Tail Risk Hedging Performance:
Measuring What Counts

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Abstract

We discuss the importance of using an alternative set of metrics for measuring the historical performance of tail risk hedging portfolios in particular, and for any strategy with levered payoffs in general. It is our view that simply using historical compounded returns when the payoffs are multiples of the investment, and ignoring the timing and magnitude of cash-flows can potentially paint an inaccurate picture, sometimes grossly so, of the economic value of such strategies. To obtain a more accurate picture, the timing and magnitude of cash-flows has to be included in the analysis of the impact of such strategies on portfolios.

Key Takeaways

- Unlike fully-funded strategies, only providing NAV based returns fails to communicate the efficacy of a tail hedge
- In order to get a complete view of a tail hedge strategy, NAV, cash flows and NAV based returns should be presented together
- By performing such analyses, it can be demonstrated that cost-effective tail hedging can provide risk-adjusted return enhancement, rather than being a negative expected return investment

As practitioners providing tail risk hedging solutions to investors, we are often asked to provide the return time series, and also compounded returns, both hypothetical and actual, for tail risk hedging strategies. While the summary returns data is easily calculated through the calculus of compounding, we have to hasten to explain to investors that the meaning of such data has to be thoroughly understood before it is used in making portfolio decisions. In this paper we will try to give a clear exposition for this need so investors are looking at the correct metrics for evaluating the benefits of such highly convex and non-linear strategies in their portfolios. The need is even more critical, since current portfolio optimization approaches and software, such as single period optimization using a mean-variance type of approach can give precisely the wrong answer if the correct inputs are not used.

An analogy will make this clear. Rarely, if ever, do homeowners ask their insurance providers to send them the returns statistics on their insurance premiums paid. The reason is simple: insurance on homes is bought for its desirable conditional cash-flow characteristics, i.e. even though it is expected to be a total loss every year, the relatively small insurance premium paid annually protects the home-owner from a catastrophic loss if the house burns down.

What people who buy home insurance remember is that when their home was damaged, the insurance policy paid off enough to cover the losses. They don't usually complain about the small insurance premium they pay, and hence don't compute cumulative (negative) returns on the insurance. For most homeowners, insurance is a cost. But it allows them to enjoy the home without having to set aside the full value of the house in reserve for replacement costs. Thus the reason why people buy home insurance is because (1) it is cheaper to buy insurance than to set aside a lot of money for a low probability event, and (2) if purchased from a reliable party, the insurance pays off when it is needed.

These two reasons are why we have never asked our insurance providers to provide the internal rate of return (IRR) for the last few years, maybe even decades, that we have been buying home insurance. It is not that the numbers cannot be computed - they can be. It is because they tend to result in misleading information. If the insurance provider were to come back and report that the cumulative return over the last three decades we have been buying home insurance was -99.9%, what would we do with the information anyway? We suspect that despite this dismal cumulative "performance" of our insurance policy over the last three decades, and with the expectation that it will have exactly the same type of dismal performance over the next thirty years, we would still buy insurance for another year. The reason, obviously, is that having the insurance provides us with positive cash-flows when we need them. This reason is sufficient for us to buy insurance for another year, since we cannot forecast when our homes will need the coverage due to an unseen catastrophic loss.

Moving to tail hedging of investment portfolios, we argue that there are three primary reasons that support the use of tail hedge overlays (see Bhansali[2014]):

1. Tail hedges deliver marked to market gains during periods of stress.
2. Monetization proceeds come at an opportune time when there is a need for liquidity.

3. Tail hedges improve the overall risk characteristics when combined with a hedged portfolio allowing investors to be more aggressive to achieve higher returns.

A tail hedge overlay is quite similar to our home insurance example. In exchange for a small amount of "premium" spent, the owner of a tail hedge gets protection against a catastrophic market loss. This is the first point above. But unlike home insurance, tail hedging in the financial markets has the two other features listed above. In a period of crisis in the markets, the tail hedges can be sold ("monetized") and the cash can be put to good use, including re-investing in the markets. The parallel in the home example would be an owner being able to monetize the value of the insurance payments and trade them in the markets. Unfortunately home insurance, so far, is not monetizable and tradable in the same form. The third point above is important because the inclusion of the tail hedge in the portfolio allows investors to build portfolios which have the same loss potential as an unhedged portfolio, but also allow them to garner more potential gains. In other words, the tail hedge allows a skewing of the distribution of portfolio returns.[2] There is a parallel for this in the home insurance example. Homeowners routinely select desirable, albeit high risk locations for purchasing homes, for instance in hurricane-prone areas in Florida, or earthquake or fire-hazard zones in California, as long as they are able to purchase insurance against catastrophic losses from these hazards cheaply. However, without paying attention to the conditional cash flow events, the returns from the insurance policies thus bought would still be very negative over time. The examples and the analysis below apply both to left tail (market melt-downs) and right tail (market melt-ups) (see Bhansali[2018]), though our focus here will primarily be on the left tails.

The purpose of this paper is to illustrate with simple, hypothetical examples first, and then with actual experience from managing tail risk hedging strategies, why the cash-flow based analysis is central to insurance type payoffs. While the traditional NAV based fund accounting is not incorrect, we believe it simply does not capture the reasons for including risk mitigation strategies in a portfolio. The leverage afforded by options based tail hedging strategies just magnifies the conceptual incoherence of using traditional performance metrics for measuring the performance of tail hedging strategies. To this end, and to keep the discussion explicit and transparent, we will walk through each of the points above using actual data from a tail hedge strategy, generically referred to hereinafter as "LeftTail Strategy"[3], both as a stand-alone portfolio and a portfolio overlay. Further, we will show that only providing NAV based returns for tail hedges, as is common practice for fully-funded strategies, fails to communicate their efficacy. We believe NAV, cash flows, and NAV based returns should be presented together in order to properly evaluate tail hedge strategies.

NAV Based Returns

Traditional NAV based accounting reports net performance returns typically daily or monthly, depending on the fund's investor needs. These returns are often used to calculate

[2] See Exhibit 11

[3] LeftTail Strategy data is sourced from an LTA-sponsored private fund product which previously employed the tail hedge strategy described herein. The data has not been independently verified or confirmed and is presented here for illustration and discussion purposes only. Use of independent, non-affiliated fund data will likely yield materially different results than any presented herein.

compounded historical returns looking back over various prior periods: quarter-to-date, year-to-date, and so on. The methodology is:

$$Return = \frac{PnL}{Starting\ NAV + Subscription}$$

where:

$$Starting\ NAV = Prior\ Ending\ NAV - Redemption$$

The inception to date or on-going cumulative compounded returns are predicated on the concept that an investor contributes an amount of capital on day one and does nothing throughout the life of the investment. The initial capital and any gains or losses flow directly into the start of the next period, or are invested from period to period at the internal rate of return r_i for each period i,

$$Compounded\ Return = [(1 + r_1) * (1 + r_2) \dots (1 + r_n)] - 1$$

As a shortcut for analysis, fund return streams are provided as a series of per period percentages so investors can simply take the product of their starting capital and the return stream at any point along the series to get an estimate of what their performance may have looked like. Similarly, compounded returns are usually provided so investors can easily calculate what expected performance over a longer period of time has looked like historically. This standard methodology also allows for easy comparison between funds, such as computing Sharpe ratios, volatilities etc. It is common knowledge that this type of analysis can differ from actual returns experienced by a given investor, but it is assumed that the hypothetical investor who has entered the fund on day 1 has re-invested all cash flows back into the fund and thus this investor's experience represents the performance of the fund so another investor can make an informed analysis relying on this long term return series.

We begin with two simple scenarios that demonstrate the NAV based accounting methodology. Exhibits 1-2 differ in the volatility of their respective returns, with Exhibit 2 having returns more akin to a highly leveraged overlay strategy, such as a tail hedge. The starting capital for both examples is $10. In all the examples, we will compute two returns. The first return, which we call "compounded return", uses the equation above that strings together the returns using the compounding formula above. The second return looks at the total terminal dollar value received, and computes the return of the dollar capital relative to the dollar value initially invested. Note that in both examples, there is no present value factor, since we are computing the ex-post summary return of a time-series of investor experiences.

In both Exhibits, the compounded NAV based return equals the actual dollar return of each investment, which should be no surprise:

Period	Starting NAV	Subscription	PnL	Ending NAV	Redemption	Return
1	0	10	0.4	10.4	0	4.00%
2	10.4	0	0	10.4	0	0.00%
3	10.4	0	0.2	10.6	0	1.92%
		10	0.6		0	

Compounded Return	6.00%
Dollar Return	6.00%

Exhibit 1: Single Subscription Low Return Volatility

Period	Starting NAV	Subscription	PnL	Ending NAV	Redemption	Return
1	0	10	1	11	0	10.00%
2	11	0	-1	10	0	-9.09%
3	10	0	7	17	0	70.00%
		10	7		0	

Compounded Return	70.00%
Dollar Return	70.00%

Exhibit 2: Single Subscription High Return Volatility

$$Ending\ NAV = Starting\ NAV + Subscription + PnL$$

$$Dollar\ Return = \frac{\sum_i PnL_i}{\sum_i Subscription_i)}$$

Note that in both Exhibits and respective calculations above, we are inherently assuming the use of a buy and hold strategy, which is what makes the process of stringing together single period returns to get long term returns possible. If there are no additional cash flows in or out of the fund during the life of the investment, the compounded return and dollar return will be equal to one another.

Tail hedges, or insurance contracts in general, however, are generally not buy and hold strategies. Tail hedges are intended to be time and event specific and proper utilization of tail hedges require active monetization, whether mandatory, as when the home burns down, or voluntary, as when market tail hedges are sold before expiry. Further, investors of tail hedge funds typically want to access liquidity provided by a monetization event as soon as possible via a redemption to either offset losses from the underlying portfolio or redeploy into the market and potentially catch a rebound in the markets. Finally, it is possible (and in many cases, likely) for the premium in a tail hedge to decay to zero, which means investors may be required to add a subscription in order to extend and maintain the hedge. For these reasons, we must include cash flows in our analysis when looking at fund performance. From our perspective, ignoring the cash-flows can paint an egregiously inaccurate picture of the value of tail hedges, which surprisingly, is not familiar to many professional practitioners in finance, who clearly understand compounding. The reason, as we will show, is that when the cash flows are small compared to the size of the investments, the mismatch between the two measures of return are small, but when the payoffs and cash flows are large compared to the investment, as in the case of premium based hedging strategies, the two measures can diverge substantially, to the point of having opposite signs.

Building on our previous examples, we will see that when cash flows are included, holding return streams constant, compounded returns and dollar returns are no longer equal. Exhibit 3 below has an identical return series to Exhibit 1 and Exhibit 4 has an identical return series to Exhibit 2, except there are redemptions in period 1. However, the actual PnL or dollar based return is no longer the same and can begin to diverge quite quickly as shown in Exhibit 4.

Period	Starting NAV	Subscription	PnL	Ending NAV	Redemption	Return
1	0	10	0.4	10.4	0.4	4.00%
2	10	0	0	10	0	0.00%
3	10	0	0.19	10.19	0	1.92%
		10	0.59		0.4	
Compounded Return						6.00%
Dollar Return						5.92%

Exhibit 3: Low Return Volatility with Redemption

Period	Starting NAV	Subscription	PnL	Ending NAV	Redemption	Return
1	0	10	1	11	1	10.00%
2	10	0	-0.91	9.09	0	-9.09%
3	9.09	0	6.36	15.45	0	70.00%
		10	6.45		1	
Compounded Return						70.00%
Dollar Return						64.55%

Exhibit 4: High Return Volatility with Redemption

Now that we have set the stage for the main message, we can take the analysis one step further to model returns from funds where redemption or monetization flows are of magnitude that are more in-line with what an investor would expect to receive from a tail hedge. In Exhibit 5, as the size of percentage returns increase, the difference between the two calculations continues to diverge. Note, it's broadly recognized in the industry that a 5x or 500% return is not necessarily considered outsized for a tail hedging portfolio. As a matter of fact, and as described in the next section, a 5x to 10x return on premium deployed is quite within expectations for a typical tail hedging strategy during a market event that the tail hedge is targeting[4].

Period	Starting NAV	Subscription	PnL	Ending NAV	Redemption	Return
1	0	10	40	50	40	400.00%
2	10	0	0	10	0	0.00%

[4] Expected returns should not be considered reliable predictions of future events and should not be relied on as such. Actual realized returns on investments will depend on a variety of factors, such as the value of the assets and market conditions at the time of a transaction, any related transaction costs, and the timing and manner of sale, all of which may differ from the assumptions on which expected returns are based. Actual realized returns on investments may differ materially from any expected returns range presented herein.

3	10	0	30	40	0	300.00%
		10	70		40	
Compounded Return						1900.00%
Dollar Return						700.00%

Exhibit 5: Large Tail Hedge Returns with Redemption

Exhibit 6 shows the effects of large negative returns which, again, are expected for any tail hedge portfolio as options decay to zero. Here, the portfolio makes a 5x return in our first period, and the investor redeems the $40 profit. There is no change in value in the second period, and the portfolio loses the majority of its value in the third period. If we look at the dollar based return, the investor made $31 on a $10 investment. However, because of the effect of the cash flow redemption, the compounded return is -50%. A negative return when the investor made 4x on the initial investment is clearly not representative of the investor's true experience in the example.

Period	Starting NAV	Subscription	PnL	Ending NAV	Redemption	Return
1	0	10	40	50	40	400.00%
2	10	0	0	10	0	0.00%
3	10	0	-9	1	0	-90.00%
		10	31		40	
Compounded Return						-50.00%
Dollar Return						310.00%

Exhibit 6: Large Negative Returns

Finally, in Exhibit 7, we show a return stream where the tail hedge value has decayed to zero in the first period resulting in a -100% return. To continue the tail hedge program, a new subscription of $10 is done in the second period and earns a +500% return, followed by a small loss in the third period. The dollar PnL net of total subscriptions is positive but the compounded return is -100%. The first period return of zero effectively corrupted the future return stream since all future returns will be multiplied by the initial -100% return. While the compounding based computation is not incorrect, it simply does not communicate the positive dollar returns that were realized in this example. While the likelihood of a fund losing its entire value at a single point in time is unlikely, this example is meant to demonstrate that the simple mathematics of these calculations may not always be revealing of the actual performance of the fund. Anecdotally, in March of 2020, VIX call option strategies and to a close degree S&P 500 index put options strategy demonstrated almost exactly this type of return profile. While these options had lost close to 100% of their premium value over the last ten plus years, they delivered large enough returns to make up for all the cumulative losses in one episode! An observer looking at the cumulative returns even after the large gain would compute the compounded return to be close to -100%, paying no attention to the gains realized when the hedge was effective.

Period	Starting NAV	Subscription	PnL	Ending NAV	Redemption	Return
1	0	10	-10	0	0	-100.00%

2	0	10	50	60	0	500.00%
3	60	0	-5	55	0	-8.33%
		20	35		0	
Compounded Return						-100.00%
Dollar Return						175.00%

Exhibit 7: Loss of Premium over a Single Period

As we hope these examples have shown, we believe providing NAV based returns in isolation for tail hedge funds are not sufficient to provide a clear picture of performance. The inclusion of cash flows and NAV as part of the analysis of a tail hedge is necessary as redemptions are important to get the correct picture of the performance. The NAV and performance based on it only shows the performance of the non-monetized value remaining in the fund.

Now that we have established a clear background for appropriate performance computations, we proceed to use this framework to prove the three main points of this paper outlined in the introduction.

A More Complete View of a Tail Hedge

To help better communicate the historical performance of a fund and what an investor experience might have been, we present our data in a dollar based, normalized manner for a tail risk hedging strategy that we have managed. More details on the experience through COVID-19 and prior are in a recent paper on monetization strategies that use identical data (see Bhansali et. al. [2020]) .One reason for this is to use the tools described above in a realistic setting. The other reason is to show the value added from tail hedging in the simplest and most transparent manner, so investors can scale the payoffs and returns for their own purpose.

To achieve this, we have made the following assumptions in our calculations:

1. Portfolios have a starting value of $100
2. The sum of all subscriptions for the life of the LeftTail Strategy are normalized to a $2 annualized spend. This means that on average, the cost of the hedge was 2% per year.
3. Month-end returns are reflective of monthly returns on the LeftTail Strategy
4. Daily returns are based on market value data as provided by the Fund Administrator and Prime Brokers, and adjusted to be net of fees on a daily basis.

Exhibit 8 shows the normalized market value of the LeftTail Strategy which is approximate to NAV in blue. The SPX is shown in grey and set to begin at a value of $100. Cash flows are shown as bars where subscriptions are red and redemptions are green.

We can observe that the performance of the tail hedge relative to the SPX shows marked to market gains during two periods of market stress where the grey line has the most significant declines. In December of 2018, the SPX declined just under 10% while the net return of the LeftTail Strategy for the same month was 45.86% (Appendix Exhibit 12). During the COVID

crisis of March 2020, the SPX dropped over 12% and the LeftTail Strategy's net return was 168.43%.

Exhibit 8: LeftTail Strategy Market Value and Cash Flows
Source: LongTail Alpha, Bloomberg

When we compound the historical month-end NAV returns, we get a value of -93.87% suggesting that the tail hedge lost almost the full amount of total subscriptions into the LeftTail Strategy (Appendix Exhibit 12). This would seem like a dismal performance for a strategy to most investors. But looking at the redemption cash flows paints a very different picture of the costs vs benefits. When we look at the sum of premium cash flows vs. monetization cash flows in Exhibit 9, we see that the LeftTail Strategy spent a total of $5.33 in subscriptions and earned $4.19 in redemptions for a total net loss of $1.14. Although this is still a net negative dollar amount, it is closer to only a 21% loss of the total subscriptions which is much smaller than the calculated compounded return. Clearly most investors would not mind having a 21% loss on a small amount of premium in order to have a substantial payoff when the markets were crashing and there was widespread panic and distress.

Cash Flow Date	Premium Cash Flow	Monetization Cash Flow
8/1/2017	0.75	
12/1/2017	0.3	
3/1/2018	0.9	
10/1/2018	0.45	
1/1/2019	0.75	
4/1/2019	0.75	
7/1/2019	0.68	
9/1/2019	0.75	

3/31/2020		-4.19
Total	5.33	-4.19

Exhibit 9: LeftTail Strategy Cash Flows
Note: Assumes an annualized Premium Cash Flow budget of $2 to protect $100.

Combining With a Hedge Portfolio

In this section we demonstrate that this fortuitous timing of the cash flows also plays an important role when combining a tail hedge with the overall portfolio, in terms of increasing long term risk adjusted expected returns. Some of this was discussed in theory and practice in Bhansali and Davis [2010]).

We will continue on with the same LeftTail Strategy, but use it as an overlay alongside a base portfolio solely comprised of the S&P 500 Index. As before, the tail hedge market value and cash flow amounts are normalized so that the annualized sum of all subscriptions is $2 per year. Our total portfolio will have a value of $100 and all subscriptions will be funded from this amount as they are needed for the tail hedge portfolio. Similarly, any redemptions will be reinvested back into the S&P 500 Index on the month following the redemption.

Looking at two largest S&P 500 Index declines in December 2018 and March 2020, we can see that the overlay portfolio had a marked improvement over the S&P 500 Index alone.

	S&P 500 with LeftTail Strategy	S&P 500
…		
10/31/2018	-6.68%	-6.84%
11/30/2018	1.72%	2.04%
12/31/2018	-8.68%	-9.03%
…		
1/31/2020	-0.07%	-0.04%
2/29/2020	-7.61%	-8.23%
3/31/2020	-9.89%	-12.35%
…		

Exhibit 10: S&P 500 with LeftTail Strategy Overlay
Source: LongTail Alpha

Exhibit 11 shows several statistics for the two portfolios. Focusing on the inception to date return, we can see that the hedged portfolio underperformed by about 23bp on an annualized

basis. However, the hedged portfolio had almost 3% less of a drawdown, an improved left tail skew and a lower volatility. This improvement in the overall risk characteristics when compared to the index portfolio alone allows the investor to be more aggressive in order to achieve higher returns. If the two portfolios were normalized to target the same 15% volatility, the hedged portfolio would outperform by around 50bp on an annualized basis. In other words, for the same amount of risk, the investor is able to generate more long term returns. This idea has been discussed by us in other papers written many years ago.

	QTD	YTD	1-YR*	3-YR*	ITD (8/2017)*
S&P 500 with LeftTail Strategy	12.15%	22.52%	22.45%	14.03%	15.02%
S&P 500	12.15%	18.40%	18.34%	14.17%	15.25%

	Max Drawdown	Monthly Skew	Monthly Vol	ITD 15% Vol*
S&P 500 with LeftTail Strategy	-16.80%	-0.27	16.66%	13.57%
S&P 500	-19.60%	-0.51	17.63%	13.06%

Exhibit 11: Overlay Summary Statistics
Source: LongTail Alpha

Conclusions

We discuss the importance of using a more comprehensive set of metrics for measuring the performance of tail risk hedging portfolios in particular, and any strategy with levered payoffs in general. Using historical compounded returns when the payoffs are multiples of the premium, and such payoffs are withdrawn, can paint an inaccurate picture, sometimes grossly so, of the economic value of such strategies. The reason, as discussed above, is that the timing and magnitude of the cash flows matter immensely, and when such cash flows are withdrawn, the impact on the compounded returns has to be corrected for the value added from the cash flows. Otherwise one can arrive at exactly the wrong conclusions. As an example, we demonstrate that when the cash flows generated during market crises are re-invested in the markets, the strategy increases the long term risk-adjusted returns, rather than reducing the returns of the portfolio as one would expect from the negative expected return of owning an insurance policy. We hope that we have demonstrated that tail hedges can be value-additive to portfolios by providing protection during market events, providing liquidity, and improving overall risk characteristics. However, to properly evaluate the performance of a tail hedge or other high payoff strategies, the full set of measurement tools must be applied. In particular, we conclude that one cannot just limit the analysis to compounded hypothetical returns that don't pay attention to cash-flow magnitude and timing alone.

Appendix

Month End	Net of Fee Monthly Return
8/31/2017	-7.55%
9/30/2017	-11.21%
10/31/2017	-9.56%
11/30/2017	-5.83%
12/31/2017	-6.39%
1/31/2018	-6.18%
2/28/2018	10.86%
3/31/2018	-1.31%
4/30/2018	-17.98%
5/31/2018	-15.51%
6/30/2018	-5.70%
7/31/2018	-29.61%
8/31/2018	-20.41%
9/30/2018	-20.51%
10/31/2018	12.94%
11/30/2018	-31.61%
12/31/2018	45.86%
1/31/2019	-51.16%
2/28/2019	-36.10%
3/31/2019	-33.43%
4/30/2019	-17.17%
5/31/2019	17.25%
6/30/2019	-30.23%
7/31/2019	-7.98%
8/31/2019	0.34%
9/30/2019	-13.83%
10/31/2019	-18.81%
11/30/2019	-20.07%
12/31/2019	-17.65%
1/31/2020	-4.81%
2/29/2020	81.90%

Exhibit 12: LeftTail Strategy NAV Returns

Note: Net performance is presented with a management fee of 10bps (or 0.1%) on the notional amount under protection.
Source: LongTail Alpha

Month End	S&P 500 with LeftTail Strategy	S&P 500
8/31/2017	0.25%	0.31%
9/30/2017	1.97%	2.06%
10/31/2017	2.26%	2.33%
11/30/2017	3.02%	3.07%
12/31/2017	1.05%	1.11%
1/31/2018	5.64%	5.73%
2/28/2018	-3.59%	-3.69%

3/31/2018	-2.52%	-2.54%
4/30/2018	0.10%	0.38%
5/31/2018	2.18%	2.41%
6/30/2018	0.55%	0.62%
7/31/2018	3.39%	3.72%
8/31/2018	3.10%	3.26%
9/30/2018	0.46%	0.57%
10/31/2018	-6.68%	-6.84%
11/30/2018	1.72%	2.04%
12/31/2018	-8.68%	-9.03%
1/31/2019	6.97%	8.01%
2/28/2019	2.90%	3.21%
3/31/2019	1.77%	1.94%
4/30/2019	3.84%	4.05%
5/31/2019	-6.17%	-6.35%
6/30/2019	6.69%	7.05%
7/31/2019	1.32%	1.44%
8/31/2019	-1.56%	-1.58%
9/30/2019	1.60%	1.87%
10/31/2019	1.86%	2.17%
11/30/2019	3.35%	3.63%
12/31/2019	2.83%	3.02%
1/31/2020	-0.07%	-0.04%
2/29/2020	-7.61%	-8.23%
3/31/2020	-9.89%	-12.35%
4/30/2020	12.82%	12.82%
5/31/2020	4.76%	4.76%
6/30/2020	1.99%	1.99%
7/31/2020	5.64%	5.64%
8/31/2020	7.19%	7.19%
9/30/2020	-3.80%	-3.80%
10/31/2020	-2.66%	-2.66%
11/30/2020	10.95%	10.95%
12/31/2020	3.84%	3.84%

Exhibit 13: S&P 500 with LeftTail Strategy Overlay Returns

Note: Net performance is presented with a management fee of 10bps (or 0.1%) on the notional amount under protection. The portfolio implementing this strategy was wound down and closed on 3/31/2020. Returns in the overlay from 4/1/2020 - 12/31/2020 are the results of S&P 500 returns only.

Source: LongTail Alpha

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Overlay market values are for illustrative, informational purposes only. They are computed using actual fund flows and net of fees performance. All cash flows are reflective of the strategy's cash flows, but normalized to a $2 per year annualized sped. This implied that the total notional value being hedged is $100 with a $2 annual implementation cost.

Tail Risk hedging strategies are generally designed to protect against large unexpected financial market moves. The concept is to sacrifice a portion of return each year in order to protect a portfolio against a sharp adverse market meltdown or meltup. Tail Risk hedging strategies purchase out of the money options and option structures. In exchange for the leverage offered by these options, an investor is explicitly taking the risk that the total value of the premium spent on purchasing the options or options structures decays to zero.

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The performance shown was prepared by LongTail and has not been compiled, reviewed, or audited by an independent accountant. The results are based on internal books and records and are subject to adjustment following year-end audit. The strategy's returns are shown, in each case, at the end of the period indicated. The results are based on the periods as a whole, but results for individual months or quarters within each period will vary and will be more or less favorable than the average. The performance shown reflects investment of limited funds for a limited period and does not reflect performance in different economic or market cycles. Investors may not experience returns, if any, comparable to those shown. Past performance is not necessarily indicative of future results.

Options involve risks and are not suitable for all investors. There are many factors that an investor should be aware of when trading options including interest rates, volatility, stock splits, stock dividends, stock distributions, currency exchange rates, etc. Investors should only engage in options trading that is best suited to their financial condition and option experience and which considers current market conditions. The use of derivative instruments, such as options contracts, can lead to losses because of adverse movements in the price or value of the underlying asset, index or rate, which may be magnified by certain features of the derivatives. Investing in options and other instruments with option-type elements may increase volatility and/or transaction expenses. An option may expire without value, resulting in a loss of an initial investment and may be less liquid and more volatile than an investment in the underlying securities. Investments in debt securities typically decrease in value when interest rates rise. This risk is usually greater for longer-term debt securities. Any "limited-risk" and "no margin call" features of options apply only to the purchase of options but not to the holding of the options themselves. The "limited-risk" feature of options includes the full amount of the premium and transaction costs including commissions.

Certain of the exhibits included in this paper are examples for illustrative purposes only and are presented through hypothetical scenarios with hypothetical returns. Hypothetical performance results have many inherent limitations, some of which, but not all, are described herein. No representation is being made that any strategy will or is likely to achieve profits or losses similar to those shown herein. In fact, there are frequently sharp differences between hypothetical

performance results and the actual results subsequently realized by any particular investment strategy. One of the limitations of hypothetical performance results is that they are generally prepared with the benefit of hindsight. In addition, hypothetical trading does not involve financial risk, and no hypothetical trading record can completely account for the impact of financial risk in actual trading. For example, the ability to withstand losses or adhere to a particular trading program in spite of trading losses are material points which can adversely affect actual trading results. The hypothetical performance results contained herein represent the application of certain strategies as currently in effect and there can be no assurance that the strategies will remain the same in the future or that an application of the current strategies in the future will produce similar results because the relevant market and economic conditions that prevailed during the hypothetical performance period will not necessarily recur. There are numerous other factors related to the markets in general or to the implementation of any specific trading program which cannot be fully accounted for in the preparation of hypothetical performance results, all of which can adversely affect actual trading results. Discounting factors may be applied to reduce suspected anomalies. Hypothetical performance results are presented for illustrative purposes only and should not be relied upon in making an investment decision.

Max Drawdown is the worst peak to through return since inception.

The skewness of a dataset measures the degree of distortion from the symmetrical bell curve in a probability distribution and can be calculated by subtracting the mode from the mean and dividing the difference by the standard deviation

Volatility is the standard deviation of returns annualized.

CAGR 15 Vol (Cumulative Annual Growth Rate) represents the return since inception annualized assuming the returns were scaled to achieve a 15% annualized volatility.

This information is provided to you on the understanding that, as a sophisticated investor, you understand and accept the inherent limitations of the data presented, and you will not rely on it in making any investment decision. No representation is being made that any of the strategies will or are likely to achieve returns similar to any of those included. The financial information and data contained in this document represent unaudited financial information and is subject to future adjustment and revision.