PARAMETRIC

September 2021

Comparison of Tenors in Option-Writing Strategies

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During the past decade, option-selling strategies have garnered significant interest from investors, driven by a combination of heightened sensitivity to equity risk, the search for increased yield amidst near-zero interest rates, and dissatisfaction with hedge funds' high fees and low realized alpha. At the same time, ease of implementation in option-linked strategies increased as option volumes soared, trading costs declined, and the range of available exchange-traded instruments expanded.

Some investors pursued these option-writing strategies to access the volatility risk premium (VRP), which is the expected excess return earned when the level of volatility implied in an option's price is greater than the volatility subsequently realized in the option's underlier. Investors have viewed these strategies as a means to enhance portfolio returns and improve diversification.

Historically, most option-writing strategies, including popular public benchmarks like Cboe BXM and PUT indexes, have focused on writing options with approximately one month remaining until expiration. More recently, increases in the range of available exchange-traded instruments have allowed for shorter tenor strategies, including initial tenors of one week or less.

In this paper we introduce a framework for decomposing the performance of short options into two components—time-varying market exposure (TVME) and volatility. We then use that framework to explore differences between one- and four-week options on both components. We'll conclude with a case study on performance and drawdowns during the COVID-19 crisis.

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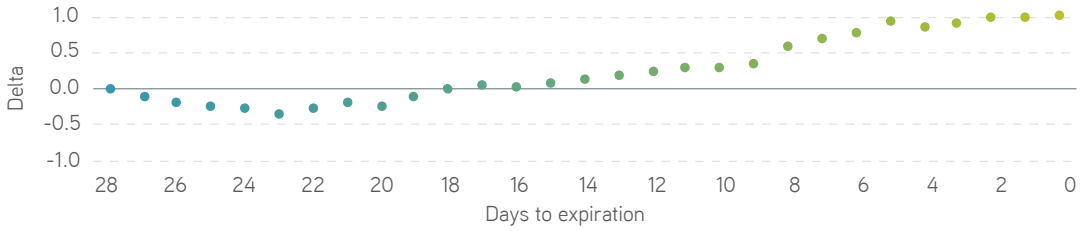
Decomposition of short option performance

Let's begin with a methodology for decomposing short option returns into two components, one related to directional market exposure and the other to volatility exposure. Suppose a short at-the-money (ATM) straddle (short one unit each of ATM put and call) is established with market-neutral exposure at initiation. Over its life, the position accrues positive or negative directional exposure if the underlying price were to fall or rise, respectively. This directional sensitivity to movements in the underlying instrument is known as the option position delta.[1]

Suppose that at the close of each trading day we record a snapshot of that delta and then apply it proportionally to the subsequent trading day's underlying price change. We track the daily product—the net delta from the prior day's close multiplied by the next day's market return—until expiration and tally a cumulative total. The resulting sum is TVME, the first component of our decomposition.

Figure 1 illustrates the contribution to TVME over an option's life cycle, showing daily deltas for a hypothetical four-week straddle. During the first 10 days (days to expiration 28 through 18), the underlying price has increased modestly, resulting in negative net deltas. Subsequently, a decline in the underlier results in positive net deltas that mature to 1.0 at expiration (when the put option expires in-the-money).

Figure 1: Hypothetical example of one-unit short straddle delta



Source: Parametric, 2021. For illustrative purposes only. Not based on any specific option pair or market movement.

Crucial to this performance decomposition is the idea that any day's net delta can be offset through long or short exposure in the underlier (through futures, for example). The practice of offsetting the directional exposure in options is known as delta-hedging. In figure 1, when the short straddle accrues –0.3 units of delta, a long futures position equal to +0.3 units could render the combined position (short straddle plus long futures) delta-neutral. This delta-hedging activity could occur daily until option expiration.

[1] An option's delta is the first-order derivative of option price with respect to the underlying price. It's market practice to refer to an option's delta between zero and 100 (in reference to 0% and 100% proportionate sensitivity to its underlier). As such, a 50-delta *call* has a numerical reference of 0.5 units per 1.0 unit increase in underlying. Inversely, a 50-delta *put* has a numerical reference of –0.5 units per 1.0 unit increase in its underlier (despite absolute 50 reference). Delta-neutral exposure implies that the option position's deltas are neutralized and thus amount to zero. In the ATM straddle example, we assume that the short put option derives +0.5 units of delta and the short call option derives –0.5 units of delta.

One way to think about delta-hedging is as a point-in-time, linear offsetting of an option's directional market exposure. Another, less obvious way is to recognize delta-hedging as a form of replicating the payoff of the option itself. However, linear instruments such as futures cannot perfectly replicate the payoff of a convex instrument (option). This is where our second return component—volatility—comes into play.

Ex post returns attributable to VRP can be quantified through evaluation of the spread between implied volatility (IV) and realized volatility (RV). This spread characterizes the option's pricing (rich or cheap) relative to a linear-based, manufactured payout. To capitalize on a positive IV-RV spread, an investor simply takes on the *relative value* of selling what is expensive (the option) and buying what is cheap (the futures-based replication). The cumulative return from this activity, which we call volatility, is derived from the combination of short options and their associated delta-hedging trades.

Figure 2: Potential IV-RV spreads and expected return from volatility

Implied vs. realized volatility	Replication vs. option return	Delta-hedged short option
Implied = realized	Equal	Flat return
Implied > realized	Replication *outperforms*	Positive return
Implied < realized	Replication *underperforms*	Negative return

Source: Parametric, 2021.

An investor isolates exposure to volatility by shorting the option and offsetting the directional sensitivity with the same periodicity used in the calculation of volatility itself (conventionally daily). In the absence of delta-hedging, the short option position has exposure to both volatility and TVME:

$$\textit{Short option return (unhedged)} = \textit{volatility} + \textit{TVME}$$

$$\textit{Short option return (delta-hedged)} = \textit{volatility}$$

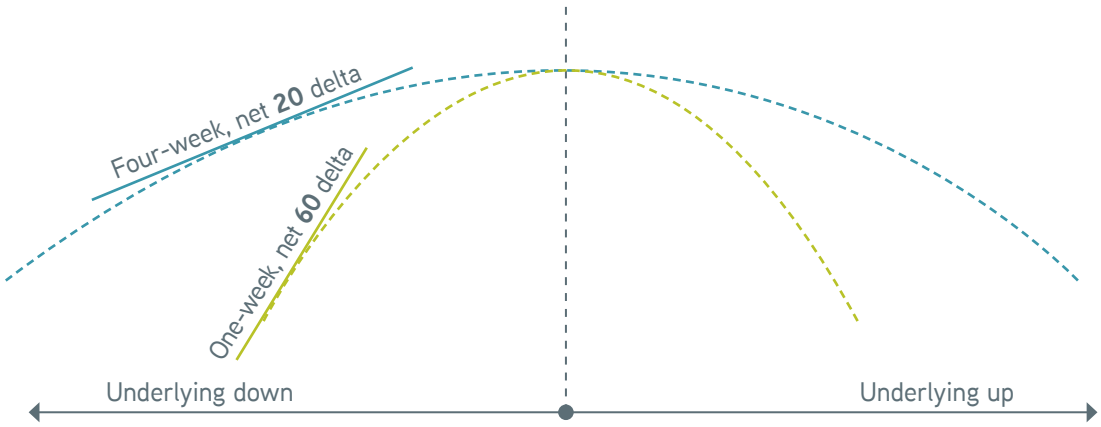
Assumed methodology

To isolate the relevant exposure differences between option tenors, we focus on short S&P 500® Index ATM straddles with one- and four-week initial tenors. We assume a systematic, equal-weighted ladder of options with staggered expirations occurring every Monday, Wednesday, and Friday. As such, four-week straddles are broken into 12 tranches, while one-week straddles are broken into three tranches. Once initiated, options are held to expiration.

TVME comparison

To understand what distinguishes TVME in one- and four-week straddles, we'll discuss differences in their typical delta sensitivities. Figure 3 plots profit and loss arcs for both straddles based on moves in the underlier. For any point on the arc, the slope of the tangent line represents the position's delta. Note that for every pair of tangent lines drawn on these two arcs, the one-week line has a steeper slope (delta) in absolute value terms than that of the four-week. In other words, the shorter the tenor, the greater the accumulated directional exposure for a given move in the underlier. This increased rate of change in delta for one-week options is known as greater gamma.

Figure 3: ATM straddle profit and loss arcs

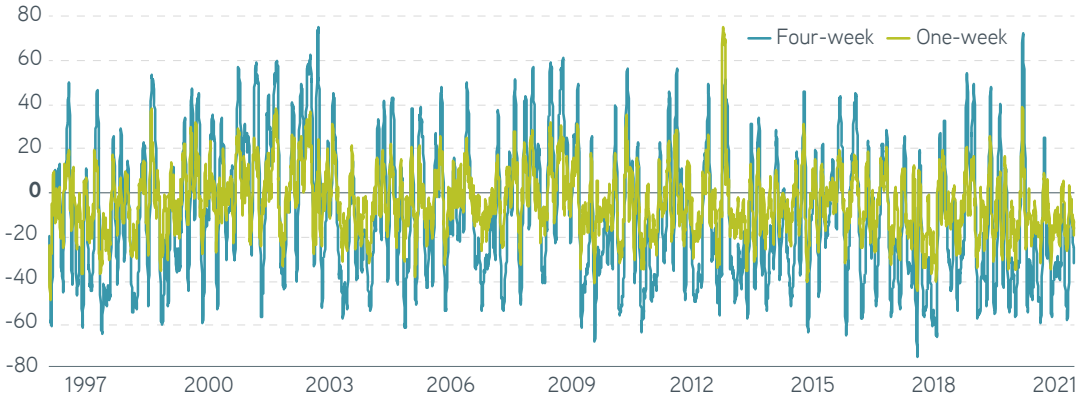


Source: Parametric, 2021. For illustrative purposes only.

An opposing force counteracts the higher gamma associated with shorter tenors; however, frequency of expiration naturally eliminates accumulated market exposure, similar to the effect of delta-hedging on non-expiration days. For one-week tenor options, this organic delta reset occurs four times in a four-week period (as opposed to just once for the four-week tenor option).

The relative strength of these opposing forces—gamma versus expiration frequency—determines relative delta variability between the two simultaneous positions. Which force is greater? Our research shows that, on average, the neutralizing impact of increased expiration frequency in one-week tenors is stronger than the opposite impact derived from their higher gamma. Figure 4 plots the rolling average net delta for both tenors, most often closer to zero (or neutral) for the one-week than for the four-week. As such, the carried delta return impact in one-week straddles (TVME) is less prone to outsized gains and losses (for better or worse) than that of the four-week.

Figure 4: Delta (rolling one-month average)



Source: Parametric, 2021. Time frame represents longest period in which reliable data is available. For illustrative purposes only.

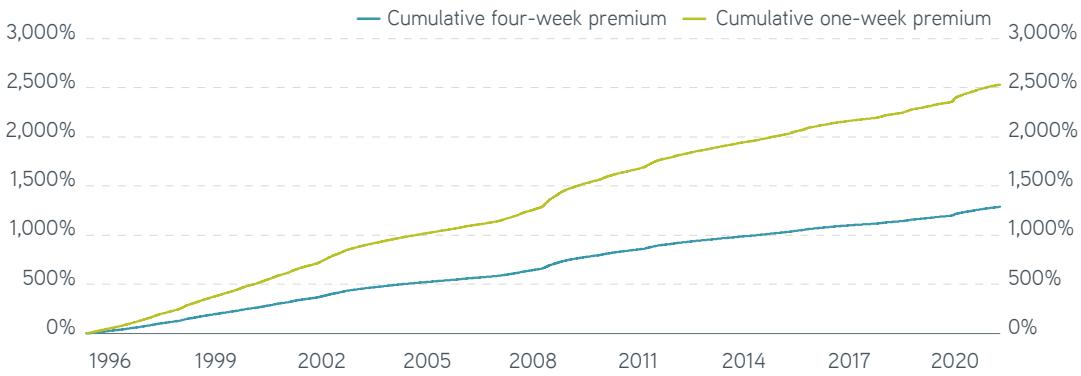
How does this impact performance? In short, it depends on the degree of daily autocorrelation (trending versus mean-reverting markets) over a particular period. Generally speaking, greater absolute delta exposure has a negative impact on TVME in trending underlying price action (positive autocorrelation) but a positive impact on TVME during reverting underlying price action (negative autocorrelation).

Volatility comparison

How does volatility exposure in one- and four-week straddles differ? Recall that the volatility component is the return derived from the short options, combined with delta-hedging, where the delta-hedging aims to replicate the payout of the straddle itself, but from the long perspective. The straddle premium, therefore, credits the seller for an anticipated shortfall in producing that payout using linear instruments only amid expected volatility.

Holding all inputs constant, it is mathematically shown that the cumulative premium received for four consecutive one-week straddles is greater than that of a single four-week straddle. This results from volatility's scaling with respect to the square root of time (as opposed to linearly). Accordingly, despite having four times the life of a one-week straddle, the four-week straddle generates only twice the premium. Four one-week straddles produce twice the cumulative premium of a single four-week straddle. Figure 5 compares the cumulative premiums for the two tenors using simulated historical data with dynamic implied volatilities from 1996 to 2021. Note that, with real historical market data, the cumulative premium for the one-week tenors is approximately double that of the four-week. We can simplify by stating that the cumulative volatility exposure over time compounds at twice the pace, and the premium reflects that risk.

Figure 5: Cumulative premiums (simple sum)



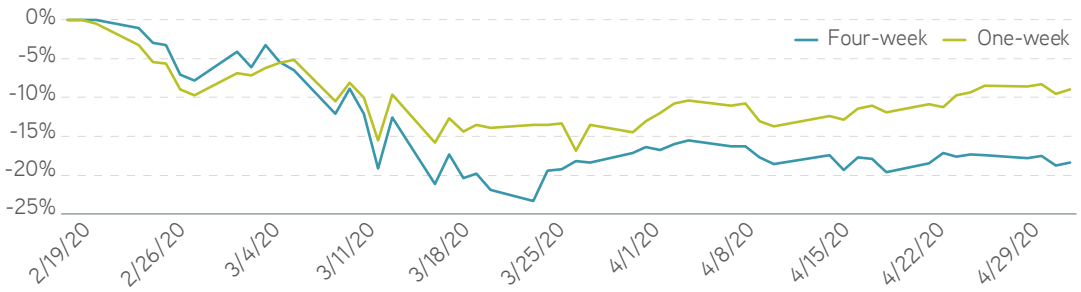
Sources: Parametric and Bloomberg, 2021. Premiums reflect one- and four-week straddles using historical S&P 500® Index options data and are shown net of estimated transaction costs (0.50%/yr for one-week; 0.25%/yr for four-week). Time frame represents longest period for which reliable data is available. Simulated data is for illustrative purposes only, does not represent the results of any investor, and may not be relied upon for investment decisions. Actual outcomes will vary from those demonstrated. All investments are subject to loss.

As it relates to VRP—the expected, long-run excess return driven by an IV-RV surplus—the one-week straddles contain twice the exposure to VRP, as well as twice the risk.

Relative performance during COVID-19 drawdown and recovery

We have described the two exposures that comprise short straddles—TVME and volatility—and explained how those two components differ within one- and four-week short straddles. In this section, we examine the relative performance of each tenor and component during Q1 2020. Figure 6 begins with a drawdown comparison from the market peak on February 19, 2020.

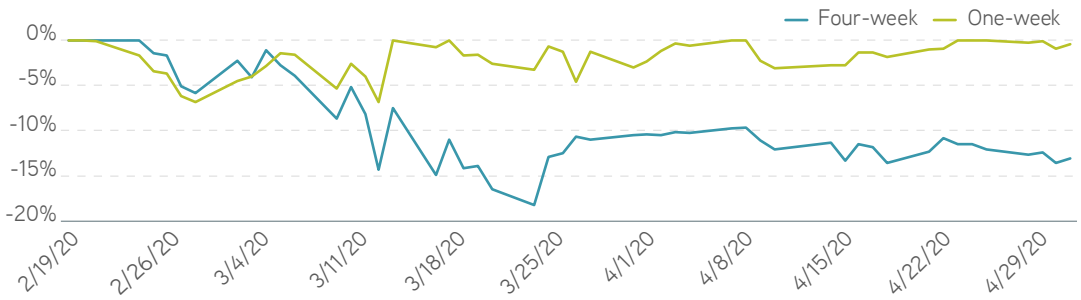
Figure 6: Four-week versus one-week straddle: Drawdown %, 2/19/2020 through 4/30/2020



Sources: Parametric and Bloomberg, 2021. Simulated data is for illustrative purposes only, does not represent the results of any investor and may not be relied upon for investment decisions. Actual outcomes may vary from those demonstrated. Relative performance is shown net of estimated transaction costs (0.50%/yr for one-week; 0.25%/yr for four-week).

While the drawdown for the four-week straddle was greater than the one-week (–23.3% compared with –16.8%), we see that this underperformance resulted almost entirely from the TVME component shown in figure 7.

Figure 7: Four-week versus one-week straddle: TVME drawdown %, 2/19/2020 through 4/30/2020

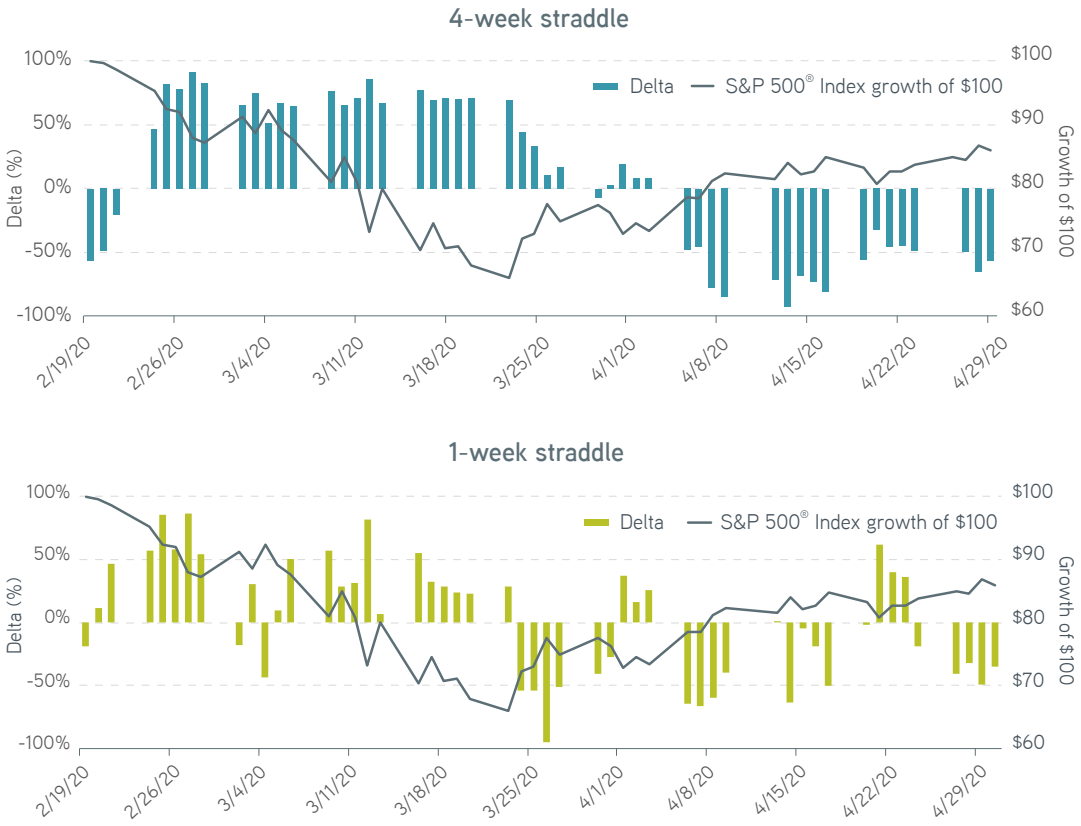


Sources: Parametric and Bloomberg, 2021. Simulated data is for illustrative purposes only, does not represent the results of any investor, and may not be relied upon for investment decisions. Actual outcomes may vary from those demonstrated. Relative performance is shown net of estimated transaction costs (0.50%/yr for one-week; 0.25%/yr for four-week).

Looking at this component more closely, figure 8 plots the daily delta for each tenor alongside S&P 500® Index growth of $100. For the four-week straddles, the delta positioning was unfortunate; the long deltas coincided with sharp declines, followed by negative deltas against sharp increases.

In contrast, the deltas of the one-week straddles were less unfavorable during the same period. Initially there were sizable long deltas in the teeth of a declining S&P 500® Index, but the more rapid expirations were a valuable reset toward neutrality. During the most volatile period in mid-March, one-week TVME added significantly alongside strongly negative autocorrelation (daily price reversals), propelling a recovery with minimal setbacks in April.

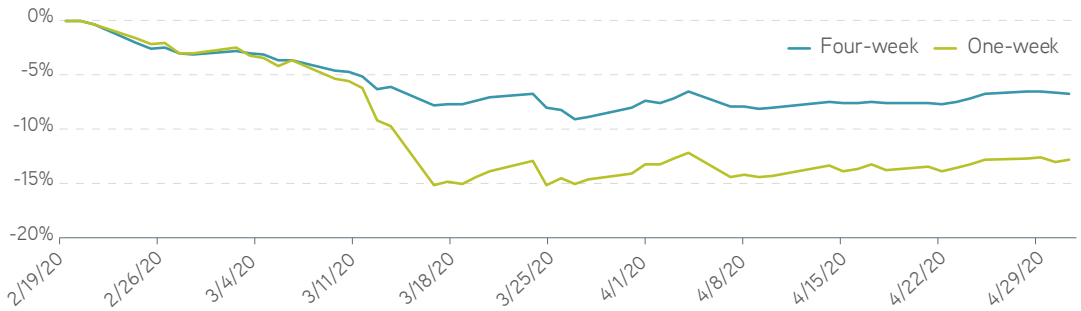
Figure 8: TVME delta versus S&P 500®, 2/19/2020 through 4/30/2020



Sources: Parametric and Bloomberg, 2021. For illustrative purposes only.

On to the second component—volatility. In such an environment, we would expect one-week straddles (with greater accumulated exposure to volatility) to exhibit larger drawdowns in this component. Figure 9 shows exactly that; the drawdown was –15.2% for the one-week versus –9.1% for the four-week.

Figure 9: Four-week versus one-week straddle: Volatility drawdown %, 2/19/2020 through 4/30/2020



Sources: Parametric and Bloomberg, 2021. Simulated data is for illustrative purposes only, does not represent the results of any investor, and may not be relied upon for investment decisions. Actual outcomes may vary from those demonstrated. Relative performance is shown net of estimated transaction costs (0.50%/yr for one-week; 0.25%/yr for four-week).

Conclusion

As interest surrounding option-related strategies has grown over the past decade, so has the availability of instruments to put those ideas into action. The exchange's listing of more option expirations inside one month or less across major equity indexes has been an important development on that front. We've presented a framework for performance attribution of option exposures between two components—TVME and volatility—and demonstrated how one- and four-week options differ in exposure to each of these components.

During the COVID-19 crisis, nearly all short volatility strategies experienced difficulties from the unprecedented shock to realized volatility. Our analysis shows that one-week straddles performed worse than four-week straddles in the volatility component but much better in TVME, given the swift market recovery.

In our view, prudent implementation of short-option strategies requires diversification of tenors through tranching to reduce the concentration of risk in both the TVME and volatility components.

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Appendix

Figure 10 shows the cross-correlations between the return components of the two tenors. The variability in delta between one- and four-week straddles—at times, even going in opposite directions (positive delta for one-week and negative for four-week)—accounts for much of the diversification benefit in combining the tenors. Note that the blend maintains the superior Sharpe for TVME, but produces a Sharpe for volatility that resembles the average of the two tenors. The blend's total Sharpe matches that of the one-week in isolation; we contend that the diversification obtained from the subcomponents is the safest bet for unpredictable future regimes in both volatility (–VRP/+VRP) and path (trend/reversion) risk.

Figure 10: Cross-correlation

		4-week		
		TVME	Volatility	Total
1-week	TVME	0.44	-0.08	0.32
	Volatility	0.11	0.89	0.52
	Total	0.43	0.62	0.66

Source: Parametric, 2021.

Figure 11: Blend of one- and four-week tenors

	4-week			1-week			Blend		
	TVME	Volatility	Total	TVME	Volatility	Total	TVME	Volatility	Total
CARR	2.0%	3.7%	5.8%	2.7%	4.4%	7.4%	2.4%	4.1%	6.6%
Std. dev.	6.4%	3.8%	7.8%	6.5%	6.3%	8.2%	5.4%	4.9%	7.3%
Sharpe	0.31	0.98	0.74	0.42	0.70	0.90	0.44	0.83	0.91

Source: Parametric, 2021.