Cash Flows Matter for Tail Hedging Strategies

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As practitioners providing tail risk hedging solutions to investors, we are often asked to supply return time series and compounded returns for tail risk hedging strategies. The purpose of this paper is to illustrate with simple, hypothetical examples why cash flow based analysis is central to evaluating strategies with high volatility payoffs. While the traditional NAV based fund accounting is not incorrect, we often have to explain to investors that the meaning of such data has to be thoroughly understood before it is used in making portfolio decisions. The need is even more critical today, 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 long term "return" 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 the insurance premium is expected to be a total loss every year, the relatively small insurance premium paid annually protects the home-owner from a potential catastrophic loss. Computing the total cumulative return on this premium, as is done for traditional investments might mathematically be sound, but conceptually is not very relevant.

What people who buy home insurance remember is that when their home was damaged, the insurance policy paid off enough to cover the losses. This means that the salient feature of insurance-like investments is the reliability of the contingent payoffs when they matter. For

most homeowners, it is a given that home insurance is a cost. In exchange, 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; (2) if purchased from a reliable party, the insurance pays off when it is needed; and (3) the cash flow is sufficient and satisfactory for the premium cost incurred.

These three reasons are why the authors have never asked our home insurance providers to provide the internal rate of return (IRR) for the years, maybe even decades, that we have been buying home insurance. It is not that the numbers cannot be computed - they can be, but the numbers may lead to the wrong conclusions and erroneous decisions around the value of the insurance policy. 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? 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, even though the mathematical expected return on the insurance by itself is a total loss. 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 unforeseen catastrophic loss.

The Potential Wrong Message Sent by NAV Based Returns for Tail Hedges

Traditional NAV based accounting reports net performance returns typically daily or monthly. These returns are often used to calculate compounded historical returns looking back over prior periods: quarter-to-date, year-to-date, and so on. The methodology is:

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

where:

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

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

The inception to date or on-going cumulative compounded returns are predicated on the assumption 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*,

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

As a shortcut for analysis, fund return streams usually 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 an 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 representative investor's experience represents the performance of the fund.

We begin with two simple scenarios that demonstrate the NAV based accounting methodology. Exhibits 1-2 differ in the volatility of their respective returns. 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", strings together the period returns using the compounding formula above. The second return, which we call "dollar return", looks at the total terminal dollar value received, and computes the return of the dollar capital relative to the total dollar value 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.

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

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

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

Tail hedges, 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. Further, investors of tail hedge funds typically want to access liquidity provided by a monetization event as soon as possible to either offset losses from the underlying portfolio, or

for redeployment into the market and potentially catch a rebound. 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 immediately 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.

> "Ignoring the cash flows can paint an egregiously inaccurate picture of the value of tails hedges."

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. The actual profit 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

Taking the analysis one step further, we 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 that a 5x or 500% return is not considered outsized for a tail hedging portfolio.

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	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 the 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 in this strategy would hypothetically make $31 on a $10

return is -50%. A negative cumulative 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 profit net of total subscriptions is positive in this hypothetical example, 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 in reality, this example is meant to demonstrate that the simple mathematics of NAV based performance calculations may not always be conceptually representative of the actual value to the investor.

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

"The timing and magnitude of the cash flows matter immensely."

Conclusion

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, in the context of the underlying portfolio that is being hedged is necessary. 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 adjusted for the value of the cash flows. Otherwise, one can arrive at exactly the wrong conclusions regarding the efficacy of tail hedging strategies.

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