Convexity: Slowly... Then All of a Sudden

Explaining Return Differentials in 2020 vs. 2025 | CAOS ETF

Summary

- Tail hedging can help offset deep market drawdowns, but traditional approaches often bleed capital in calm markets, making them tough to hold long term.
- CAOS seeks to solve this challenge by combining protective puts[1] with a return profile seeking to provide convex returns during sharp selloffs with net positive long-term returns.
- In April 2025, some investors expected similar outsized gains; however, when adjusting for drawdown magnitude, CAOS's performance was broadly consistent with 2020, with smaller differences partly explained by crash speed, fear levels, and path dependency.

The promise of tail hedging products can sound appealing to investors seeking to minimize drawdowns and diversify portfolios: hold protective puts in an attempt to earn insurance-like payoffs during crisis periods. The challenge is that while these assets can pay off handsomely during fast crashes, they usually generate losses that are difficult to tolerate over time.

The Alpha Architect Tail Risk ETF (ticker: CAOS) seeks to address this issue by aiming to produce net positive returns over the long term while maintaining protective puts in preparation for potential fast market declines.

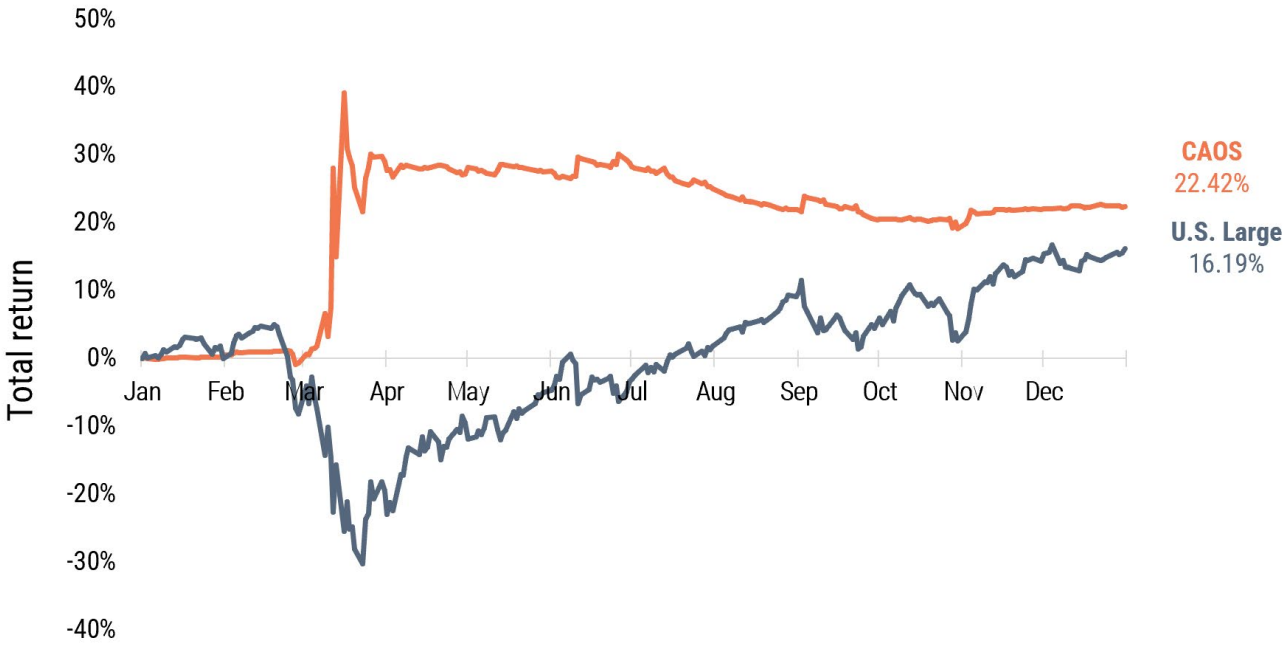
Historically, CAOS has responded well to fast market declines.

Most notably, during the COVID market drop in March 2020, CAOS returned 39.21% while the U.S. large blend category average lost -33.51%. Periods like this often prompt investors to consider holding at least a portion of their portfolio in insurance-like exposures.

[1] Protective puts is an industry term that refers to deep out-of-the-money puts on a reference that seek to mitigate losses past a certain strike price.

EXHIBIT #1

CAOS Total Returns | 2020



Source: YCharts, Alpha Architect, FactSet. NAV total daily returns. 1/1/2020 – 12/31/2020. U.S. Large Blend represented by the average returns at NAV of the biggest 50 ETFs in the US Large Blend category based on assets under management (AUM). Categories are determined by YCharts. **The performance data quoted represents past performance and is no guarantee of future results. Investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance may be lower or higher than the performance data quoted. For the most recent month-end and standardized performance, please call 215-882-9983 or visit the Fund's website at** funds.alphaarchitect.com/caos.

Of course, these crashes are rare, and while no event of similar magnitude and speed has occurred since then, there have been a few notable instances where fear gripped the market. The first came on August 5, 2024, when the Japanese stock market fell over 12% overnight and U.S. futures dropped in tandem. Fortunately, much of the volatility subsided overnight and early in the U.S. trading morning, and by noon EST the following day most of it had already disappeared. Still, this event produced the highest (pre-market) volatility reading since 2020.

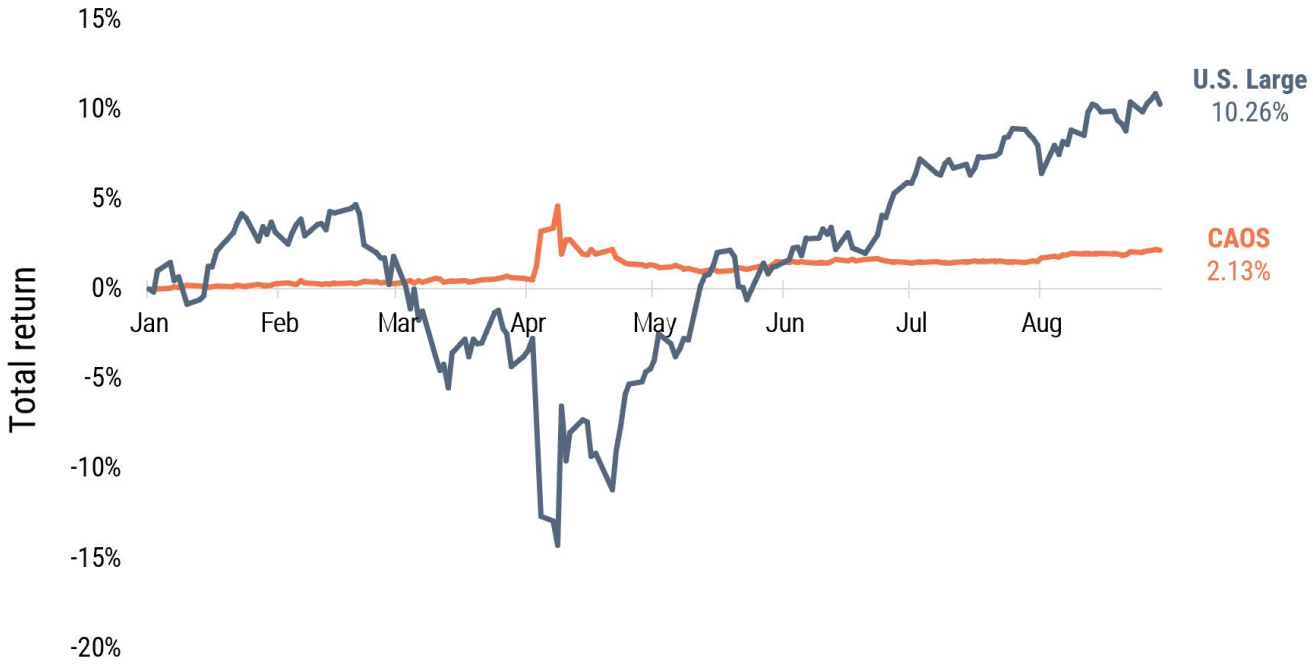
The second event, known as the "day of liberation," unfolded on April 2, 2025, when President Trump announced extreme trade measures that left markets scrambling. Although this downturn lasted longer than the August 5, 2024 event, it fell short of the impact seen in March 2020.

Still, during the 2025 drawdown and volatility, many investors expected CAOS to spike higher than it did, and we received multiple emails asking, **"Where is my volatility spike?!"**

When looking at 2025 returns, many might have expected CAOS to deliver at least half the return it achieved in 2020. The thought process goes something like this: "If CAOS returned nearly 40% at its peak in 2020 while the U.S. category average dropped a bit over 30%, I would have expected at least half that return (about 20%) during an almost 20% drop in the U.S. category average."

EXHIBIT #2

CAOS Total Returns | Year-to-Date



Source: YCharts, Alpha Architect, FactSet. NAV total daily returns. 1/1/2025 – 8/31/2025. **U.S. Large Blend** represented by the average returns at NAV of the biggest 50 ETFs in the US Large Blend category based on assets under management (AUM). Categories are determined by YCharts. **The performance data quoted represents past performance and is no guarantee of future results. Investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance may be lower or higher than the performance data quoted. For the most recent month-end and standardized performance, please call 215-882-9983 or visit the Fund's website at** funds.alphaarchitect.com/caos.

While this may be a reasonable assumption, it overlooks a key characteristic that CAOS seeks to target: **convexity.**

Because out-of-the-money options can produce non-linear payoffs, the effects of convexity often emerge in chunks—slowly... then all of a sudden!

In fact, just two days accounted for the *majority* of CAOS's net returns during the March 2020 drawdown.

To understand CAOS's behavior in 2025, we'll compare the return series from these two periods and investigate any discrepancies that may arise.

A warning: Before we begin, it's crucial to understand that options are extremely complex, and even a small change in the underlying security's path of returns can significantly alter the outcome. This reflects the non-ergodic nature of options. So reader beware: while we can dissect these returns to the best of our ability, the path taken can skew the numbers, and our explanations of return differentials may not provide definite answers to every question.

Let's begin.

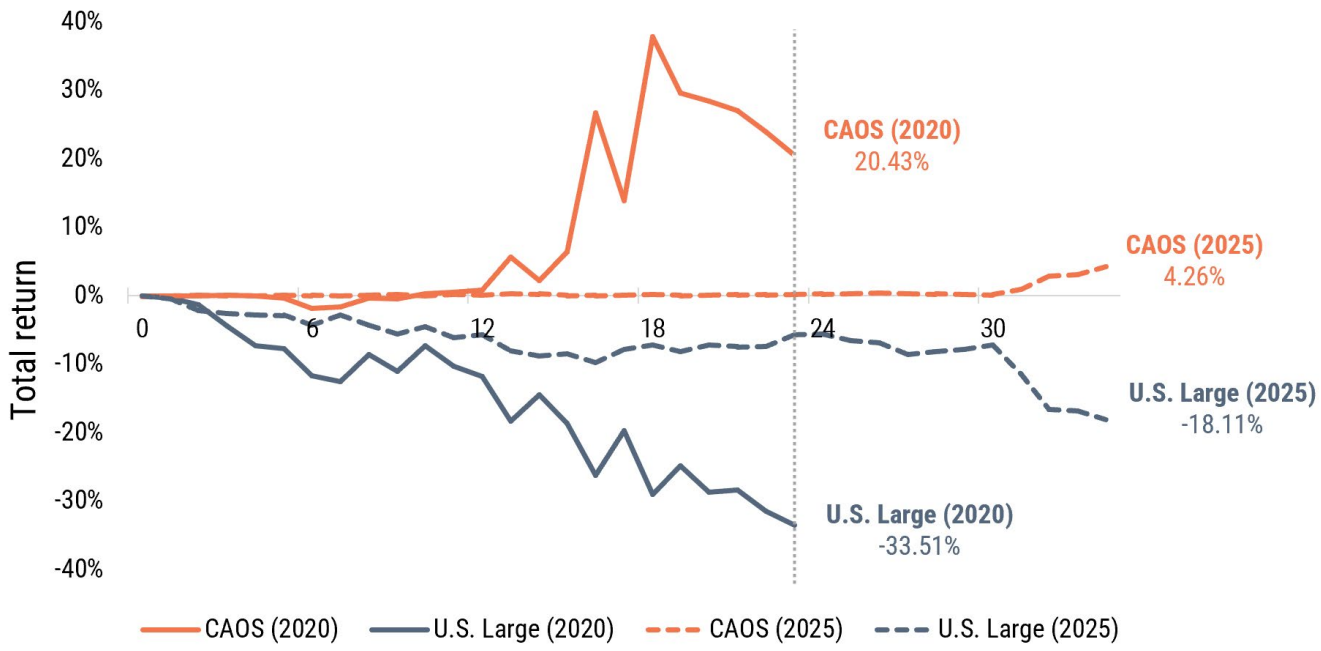
Mapping returns

To dissect the return differentials between the two periods, we'll start by mapping peak-to-trough returns. Interestingly, both market tops in 2020 and 2025 occurred on February 19. By contrast, the market bottomed on March 23 in 2020 and on April 8 in 2025.

Exhibit #3 plots these results.The x-axis represents the days following the market peak.

EXHIBIT #3

Peak-to-trough CAOS Total Returns | 2020 vs. 2025



Source: YCharts, Alpha Architect, FactSet. NAV total daily returns. 2/19/2020 – 3/23/2020 & 2/19/2025 - 4/8/2025. U.S. Large Blend represented by the average returns at NAV of the biggest 50 ETFs in the US Large Blend category based on assets under management (AUM). Categories are determined by YCharts. **The performance data quoted represents past performance and is no guarantee of future results. Investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance may be lower or higher than the performance data quoted. For the most recent month-end and standardized performance, please call 215-882-9983 or visit the Fund's website at** funds.alphaarchitect.com/caos.

Right off-the-bat, two main conclusions stand out when looking at this chart:

1. CAOS's returns in 2020 were far more pronounced than in 2025—no surprise there. However...
2. **U.S. stocks dropped faster and more violently in 2020 than in 2025.**

For a more apples-to-apples comparison, we need to control for the **magnitude of each crash**. Only then can we see whether CAOS's response to each drop is comparable.

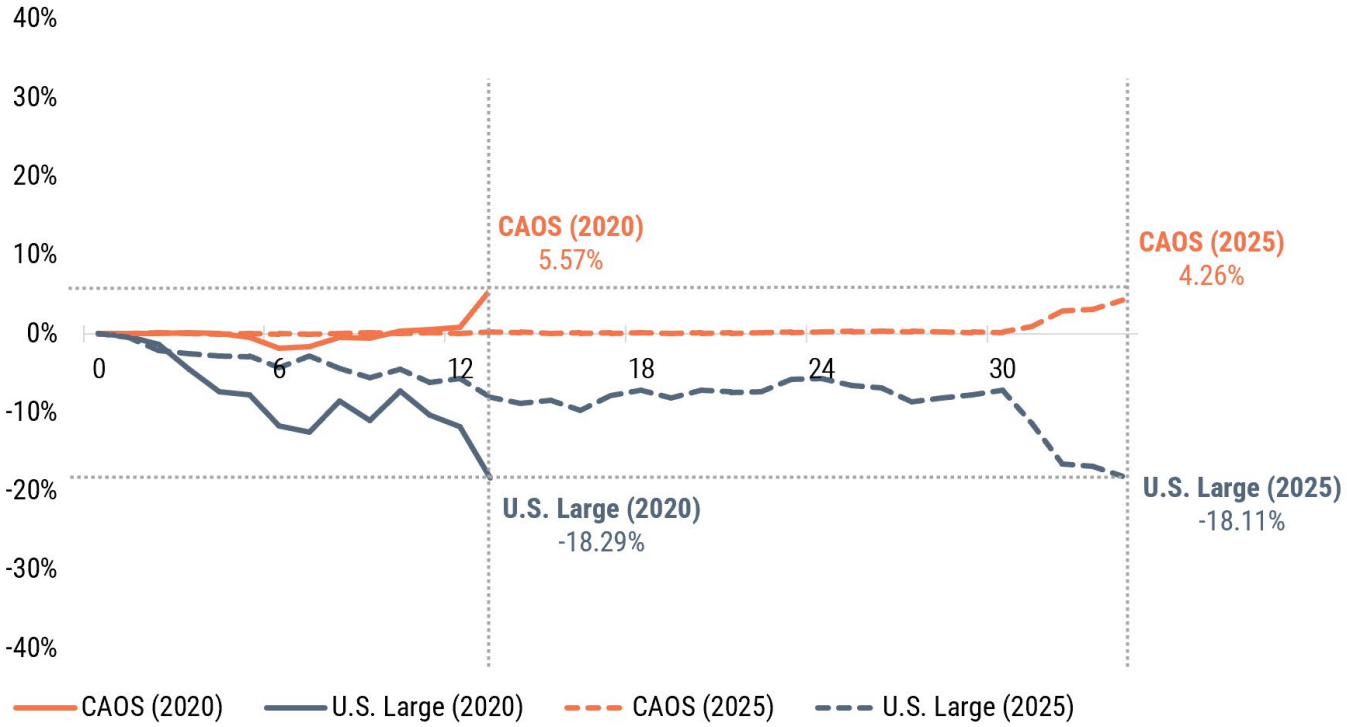
Controlling for drawdown magnitudes

To analyze how CAOS reacted to the market's price drop, Exhibit #4 plots returns again, but stops the return series in both 2020 and 2025 once U.S. large-cap losses surpass the 2025 market bottom, corresponding to an 18.11% decline.

The x-axis represents the days following the market peak.

EXHIBIT #4

CAOS Total Returns to 2025 Market Lows | 2020 vs. 2025



Source: YCharts, Alpha Architect, FactSet. NAV total daily returns. 2/19/2020 – 3/23/2020 & 2/19/2025 - 4/8/2025. U.S. Large Blend represented by the average returns at NAV of the biggest 50 ETFs in the US Large Blend category based on assets under management (AUM). Categories are determined by YCharts. **The performance data quoted represents past performance and is no guarantee of future results. Investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance may be lower or higher than the performance data quoted. For the most recent month-end and standardized performance, please call 215-882-9983 or visit the Fund's website at** funds.alphaarchitect.com/caos.

Here, the picture becomes much clearer: CAOS's returns were similar, having returned 5.57% when U.S. large cap fell -18.29% in 2020, and 4.26% when U.S. large cap fell -18.11% in 2025.

While a return of 5.57% is preferable to 4.26%, the difference is much narrower.

Still, investors should ask why the 1.31% differential exists. While there are countless ways to slice the data, let's explore two main variables that might explain some of this discrepancy:

1. Path Dependency

Depending on the order of returns, chosen strike prices, timing of trades, and how volatility unfolds, options-based portfolios with similar directional views can produce very different results. In fact, with options, you can be directionally correct and still manage to produce negative returns. Remember, **options are on a ticking clock**, and rebalance timing can—and likely will—introduce noise at the portfolio level.

While it's difficult to determine how much of the return differential stems from path dependency, the timing element likely introduced a respectable, and expected, amount of noise into portfolio returns.

2. Fear Levels

Another factor at play is the nature of the events behind these market downturns. While the April 2025 crash was certainly alarming, it was largely self-induced. As President Trump announced imminent and punitive tariffs on U.S. trading partners, investors reacted to a world that could be—but didn't have to be. Many waited for the President to reverse course... which he eventually did. It's fair to say that the market likely priced in some probability of a quick return to normalcy, since the same institution that caused the disruption could also resolve it.

March 2020 was a completely different story.

As news of a deadly, widespread virus continued to unfold, the market realized that an imminent economic shutdown was the most likely response. No president could "rescind" the virus; nature would run its course, and the economy had to take the hit first in order to protect public health. Fear overtook the markets. **High-yield option-adjusted spreads were over 50% higher on March 9, 2020, than on April 8, 2025[2].** In 2020, the market fell from an all-time high to –18.29% in just 14 days. By comparison, in 2025 it took 35 days to decline from all-time highs to –18.11%.

Overall, while peak-to-trough market losses were similar through March 9, 2020 and April 8, 2025, investors had likely priced in worsening conditions during the COVID drawdown and a possibility of mean reversion during the tariff wars.

Conclusion

Convexity is an often-misunderstood concept. In this article, we've shown that while CAOS produced very different returns in 2025 versus 2020, the results were much closer once when controlling for the differential in drawdown magnitude.

But what does this say about the potential behavior of CAOS in future drawdowns?

While we cannot offer a definite schedule of future returns (I would love to see that list!), actual return outcomes will heavily depend on the path the market takes. Still, we hope that the protective puts in the CAOS portfolio will react positively to crashes, provided they occur in a fast and meaningful manner.

As always, we remain committed to our disciplined approach to tail hedging, and believe that CAOS can play a pivotal role in portfolios seeking to diversify away from equity risk.

[2] **Source:** Federal Reserve Bank of St. Louis

IMPORTANT RISK INFORMATION

Investors should carefully consider the investment objectives, risk, charges, and expenses of the funds. This and other important information is in the indicated fund's prospectus, which can be obtained by calling (215) 882-9983 or by visiting www.AlphaArchitect.com/funds. The prospectus should be read carefully before investing.

Investing involves risk, including the possible loss of principal. Shares of any ETF are bought and sold at market price (not NAV) and may trade at a discount or premium to NAV. Shares are not individually redeemable from the Fund and may only be acquired or redeemed from the fund in creation units.

There is no assurance that the Fund will achieve its investment objective. An investor may lose money by investing in the Fund. An investment in the Fund is not a bank deposit and is not insured or guaranteed by the FDIC or any government agency.

Definitions

At-the-money: An option is considered at-the-money when its strike price is equal to or very close to the current market price of the underlying asset.

Call Option: a financial contract that gives the holder the right, but not the obligation, to buy a specified amount of an underlying asset at a predetermined price (known as the strike price) within a specified time frame.

Implied Volatility: the market's estimate of how much an asset's price is likely to fluctuate in the future, based on current option prices.

In-the-money: An option is classified as in-the-money if it possesses intrinsic value, meaning a call option's strike price is below the market price or a put option's strike price is above the market price.

Out-of-the-money: An option is out-of-the money when it lacks intrinsic value, with a call option's strike price above the market price or a put option's strike price below the market price.

Put Option: a financial contract that gives the owner the right, but not the obligation, to sell a specified amount of an underlying asset at a predetermined price (known as the strike price) within a specified time frame.

Protective Put: a deep out-of-the-money put on a reference that seeks to mitigate losses past a certain strike price.

US Large Cap is represented by ETFs that are fairly representative of the overall U.S. stock market in size, growth rates, and price. Stocks in the top 70% of the capitalization of the U.S. equity market are defined as large cap. The blend style is assigned to portfolios where neither growth nor value characteristics predominate. As of 03/10/2025, there are 238 ETFs in the US Large Blend category.

PRINCIPAL INVESTMENT RISKS

Selling or Writing Options Risk. Writing option contracts can result in losses that exceed the seller's initial investment and may lead to additional turnover and higher tax liability. The risk involved in writing a call option is that there could be an increase in the market value of the underlying or reference asset.

Buying or Purchasing Options Risk. If a call or put option is not sold when it has remaining value and if the market price of the underlying asset, in the case of a call option, remains less than or equal to the exercise price, or, in the case of a put option, remains equal to or greater than the exercise price, the buyer will lose its entire investment in the call or put option.

Box Spread Risk. A Box Spread is a synthetic bond created by combining different options trades that have offsetting spreads (e.g., purchases and sales on the same underlying instrument, such as an index or an ETF, but with different strike prices). If one or more of these individual option positions are modified or closed separately prior to the option contract's expiration, then the Box Spread may no longer effectively eliminate risk tied to the underlying asset's price movement.

FLEX Options Risk. FLEX Options are exchange-traded options contracts with uniquely customizable terms like exercise price, style, and expiration date. Due to their customization and potentially unique terms, FLEX Options may be less liquid than other securities, such as standard exchange listed options.

Derivatives Risk. Derivatives are instruments, such as futures contracts, whose value is derived from that of other assets, rates, or indices. The use of derivatives for non-hedging purposes may be considered to carry more risk than other types of investments.

Counterparty Risk. Counterparty risk is the risk that a counterparty to a financial instrument held by the Fund or by a special purpose or structured vehicle invested in by the Fund may become insolvent or otherwise fail to perform its obligations, and the Fund may obtain no or limited recovery of its investment, and any recovery may be significantly delayed.

Leverage Risk. Leverage risk refers to the potential for increased volatility and losses in a portfolio due to the use of derivatives or other financial instruments that may magnify gains and losses beyond the initial investment. The Fund will utilize derivatives, such as options, to gain exposure to certain assets or markets with a smaller initial investment. While leveraging derivatives can amplify gains, it can also magnify losses significantly. Leverage could possibly create increased volatility for the Fund.

Cash and Cash Equivalents Risk. At any time, the Fund may have significant investments in cash or cash equivalents. When a substantial portion of a portfolio is held in cash or cash equivalents, there is the risk that the value of the cash account, including interest, will not keep pace with inflation, thus reducing purchasing power over time.

Market Risk. The Fund's investments are subject to changes in general economic conditions, general market fluctuations and the risks inherent in investment in interest rate sensitive markets. Interest rate markets can be volatile and prices of investments can change substantially due to various factors including, but not limited to, economic growth or recession, the investment's average time to maturity, changes in interest rates, changes in the actual or perceived creditworthiness of issuers, and general market liquidity. The Fund is subject to the risk that geopolitical events will disrupt securities markets and adversely affect global economies and markets. Local, regional or global events such as war, acts of terrorism, the spread of infectious illness or other public health issues, or other events could have a significant impact on the Fund and its investments.

Equity Securities Risk. Investments in securities whose performance is linked to that of equity securities, such as SPX Options, may fluctuate in value in response to many factors, including the activities of the individual issuers included in the Index, general market and economic conditions, interest rates, and specific industry changes. Such price fluctuations subject the Fund to potential losses.

Investment Risk. When you sell your Shares of the Fund, they could be worth less than what you paid for them. Therefore, you may lose money by investing in the Fund.

Large-Capitalization Companies Risk. Large-capitalization companies may trail the returns of the overall stock market. Large-capitalization stocks tend to go through cycles of doing better - or worse - than the stock market in general. These periods have, in the past, lasted for as long as several years. Larger, more established companies may be slow to respond to challenges and may grow more slowly than smaller companies.

Investment Company Risk. An investment in other registered investment companies (including other ETFs, affiliated and non-affiliated) is subject to the risks associated with those investment companies, which include, but are not limited to, the risk that such fund's investment strategy may not produce the intended results; the risk that securities in such fund may underperform in comparison to the general securities markets or other asset classes; and the risk that the fund will be concentrated in a particular issuer, market, industry or sector, and therefore will be especially susceptible to loss due to adverse occurrences affecting that issuer, market, industry or sector. Moreover, the Fund will incur duplicative expenses from such investments, bearing its share of that fund's expenses while also paying its own advisory fees and trading costs. In addition, the Fund may invest in underlying funds which invest a larger portion of their assets in one or more sectors than many other mutual funds, and thus will be more susceptible to negative events affecting those sectors.

The Fund may invest in affiliated ETFs managed by the Adviser and/or Sub-Adviser, including the Architect 1-3Month Box ETF. The Adviser and/or Sub-Adviser may be subject to potential conflicts of interest in selecting underlying funds because the fees paid to it by certain affiliated underlying funds are higher than the fees paid by other affiliated and unaffiliated underlying funds. To the extent the Fund invests a significant percentage of its assets in any one affiliated ETF or across multiple affiliated ETFs, the Fund will be subject to a greater degree to the risks particular to the investment strategies employed by the Adviser and/or Sub-Adviser.

Valuation Risk. Some portfolio holdings, potentially a large portion of the Fund's investment portfolio, may be valued on the basis of factors other than market quotations. This may occur more often in times of market turmoil or reduced liquidity. There are multiple methods that can be used to value a portfolio holding when market quotations are not readily available. The value established for any portfolio holding at a point in time might differ from what would be produced using a different methodology or if it had been priced using market quotations. Portfolio holdings that are valued using techniques other than market quotations, including "fair valued" securities, may be subject to greater fluctuation in their valuations from one day to the next than if market quotations were used. In addition, there is no assurance that the Fund could sell or close out a portfolio position for the value established for it at any time, and it is possible that the Fund would incur a loss because a portfolio position is sold or closed out at a discount to the valuation established by the Fund at that time.

High Portfolio Turnover Risk. The Fund's investment strategy is expected to result in a high portfolio turnover rate (100% or more). This will increase the Fund's brokerage commission costs, which could negatively impact the performance of the Fund. When taking into account derivative instruments, including option contracts, and instruments with maturities of one year or less at the time acquisition, the Fund's strategy will result in frequent portfolio trading and, if these instruments were included in the calculation of the Fund's portfolio turnover rate it would exceed 100%.

U.S. Government Securities Risk. U.S. government securities risk refers to the risk that debt securities issued or guaranteed by certain U.S. Government agencies, instrumentalities, and sponsored enterprises are not supported by the full faith and credit of the U.S. Government, and so investments in their securities or obligations issued by them involve credit risk greater than investments in other types of U.S. Government securities.

Management Risk. The Fund is actively managed and the Sub-Adviser's ability to choose suitable investments and implement the strategies described above has a significant impact on the ability of the Fund to achieve its investment objectives. In addition, there is the risk that the investment process, techniques and analyses used by the SubAdviser will not produce the desired investment results and the Fund may lose value as a result.

Note on category average methodology

Constituents of a given category are determined by YCharts. As of 4/30/2024, the calculation method used to determine the category average's returns changed to account for potentially different inception dates. Previously, a straight average of constituent funds' total return net asset value (NAV) was used to determine the category's average total return NAV; the percent change of the category average NAV was then used to calculate returns. As of 4/30/2024, total returns for the category are now found using a straight average of the total NAV return (percent change) for a given frequency (daily, weekly, monthly, etc.). There may be instances where the straight average of the constituent funds' NAV returns may be higher or lower than the straight average of the total NAV return. As of 4/30/2024, all category average returns are calculated using the straight average of the constituent funds' total NAV return for a given frequency.

Category average constituent selection criteria

Unless otherwise noted, the given category is represented by the 50 biggest funds based on assets under management (AUM). The AUM figure is point-in-time and is not retroactively applied to constituent funds. In the event fewer than 50 funds are available in a given category, all funds are used in to calculate returns. Funds that may have been open for investment over the given period but are no longer active are not included. The number of constituent funds in a given category average may affect represented returns. In the event of multiple share classes, the share class with the highest AUM is referenced. Category returns are a straight average of the total return of the constituent funds over the given period. Wherever possible, we reference the 50 biggest funds by AUM to provide what we believe to be a reasonable sample of the most popular strategies that includes a mix of passive and active approaches. The highest AUM funds tend to have more established track records, providing what we believe to be a reasonable basis for returns.

The Funds are distributed by Quasar Distributors, LLC. The funds' investment advisor is Empowered Funds, LLC, which is doing business as ETF Architect. Alpha Architect, LLC serves as the Sub-adviser to the Funds. Quasar is not affiliated with ETF Architect or Alpha Architect.