that SPX options are more liquid than SPY options.

However, liquidity appears adequate since both SPY and SPX trade contracts worth hundreds of billions of dollars daily whereas the AUMs of defined outcome funds suggests that trades on the reconstitution dates are on the order of hundreds of millions of dollars.

In addition, the bid-ask spread for SPX options is 1.1 while that of SPY options is 0.8% (median of all listed SPX and SPY options traded between October 1, 2019 and February 20, 2020) [19].

Options on broad-based indices "based on the value of a group of diversified stocks or securities (such as the Standard and Poor's 500 index)" are 1256 contracts[20]. Options on VOO or SPY are not 1256 contracts.

Every sale, transfer or expiration of an option contract is a taxable event. In addition, 1256 contracts are "marked to market" – treated as sold - at year's end.

For 1256 contracts, 40% of each gain or less is treated as a short-term gain or loss and 60% is treated as long-term. For equity options of one year or less, gains and losses are always short term.

Because of the favorable 1256 treatment, the investor who buys a basket of SPX options to implement a defined outcome strategy could have a lower tax liability than the investor who buys a basket of SPY options.

Regulated investment companies such as exchange traded funds are required to distribute at least 90% of their income annually. A regulated investment company which purchases SPX option contracts might realize a phantom 1256 income and be forced to distribute this income to shareholders[21], while a regulated investment company which purchases SPY options would not.

It is unclear whether funds which purchase SPX options have a significant risk of large income distributions since exchange traded funds can minimize income recognition during the creation/redemption process, but it is clear that the internal tax machinations of the Innovator and TrueShares products are more complex than those of the FirstTrust products.

Index options are cash settled, there are no dividends and there is no risk of early assignment. Equity options are stock settled, the buyer receives any dividends, and the option could be assigned before the settlement date.

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[19] "Comparing the Liquidity of SPY vs. SPX Options, Cboe Vest, March 2020. The analysis would be more convincing if the study had been limited to 1-year FLEX options on the reconstitution dates.

[20] 2019 IRS Publication 550, p. 37.

[21] Innovator Prospectus, March 2, 2020 as supplemented July 1, 2020, p. 30. The TrueShares prospectus is substantially the same with respect to the tax treatment of FLEX options.

**Do It Yourself?** Since the holdings of defined outcome funds are published daily, an individual investor could buy the same options as a fund and potentially save the expense ratio. For example, an investor could buy VOO, buy a put spread and sell an OTM call.

This is probably unrealistic for the following reasons.

- Taxation of a basket of options as 1256 contracts is less favorable than the taxation of an ETF.
- Minimum investment is at least $30K for one contract
- There is less granularity in option prices. The ETF buys options to the penny whereas an individual likely to buy to the dollar.
- Executions may not be as favorable for an individual.

While implementing a defined outcome strategy may not be a DIY project for most investors, paying for an actively managed option overlay may be a reasonable alternative. Not only is an option overlay likely less expensive than an ETF, but it also avoids the need to liquidate the existing portfolio and it resets more frequently than annually, which some strategists find desirable[22].

Stackers. Innovator offers products which essentially double or triple the upside caps but without downside buffers.

For example, Innovator's Double Stacker ETF (DSOC) began operation at the close on September 30, 2020. It established a synthetic long position in SPY (not SPX) using 1-year FLEX options and it bought an equal allocation to at the money QQQ Calls. DSOC then sold OTM Calls on both SPY and QQQ such that the revenue from the Calls equaled the cost of the long positions.

The strike prices of the short calls were chosen so that they were each 11.61% above the current prices of SPY and QQQ.

The profit or loss diagram at expiration is shown schematically below. The horizontal axis is the price of SPY at expiration and I have assumed, in preparing this diagram, that the future value of QQQ rises faster than the future value of SPY.

Inset chart

There is no downside buffer. One hundred percent of the portfolio value is at risk, but the upside cap is larger than with the buffer ETFs. For example, the cap on BOCT is 18.3% with a 9% buffer. Note that the upside caps apply individually

There is also a triple stacker (TSOC). The design is similar. In this case, the fund bought at the money Calls on QQQ and IWM at the close on September 30, 2020 and sold 7.14% out of the money Calls on SPY, QQQ and IWM.

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[22] Sean Heron, webinar by Glenmede Investment Management, July 28, 2020.

**Active Management of Defined Outcome Funds.**

Defined outcome ETFs are liquid and there are opportunities to increase returns or downside buffers by changing from one fund to another before the end of the outcome period. The following table assumes the purchase of BJUL on its inception date at the close on June 30, 2020.

There are several possibilities for switching from BJUL to another Innovator fund in early December 2020. Innovator posts the information from which this table was derived daily at innovatorETFs.com.

| | Buffer | Gain at 12/3/2020 | Potential Upside | Necessary Change in SPX | Chance of Upside | SPX Decline before a Loss | Days |
|---|---|---|---|---|---|---|---|
| BJUL | 9 | 10.7% | 5.62% | -0.94% | 50% | 26.43 | 209 |
| BAUG | 9 | | 7.29% | 4.16% | 40% | 20.24 | 240 |
| PAUG | 15 | | 4.07% | -1.04% | 50% | 26.26 | 240 |
| BSEP | 9 | | 12.16% | 12.59% | 20% | 12.93 | 271 |
| BDEC | 9 | | 13.89% | 14.23% | 10% | 9.40 | 362 |

Definitions

- Gain: the increase (decrease) in the price of the defined outcome ETF since the beginning of the outcome period.
- Upside Potential. The difference between the current share price of the defined outcome ETF and the share price at the end of the outcome interval if SPX exceeds the upside cap less 0.79% (expense ratio). There is usually considerable option time value built into the upside potential.
- Necessary Change in SPX price before the reconstitution date to achieve the upside.

  Note that BJUL and PAUG achieve the upside in this illustration so long as the price of SPX declines by less than about one percent at the end of the outcome interval. The differences between the current prices of these ETFs and the prices at reconstitution is entirely option time value.
- Chance of Achieving the Upside. This is subjective. Since the chance of a move up is about the same as the chance of a decline, I assumed a 50% chance that SPX would not decline more than 1%. I estimated the chance of a 4.2% rise or greater as 40%, the chance of a 12.6% rise or greatest as 20% and the chance of a 14.2% rise or greater as 10%.

It may be possible to obtain estimates from option pricing, but I have not yet pursued this.

- SPX Decline Before a Loss: the maximum decline in the price of SPX as of the end of the outcome interval without the ETF suffering a loss. (B and P series only.) Computed as the SPX return since the beginning of the outcome interval plus the buffer interval less 0.75% (the expense ratio).

  BJUL: 18.22 SPX gain + 9 Buffer – 0.79 expenses = 26.43%

- Days Remaining to the reconstitution date.

I draw the following conclusions from this table.

- BJUL and PAUG have similar potential upsides, similar chances of achieving the upside and similar downsides. I see no reason to change from BJUL to PAUG.
- Moving from BJUL to BSEP would accelerate the end of the outcome interval to the present and would start over with a 9-month interval, 12% cap and 13% buffer.
- Moving from BJUL to BDEC is not as attractive as moving from BJUL to PAUG because the new interval would be shorter, the chance of achieving the upside would be less and the SPX decline before a loss would be less.

**Historical Performance.** In 2018, Milliman Financial Risk Management LLC, the Chicago Board Options Exchange (Cboe hereafter) and S&P Dow Jones Indexes collaborated to build defined outcome indices based on exposure to the S&P 500 Composite without dividends[23]. The white paper shows the specific options purchased and sold to implement each strategy.

Two of the series, the 15% and 30% buffers, match products offered by Innovator ETFs and First Trust.

The other two series employ upside leverage.

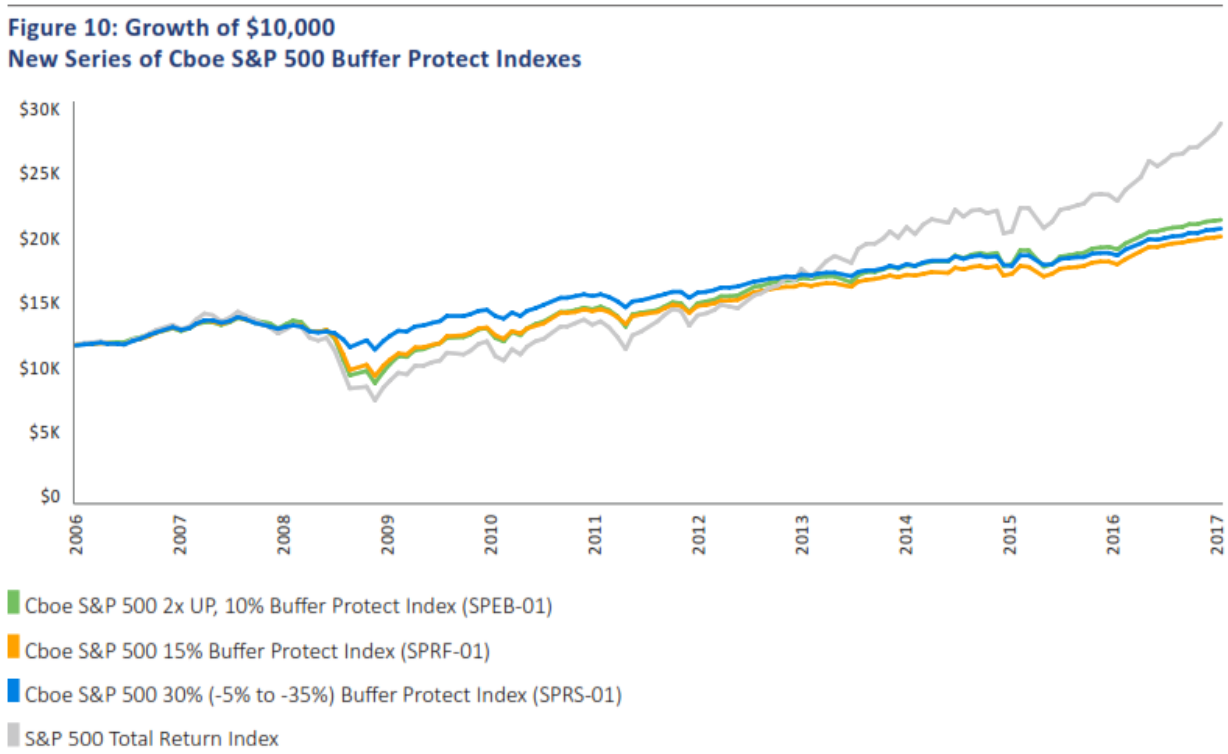
3x up, 1x down
2x up, 1x down with a 10% buffer.

Innovator has filed plans with the SEC to offer funds which employ upside leverage. This might be approved by the end of the third quarter of 2020.

The upside potential is achieved by purchasing additional OTM calls, which necessarily lowers the cap.

[23] Creating Structured Exposures to the S&P 500®, downloaded July 19 from cboe.com/publish/indexsitedocs/target-outcome-indexes-white-paper.pdf. The indices were launched in February 2018. Milliman's Wes Mathews graciously provided the simulated data from 2006

**Figure C-6. Simulated historical equity curves of three strategies and of the S&P 500 Total Return index on an arithmetic axis gross of fees**. Source: Cboe white paper.




The defined outcome strategy with the largest buffer provided the most downside protection during the 2008 bear market. There is little difference in the cumulative returns of the three defined outcome strategies over the twelve-year interval and the three defined outcome strategies lagged the S&P 500 total return index over this period.

See also the analysis in the body of this article for additional historical perspective.