Expect the Unexpected for Sustained Portfolio Performance

Option Total Return

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Option Total Return and Active Option Portfolio Management

October 11, 2023

Abstract

We introduce the concept of total return for options and option portfolios. By taking local derivatives of the option price with respect to the underlying drivers in an option pricing model (i.e. delta, gamma, vega, theta), we can decompose daily option price changes into the sum of the changes in these underlying drivers. By accumulating the contribution from the underlying drivers, we can compute each driver's contribution to the total performance of a portfolio of options. We discuss the relevance of this framework to applications such as tail risk hedging, and discuss how the approach can be useful to the active management of options portfolios. Our approach provides a natural extension of the concept of total return that is widely used for evaluation of traditional investment portfolios.

Highlights

- We introduce the concept of total return for options and option portfolios. By keeping track of the local contributions from the drivers of the options price and accumulating these contributions, we can attribute the total return to changes in these key drivers for a given horizon.
- By attributing the total return of various option structures in terms of the underlying drivers, we highlight how our approach provides important details on the trade offs involved in choosing different option structures to attain a given objective.
- With an example from the the COVID-19 crisis, we demonstrate the usefulness of this framework to active option portfolio management such as swapping from vanilla options to spreads.

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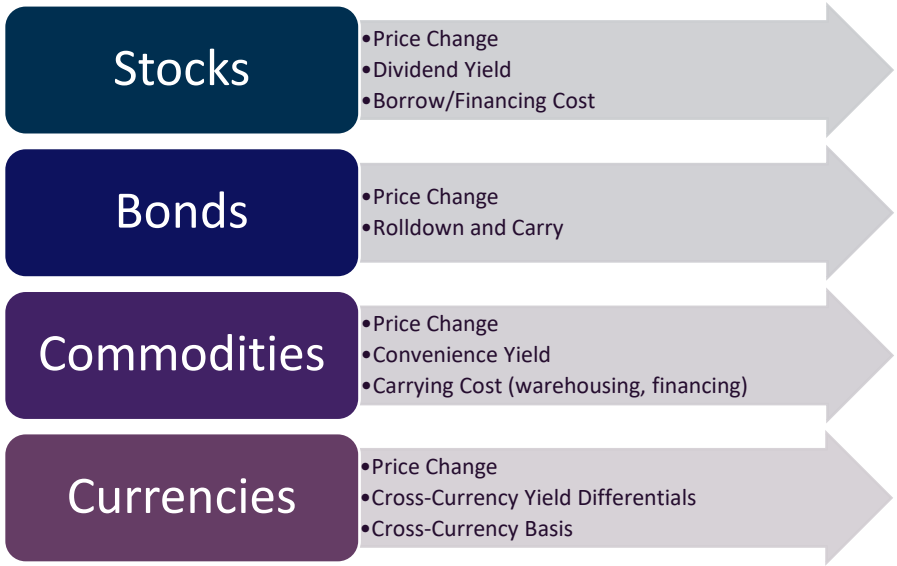
Upcoming in the Journal of Portfolio Management, April 2024 issue. Also available at LongTail Alpha Website for download Option_Total_Return_vFF.pdf (longtailalpha.com)

What is Total Return and Why Is It Important?

Two Definitions:

- The actual rate of return of an asset or portfolio over a given horizon that includes both price appreciation and income
- The total return from things that change (prices, curves, spreads, volatilities) and from things that do not change (passage of time)

The concept is important because it is possible for price return to be negative yet total return to be positive if the income is positive and large enough, e.g. recent performance of 2-year treasury notes; or total return to be negative if negative carry return exceeds positive price return, e.g. for many commodities in contango. For options the total return can be positive if the drag from theta is less than the gain from other factors.



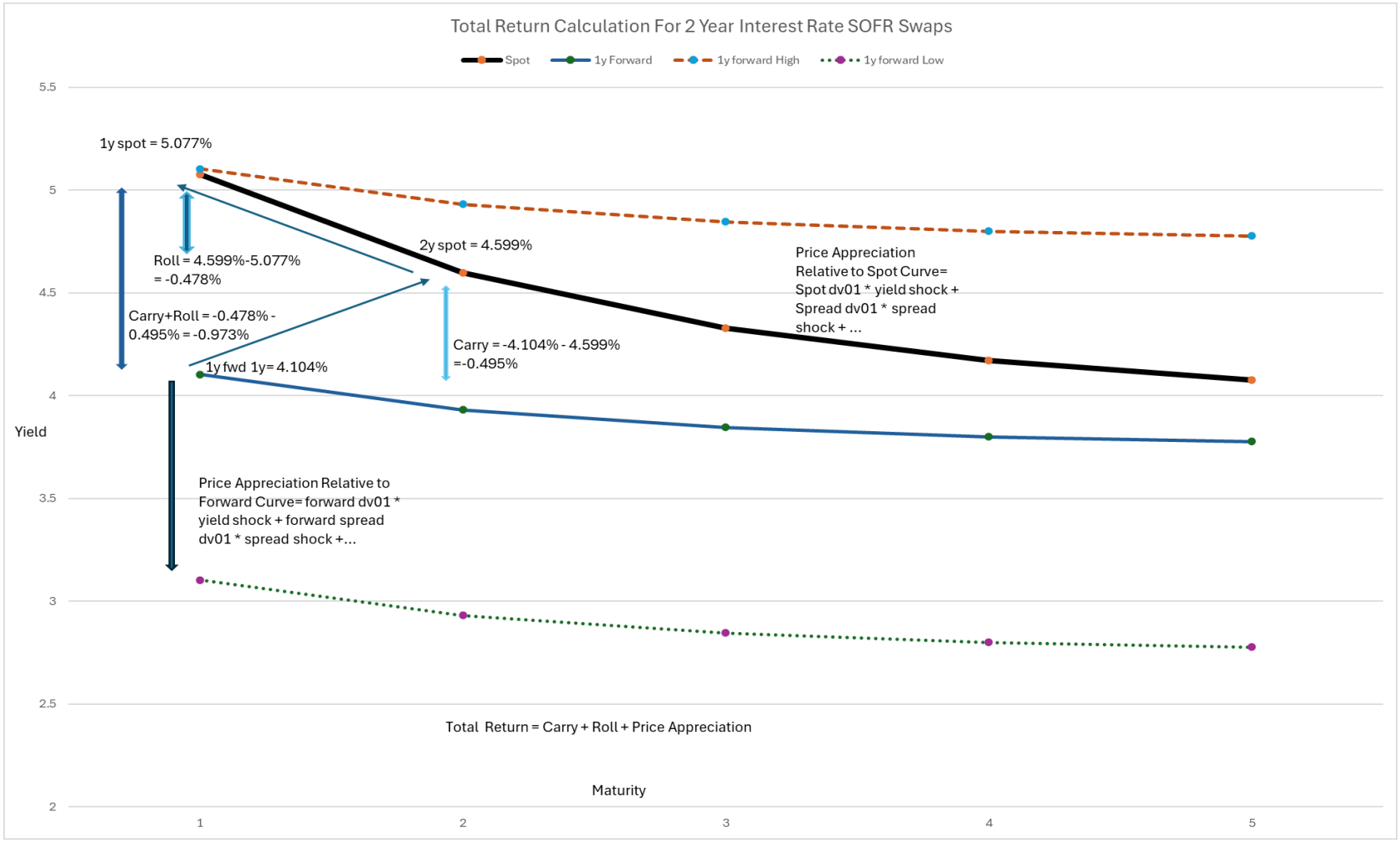
Why is The Concept of Total Return Useful?

1) *Ex-Ante Measurement* of Return Drivers and Risk Allocation

2) *Ex-Post Attribution* of Performance

3) *Active Management* of Individual Positions Within Total Portfolio For Better Total Portfolio Outcomes

Illustrative Example: Fixed Income Total Return



Source: LongTail Alpha, Bloomberg, as of 3/19/2024

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Key Ingredients For Total Return Calculation

Pricing Model:

- Be able to compute prices and sensitivities: e.g. dv01s and spread dv01s for bond prices.

Calculation Engine:

- Be able to recalculate prices for future scenarios and times: e.g. bond prices for different scenarios and times.

Accounting Engine:

- Be able to keep track of contributions from different variables through time: e.g. contribution from different yield curve shocks and spread shocks. This task is relatively straightforward for non-callable bonds because dv01s are fairly stable with time. It is much more complex when options are present.

Total Return For Options: Similar to Bonds But A Little Bit More Complex

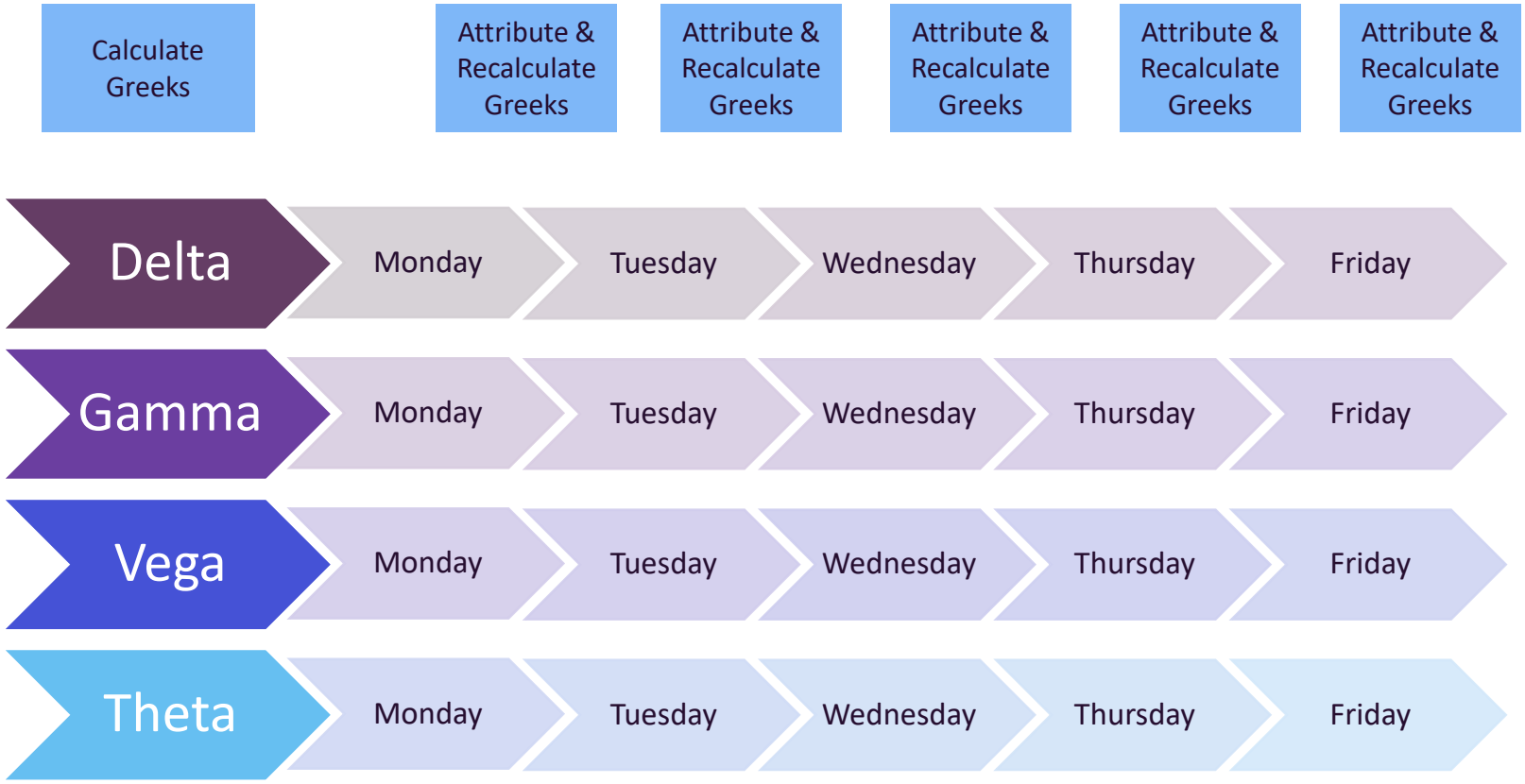
- **Option price is a complex non-linear function of many variables:**
  - Level of the underlying
  - Strike
  - Volatility
  - Interest Rates
  - Dividend yields (or counter-currency yield for currency options)
  - Time
- **Total return of options can be decomposed in terms of:**
  - Parameters that can change: underlying price, volatility, interest rates, dividend yields
  - Passage of time: time decay
- **Sensitivities can be measured in terms of "greeks":**
  - Unlike linear securities, these greeks themselves can change significantly as the parameters change and time passes
  - Analysis requires higher frequency accounting of the greeks, e.g. daily, and accumulation of return contributions, which requires real-time option prices and analytics across the whole option volatility surface
  - Accurate underlying pricing data has only become available quite recently, which now makes this technology practicable

Option Total Return Drivers

Delta	Sensitivity to changes in underlier price	Delta Attribution	= Delta * Change in Stock Price
Gamma	Change in delta with changes in price	Gamma Attribution	= ½ * Gamma * $(\text{Change in Stock Price})^2$
Vega	Sensitivity to volatility	Vega Attribution	= Vega * Change in Implied Volatility
Theta	Sensitivity to the passage of time	Theta Attribution	= Theta * Number of Days

Note: Higher order greeks and cross-greeks may also impact the attribution but can be neglected to leading order

Accumulation Over Time



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The Concept of Total Return Applied to Options and Portfolios of Options

- **Measurement and Risk Allocation:**
  - How much of the exposure should be allocated to different underlying drivers (“greeks”) and how should the individual positions be updated with time to maintain exposure, e.g. for a tail hedge?

- **Attribution:**
  - How did different greeks contribute to different outcomes for option portfolios, and are there specific actions that could have resulted in better outcomes based on historical experience?

- **Active Management:**
  - How should the exposure to different greeks be modified as the market changes and time passes, e.g. monetization and redeployment?

Three Illustrative Examples

- Example 1 - Measurement: Standalone Tail Hedge

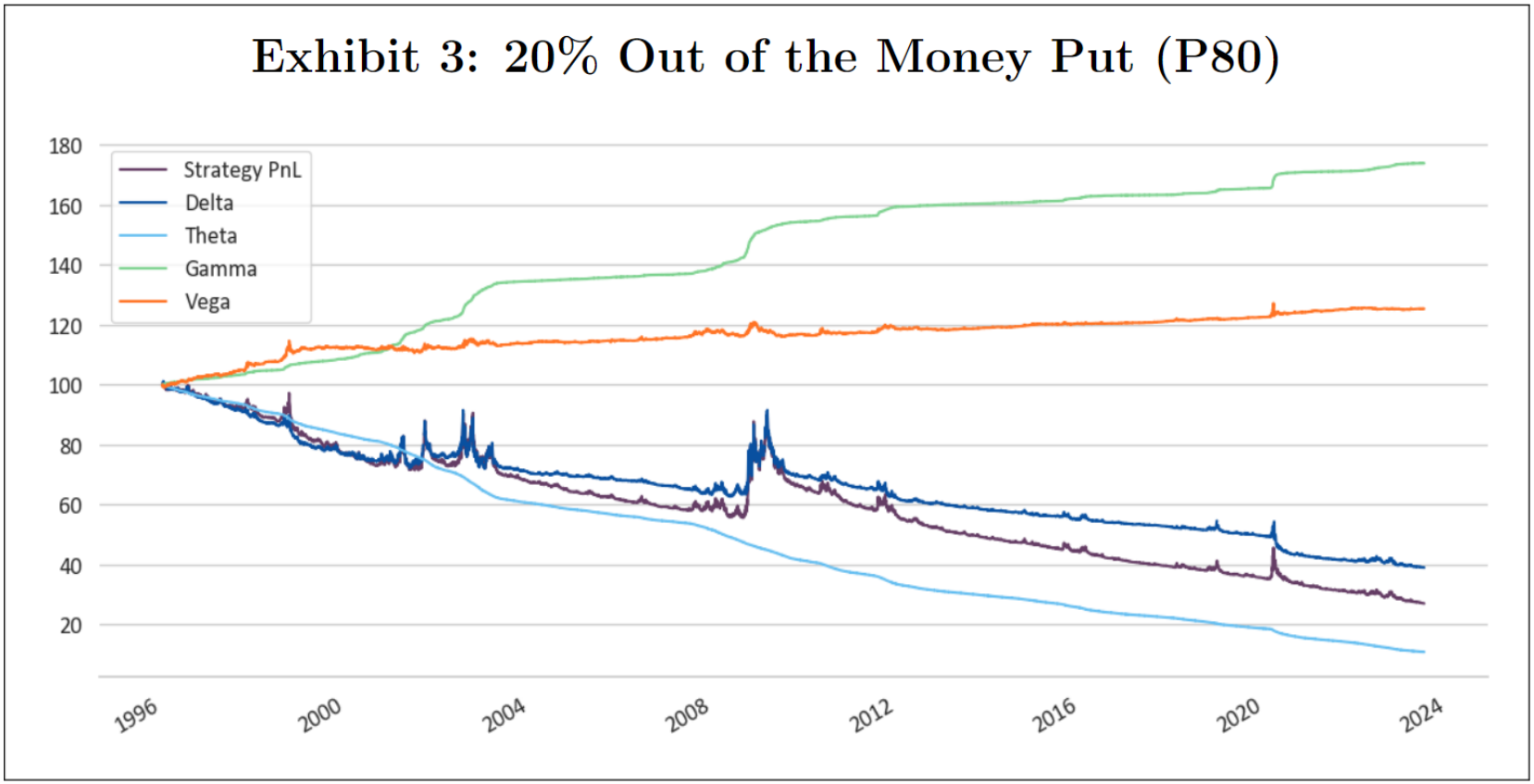
- Example 2 - Attribution: S&P 500 with a Tail Hedge during the Global Financial Crisis

- Example 3 – Active Management: Monetization and Rotation from Puts to Put-Spreads During COVID-19

Measurement: Long Position in a Put Options

A portfolio of rolling 1 year 20% OTM put options on the S&P 500

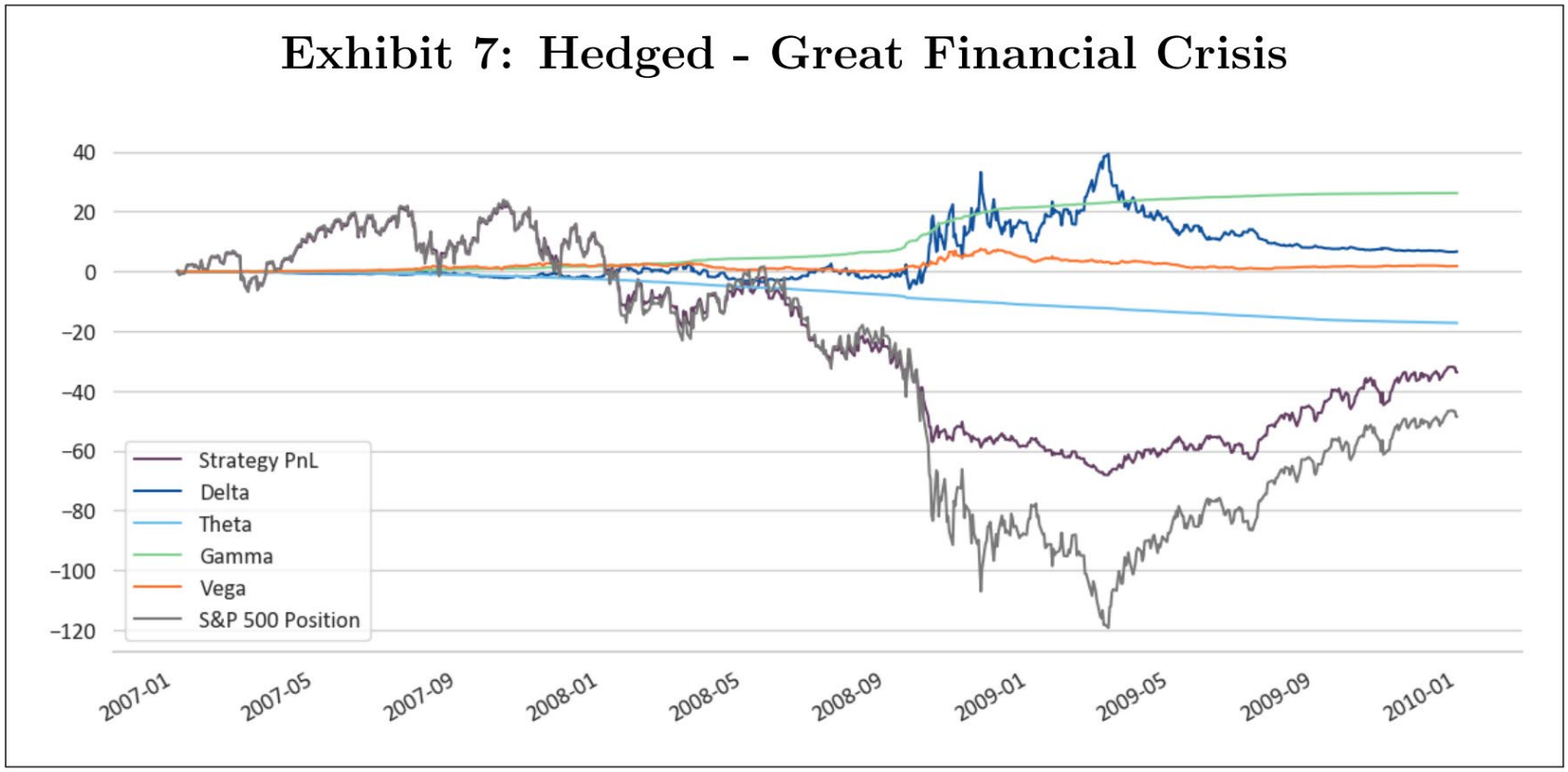
A portfolio of simple put options lost cumulative value over time. This can be seen below as arising from loss due to delta (market rally over the period), time-decay (theta), and gain in value from gamma and vega. “Theta is the price of gamma”.



Sources: LongTail Alpha, OptionMetrics

Attribution: Hedged S&P 500 Portfolio

During the Great Financial Crisis a hedged position in the S&P500 resulted in a positive gain from delta and gamma, and a loss from theta. The delta and gamma gains were larger than the loss from theta, resulting in a net positive contribution from the hedge.

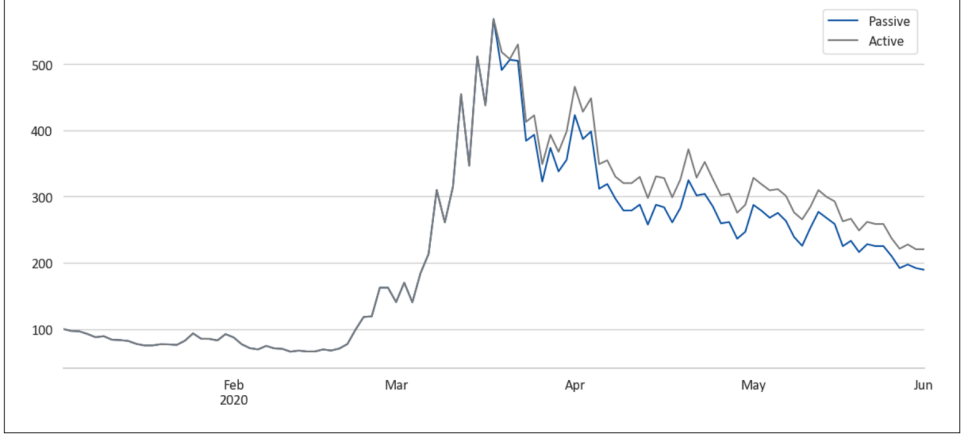


Sources: LongTail Alpha, OptionMetrics. Jan 3, 2007 - Jan 1, 2010

Active Management: Switching From Puts To Put Spreads During COVID-19

Active strategy monetizes the put option at a 5x multiple, which occurs on March 18th, 2020 and redeploys this entire premium into a put spread with the same delta and premium.

Exhibit 12: Active Monetization into Put Spread



Sources: LongTail Alpha, OptionMetrics. Rebased to 100

- S&P 500 first decreased 26.4%
- Then increased 27.4%, all within 6 months.
- Full sample, S&P 500 decreased 6.2%
- Exhibit shows gain or loss in dollars and illustrates the benefits from switching to the put-spreads, **i.e. from reducing the drag from vega (note that after a sharp selloff in the underlying index, the volatility tends to rise, resulting in losses if volatility subsequently recedes).**

Exhibit 13: Decomposition

	Full Sample		Before Monetization		After Monetization	
	Passive	Active	Passive	Active	Passive	Active
Delta	-103.0	-144.4	195.9	195.9	-298.8	-340.3
Theta	-25.5	-26.6	-15.4	-15.4	-10.1	-11.3
Gamma	132.1	135.0	77.5	77.5	54.7	57.5
Vega	85.8	156.5	210.5	210.5	-124.7	-54.0
Total	89.5	120.4	468.5	468.5	-379.0	-348.0

Source: LongTail Alpha, OptionMetrics. Full sample is Jan 1, 2020 - June 1, 2020.

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Conclusion

- The concept of Total Return is central to investment decision making over any investment horizon for all assets and portfolios.
- The concept allows investors to
  - Allocate risk *ex-ante* to different drivers and manage the impact of the passage of time.
  - Attribute performance *ex-post* to different drivers.
  - Manage portfolios actively based on the relative opportunity from different drivers.
- These concepts can be extended to options in a straightforward manner; however, given the non-linearity, multiple sensitivities and time dependence of options, it requires new technology to capture the path-dependency of the drivers.
- This technology can be used to build better option strategies and portfolios, and gain more transparency on what is driving their performance.

Appendix

Example 1: 20% Out of the Money Puts (P80): To demonstrate our approach in various settings, we compute the contribution to the option total return from various 1-year option portfolios on the S&P 500, for a historical sample period starting in 1996. All data is from OptionMetrics. The strategy buys 1-year options on a quarterly basis. The strategy sizes each new option position such that the delta of the new position is equal to 0.025 at the portfolio level. Since options are bought quarterly, the strategies reach a stable state of a "ladder", with 4 separate options positions roughly 3/6/9/12 months away from expiration, and a combined delta of roughly 0.1 (0.025 *4) at the total portfolio level.

Example 2: Hedged – Great Financial Crisis: Allocates the entire starting capital to the S&P 500. At the beginning of each quarter, a 20% OTM put is bought in a quantity such that the option's notional equals 25% of the value of the portfolio's S&P 500 position at that time (note that for illustration we assume that these options are bought on free margin, i.e. without interest expense, and the quantity of S&P 500 never changes). The cumulative cost of these options, subtracted from the value of the S&P 500 position, equals the value of the portfolio/strategy.

Example 3: Active management: Both strategies purchase a single 20% OTM S&P 500 put on January 3rd, 2020. The passive strategy simply holds the option to expiry. The active strategy mimics an active option strategy with a 5x monetization threshold; accordingly, this strategy monetizes the put at a 5x multiple, which occurs on March 18th, 2020 and redeploys this entire premium into a put spread with the same delta and premium. 5x multiple is based on premium/option value increasing 5 times compared to the price paid on the date of purchase.