

Systematic House of Cards

With Great Backtesting Power Comes Great
Responsibility

Comparing simulated returns to out-of-sample results reliably leads to model overoptimization.

In particular, there's an inherent fragility for defensive strategies in this regard, given their lower frequency and stronger path dependence.

May 2026

With special thanks to Eric Peters, Stacy Wang, Stephen Prajna, and others (including some of our bank QIS partners) for their useful comments.

Patrick Kazley

“It’s an amazing model. It seems to protect us over every time horizon – except the future, of course”.

- Overheard on the floor at One River, after evaluating an overengineered long volatility strategy

Introduction: The Backtest Olympics

Certain factions within the systematic industry increasingly bid for AUM through the competitive construction of hypothetical, high-returning hedging strategies. This has spawned the **Backtest Olympics** – where the strongest simulated track record often receives the allocation. The models driving these simulations are consequently unintuitive and overspecified, precisely engineered to navigate historical crises that impaired allocators’ portfolios - presenting an alluring portfolio panacea. Most commonly, this results in the inclusion of **episodically short convexity strategies alongside defensive ones, which can introduce significant fragility to defensive objectives by importing the problem into the intended solution.**

Some of these simulated remedies may be illusions, however, as the out-of-sample success for these models not only relies on history rhyming, but often on it repeating exactly – which it never does. The more parameters a particular model uses, the more prevalent this risk becomes. While these backtests can be convincing mirages, one must exercise caution when comparing hindsight-informed simulations to out-of-sample results. This reliably leads to an overengineering of simulated outcomes, which necessarily degrades robustness.

Recent data on QIS AUM growth and strategy proliferation show these hypothetical programs attracting record funding. Without vigilance against overengineered models, some of this growth risks becoming a delicately positioned **house of cards**, poised to collapse from the stiff wind of out-of-sample evaluation. This risk is especially acute for defensive strategies that have a lower sample size. Like your favorite old car you recently fixed up, the **last critical failure is unlikely to be the cause of the next one**, because you just fixed that particular issue. In markets, models calibrated to “solve” recent events like COVID, 2022 Rate Hikes, or April 2025 are tuned to trajectories that are categorically less likely to manifest in the near future.

While we identify some potential shortcomings of purely backtested hedging strategies, it would be remiss not to acknowledge the many benefits of transparent, tradeable, rules-based strategies that banks offer: high-quality research teams with access to broad data sets and liquid markets, capital-efficient implementations through swaps and bank platforms, and more. Further, we see many productive applications of this QIS research engine as a complement to less-optimized strategies run by fiduciaries. Alongside the many concerning trends we observe, we also see a handful of banks adopting a hybrid fiduciary model, wherein proposed solutions combine fiduciary models with substantial out-of-sample history, with simple (but effective) defensive QIS sleeves. **This combination of bank QIS and fiduciary-run models is likely the best implementation of risk mitigation at scale, provided there are strong guardrails against overoptimization.**

The siren song of overoptimization is extremely difficult to ignore – both as an allocator and a money manager. But it must be overcome in order to have a good chance at favorable out-of-sample results. This demands high discipline from those with the tools and expertise to generate simulated track records. **Fiduciaries who have the most to lose from overfitting make for a prudent pairing with non-fiduciary organizations who can discreetly discard models with poor outcomes.**

Overfitting isn’t ubiquitous across the industry, but it is far from a fringe phenomenon. Simulated returns are only as reliable as the research that fuels them, and that’s why **with great backtesting power comes great responsibility.**

Never Happened Before – Risk Mitigation Isn’t Just an Optimization Problem

Managers of risk mitigating strategies can’t lean on the age-old excuse for disappointing performance – “**that’s never happened in markets before**”. Risk mitigation exists to monetize uncertainty, which necessarily includes events without precedent. It’s paradoxical only to fear a recurrence of past portfolio traumas, when during the events used for modeling (GFC, COVID, 2022, etc.), there was very little to look back on for guidance. “That’s never happened before” is shorthand for justifying conventional failure. The conventionality of a bad outcome preserves jobs, but it’s better not to fail at all.

These strategies offered by non-fiduciaries are favored for their low management fees, capital-efficient access, and a high level of transparency - while execution costs, conflicts of interest, and front-running risks often receive less scrutiny. These backtesting engines may effectively identify relationships between fundamental or technical factors and asset prices, but do investors routinely realize the value they have been pitched? A study examined out-of-sample Sharpe ratios for a collection of alternative QIS strategies, and found a **median deterioration of 73% versus backtested levels**.¹ For fairness, this observation is not limited to QIS, but also broader simulated returns.^{2 3 4}

Among the top 18 QIS providers, over **7,000 distinct strategies** currently exist (excluding many thousands of retired strategies)⁵. In 2020, the same study showed ~3,500 live strategies. From the same report, north of **\$800bn USD** is allocated to these various programs globally as of 2025, with a wave of commitments representing an additional 8-12% AUM growth in the pipeline as of this writing.

Roughly 8% of QIS hedge fund AUM is dedicated to long volatility. For strategies like long volatility that derive most of their value from relatively infrequent market crises, is the legacy backtesting infrastructure the right tool? With hypothetical modeling already so prone to overfitting risk, should the same tools be applied to a much smaller sample size? **How do these backtesting engines approach solving a problem with a sample size of zero?**

As long as the sample is one or more, an optimizer will sink its teeth into something - even if it shouldn’t. That’s why backtesting, while an interesting lens through which to frame risk/reward, is just a small link in the chain for a good research process in long volatility. We argue that economic intuition, sound universe selection, and market structure awareness matter far more for future results - especially for explicitly defensive strategies.

If these purely hypothetical hedging programs do disappoint out-of-sample – we can preempt their post-crisis commentary: *that type of crisis has never happened before.*

Being a Quant Is Hard: No Prize for the Best Backtest

“When Isaac Newton first unveiled the concept of gravitational forces in *Philosophiæ Naturalis Principia Mathematica*, objects on earth did not suddenly begin defiantly floating. In markets, an inefficiency that has lasted decades and is discovered today can disappear immediately upon excavation.”

- *Quote from a mentor, a quant investor*

Being a quant is hard.

¹ Antti Suhonen, Matthias Lenkh, Fabrice Perez, 2017, Quantifying Backtest Overfitting in Alternative Beta Strategies, *The Journal of Portfolio Management*, 2, 90-104

² Lo, Andrew W., and A. Craig MacKinlay, 1990, Data-Snooping Biases in Tests of Financial Asset Pricing Models, *The Review of Financial Studies* 3, 431-467.

³ Jacobs, Heiko, and Sebastian Müller, 2020, Anomalies across the globe: Once public, no longer existent? *Journal of Financial Economics* 135, 213-230.

⁴ Huang, Jing-Zhi, and Zhijian Huang, 2014, Real-Time Profitability of Published Anomalies: An Out-of-Sample Test, *The Quarterly Journal of Finance*.

⁵ Premialab QIS AUM Survey

A mentor once had our quant analyst class construct a long/short equity model that would produce the highest Sharpe ratio over a fixed 3-year period. Unsurprisingly, with similar training and skill, everyone built similar models. The results were fantastic - up and to the right, minimal drawdowns, high compounded returns. When asked to explain our models, it was easy: momentum, value, quality, sentiment, dynamic combinations, and so on. I learned that a smart person could explain any model intuitively – even a nonsensical one.

We then locked in our models and extended the sample by a few years. Sharpe ratios of 3 became negative. Most of our class observed out-of-sample results that bore little in common with their backtests. Carnage. Lesson learned. **Data mining and overfitting are excellent ways to lure attention (and capital) into fragile strategies.**

Finally, we were permitted to adjust the model using the expanded sample. Sharpe ratios snapped back to 2+, and the scar tissue of the previous models vanished. Then the sample was expanded further. More carnage – almost all of the models failed again, including mine, for the same reasons.

This lesson is taught to first year quants for a reason. Experienced quants wouldn't accidentally overfit their models, they know that overoptimized models rarely survive out-of-sample, and they would see through the exercise from the start. It's standard quant training.

Good systematic investing lies at the intersection of sound economic rationale and disciplined data application. Embrace either end of this spectrum too dogmatically, however, and you end up with a model that is either **overoptimized or not insightful**. Striking that balance is what separates skilled quants from pure data miners.

Systematic hedge funds categorically avoid overfitting, because a strong backtest that fails out of sample destroys trust and, eventually, the business. For banks, the dynamics are more nuanced. Unlike most asset managers, non-fiduciaries do not need to market live audited track records. Allocators, wary of pure backtests, often insist on some history. To navigate high out-of-sample failure rates, non-fiduciaries can **“lock in” many similar models (with no capital at risk) on a given date and, years later, market only the best performer(s).**

Much of today's QIS has landed in a place of pure rules-based investing, in which full rulebooks can be shared. Referring back to the above quote about Newton: if there is alpha embedded in those models, **the rulebook is really just a playbook for alpha generators to exploit these rules-based flows**. Well-trodden risk premia may persist through such excavation, but the same can't be said for alpha-oriented strategies.

Clearly, not all systematic strategies are ill-fated. However, one should be generally skeptical if there are no live audited returns and no real capital at risk. If there's money to be made selling hypothetical results, the **financial industry at large just can't help itself** but to supply those attractive backtests.

Optimizers are effective at identifying historical relationships – just as that room of young quants did. Time spent trading real capital out-of-sample is the best arbiter of robustness. As my former quant analyst class can attest, there's no prize (or rather, shouldn't be) for having the best backtest.

The Perfect Model Part I: The Overfitting is Not Subtle

“People calculate too much, and think too little.”

- Charlie Munger

Over the last few years, there have been a number of new entrants to the risk mitigation space. However, in place of 10-to-12-year+ live track records offered by the existing industry, some of these providers have filled out their risk mitigation solutions entirely with simulated strategies.

Using various data feeds and aggregation tools, one can examine some of the simulated risk mitigation solutions - returns, presentations, model documentation - available to the market today. Here we focus on a particular non-fiduciary provider that doesn't make use of any fiduciary models for the sake of a stylistic example (anonymized, but real figures).

Without compromising defensiveness, explicitly defensive strategies are extraordinarily difficult to make high returning (not that one should try to⁶), especially over periods of equity strength like we've recently seen. To finance these low returns, one provider added a composite of simulated carry strategies that were unanimously unscathed across historical crises, and had an **18-year Sharpe ratio of +1.6**. By contrast, live hedge fund indices (e.g., the EH Hedge Fund Index) show that a long-term composite realized a Sharpe ratio of about +0.8⁷, and came with about a +0.6-0.8 equity correlation, a +0.2-0.4 beta, significant negative return skew, and repeated struggles during major market crises, as we have [shown](#).

The second responders, or prolonged drawdown protection strategies shown by this bank produced **3-4x the long-term return of the SG trend index** over the backtest horizon and appeared to remove reversal risk entirely.

Across the ~30-60 models deployed in this solution (depending on the flavor chosen); the median inception date for defensive models was about 12 months before the presentation. About ~5-6 of these models traded real capital, the rest being entirely simulated paper portfolios.

The same provider had buried in their footnotes that simulations cut estimated Sharpe ratios in half. This implies a defensive diversifiers sleeve actually had a backtested **Sharpe of 3.2 instead of 1.6 before discounting (~4x the realized results of the hedge fund industry)**.

The Perfect Model Part II: A Good Idea For Improving Dynamic Convexity

The road to overfitting is paved with good intentions. For example, long volatility strategies involve inherent tradeoffs, including whether to *preemptively monetize* intra-crisis gains (take chips off the table early in a crisis for immediate recoveries), or consider a *reactionary monetization* that waits until a crisis begins to wane. The more aggressively one monetizes a crisis as it sets in, the more the portfolio is out of the fight, sacrificing future potential convexity. A balance between monetization techniques is likely best, but being too preemptive is risky – deep declines are the most impactful to long-term equity returns and require significant convexity to hedge.

Our Dynamic Convexity strategy has been live for 11+ years. Over that time, we have researched ways to improve our model's ability to deliver on its core mandate: help an equity-centric portfolio compound better through the delivery of extreme positive convexity, negative correlation, and positive skew. That said, it hasn't made money in every equity decline – notably in shallow selloffs and in strongly V-shaped events, as we [wrote about earlier](#).

To illustrate overfitting risks, we tested several new parameters that, given certain preconditions, would meaningfully shift our monetization approach from predominantly reactionary to more preemptive. This change naturally produces many false positives (premature monetization events), and so we added another parameter to more aggressively lean into the momentum of implied volatilities to make up for potential lost ground in reflexive

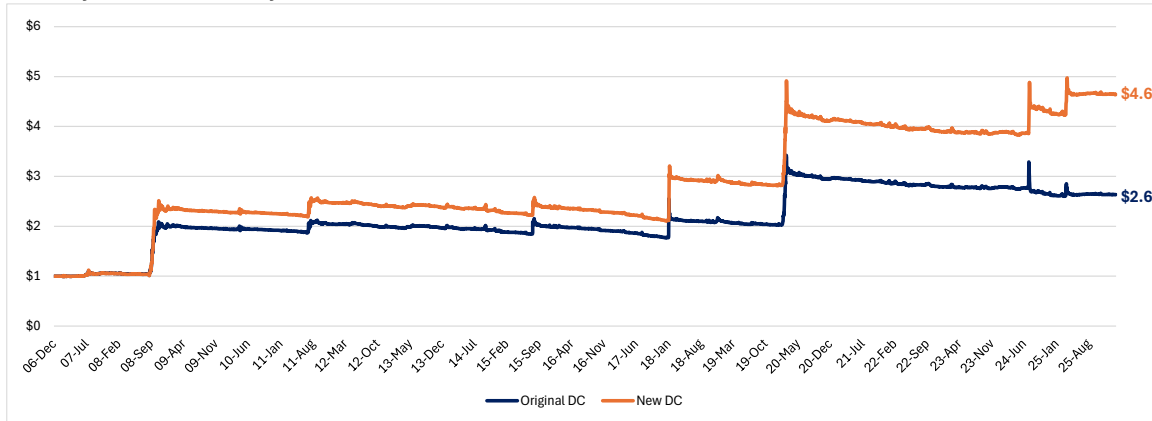
⁶ Instead of trying to improve defensive returns, it's better to realize that you're already playing offense elsewhere. Over the long-term, both procyclical, negatively skewed investments and their defensive, positively skewed counterparts can [meaningfully contribute to total portfolio outcomes](#). However, over evaluation windows that matter to investors, one side tends to dominate more meaningfully than the other. In 2026, markets are at the best (~99th percentile) 10-, 15-, and 20-year real return for developed equities versus the past century. You can guess which side of the equation has contributed more over these periods. That's OK, and expected. You may be surprised to learn, however, over this period both sides of the equation still contributed, and that a portfolio that [protected itself outperformed one that didn't](#). A well-diversified portfolio means that one shouldn't care where the return comes from, just that it comes at all and is genuinely diversified in its generation.

⁷ A figure for a non-investable index that includes sizable survivorship bias tailwinds, of course.

declines. This increased momentum, however, increased reversal risk (e.g., August 2024, April 2025), prompting us to identify technical predictors of such large reversals and preempt those too. All in, we added just 3 new parameters. The results are analyzed in Exhibits 1 and 2 below.

Exhibit 1: One River Dynamic Convexity- Original versus “New and Improved” Cumulative Growth of \$1

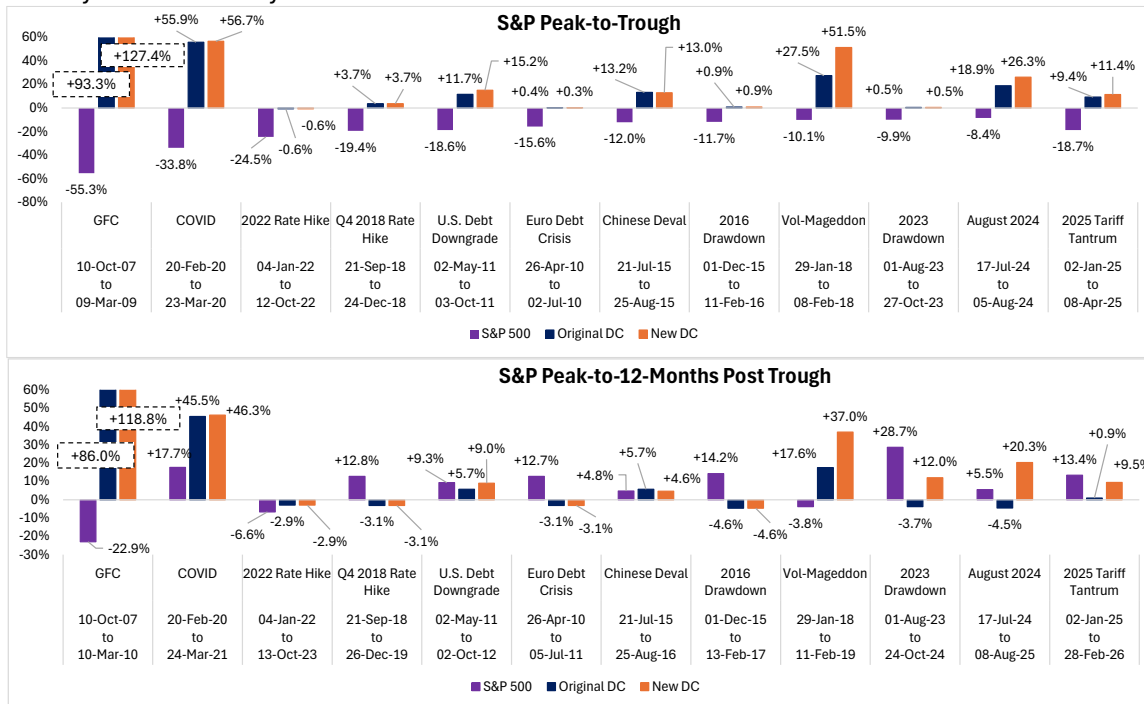
January 2007 – February 2026



[Footnote below Exhibit 2]

Exhibit 2: One River Dynamic Convexity – Original versus “New and Improved” Performance During Largest S&P 500 Drawdowns by Event

January 2007 – February 2026



One River, Bloomberg, S&P 500 uses the S&P 500 Total Return Index. The performance for Original Dynamic Convexity went live in April 2015, with returns prior to that being a hypothetical backtest. The most recent month returns are estimated, and subject to change. The return simulation uses live returns when possible, and backtested returns when necessary. New Dynamic Convexity replicates Old Dynamic Convexity returns and adds 3 new parameters (2 related to monetization, 1 related to increased risk taking). Past performance does not guarantee future results. This is a hypothetical illustration and does not constitute advice.

Exhibit 2 highlights how these models navigated the major equity drawdowns of the last 20 years. At the trough of each crisis (the peak pain point), the new model is in a favorable position. The lower chart in Exhibit 2 shows how much of this return was preserved after the market trough. Here, the model enhancements are apparent: the

selective preemptive monetization didn't impact reflexive crises like COVID and GFC, and the same new parameters successfully monetized the V-shaped shocks of August 2024 and April 2025.

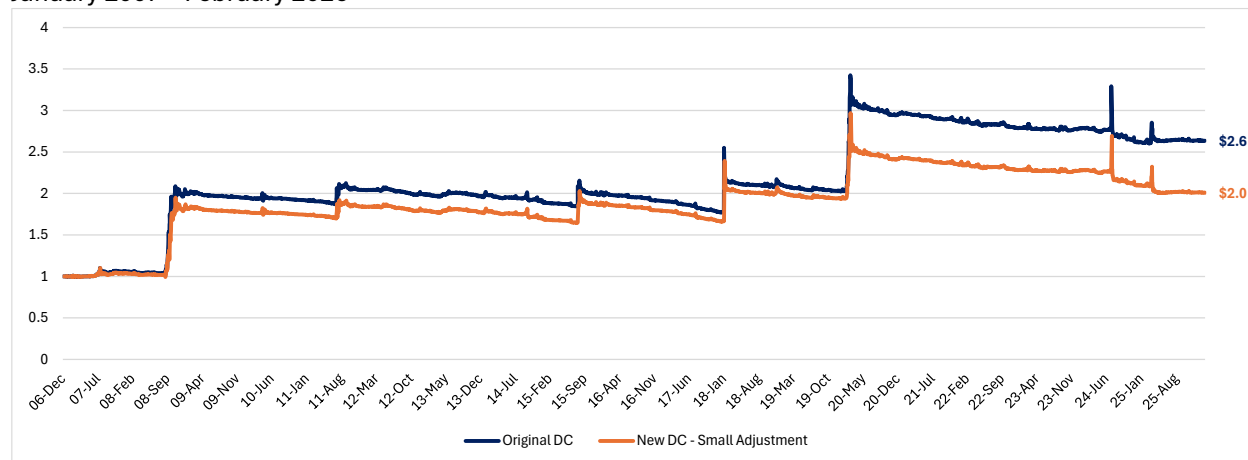
The Not So Perfect Model: Back to the Drawing Board

Next, we ran standard robustness checks. Our first test was to make economically inconsequential adjustments to the new parameters and see if it materially impacted the outcome. This quickly reveals whether a parameter introduces too much path dependence (i.e., if it lacks robustness). We've shown [some of our work](#) in this regard with respect to rebalancing convex returns. The models with the best outcomes were never the most robust, and **throwing more data at the problem doesn't change that.**

To run a similar check on the enhanced Dynamic Convexity, we shifted the lookback window of *just the newly introduced risk-taking parameters*⁸ by just **1 trading day**. These parameters trigger many hundreds of times over the long sample, so a tiny shift in horizon shouldn't have a first-order impact if the model isn't cherry-picking signals. For example, for a given parameter, instead of using the average of a rolling 3-, 4-, and 5-day window, we instead use the average of a rolling 4-, 5-, and 6-day window, and so on.

Exhibit 3: One River Dynamic Convexity- Original versus "New and Improved" with Small Adjustment Cumulative Growth of \$1

January 2007 – February 2026



Source: One River, Bloomberg. The performance for Original Dynamic Convexity went live in April 2015, with returns prior to that being a hypothetical backtest. The most recent month returns are estimated, and subject to change. The return simulation uses live returns when possible, and backtested returns when necessary. New Dynamic Convexity replicates Old Dynamic Convexity returns and adds 3 new parameters (2 related to monetization, 1 related to increased risk taking). Past performance does not guarantee future results. This is a hypothetical illustration and does not constitute advice.

The exact same alterations, when modified in an inconsequential way, reveal the fragilities of the new parameters. This secondary adjustment chops the Sortino ratio in half, reduces the long-term return profile by ~0.75x, impairs positive skew, and meaningfully increases maximum drawdown. **But you wouldn't know that unless I showed you.** It would have been very easy to leave it at Exhibits 1 and 2, and it's possible that those improved backtests could attract new capital to this strategy. But it **wouldn't be prudent to market as a real solution.**

Many quants don't even adequately appreciate these risks in their own models, which is yet another reason why **live audited track records with real capital deployed are the gold standard.**

⁸ Important note: while we shifted the parameters that drove increased risk-taking, we did not shift any monetization parameters. This is because while a host of indicators may inform risk-taking in risk mitigating strategies, when one wants to get out of the trade, they want to get out. In other words, hasty profit-taking makes sense in a trading strategy that has an expected risk of snapback or immediate recovery. Similar shocks on our robust models have a very de minimis impact.

It Doesn't Have to Be This Way: Accountability is Key

A meaningful shift in backtest evaluation practices is essential if the industry is to opt out of the Backtest Olympics.

What largely precipitated this piece was our participation in a recent tail hedge RFP where the client requested 1-to-1 protection in sharp equity declines greater than 10%, 15%+ performance in gradual 20% or greater declines, 10%+ in April 2025 (why not?), and a bleed no greater than a couple percent per annum in benign markets. We told the prospect that wasn't realistic, that the specifications were overly confident and deterministic, and provided research to support this viewpoint. They quickly replied that 3 other bank providers showcased solutions that comfortably met all of the asks. All of them with simulated track records. They asked us why we couldn't create a proposal on par with the other submissions. We told them that of course we could, but that we wouldn't. One of the submissions had a Sharpe ratio over 1. I'll put roughly 100% of my portfolio into that! We didn't get selected.

Historical optimizations do nothing more than navigate the past and extrapolate that into an uncertain future. In risk mitigation in particular, overextrapolation leads to false confidence in hypothetical results. A good outcome in a crisis is anecdotal evidence at best, and the **plural of anecdote is not data**. Extending that to a 10-, 15-, or 20+ year sample doesn't solve these issues in risk mitigation like it may for other trading strategies because of the low frequency, high magnitude, and inherent path dependency associated with defensive investing.

Overengineered models exist because **there's money to be made in justifying their construction to give the appearance of sound intuition**. This makes unrealistic backtests seem attainable, repeatable, and scalable. Even for the well-intentioned, the siren song to compete with others engaged in unsavory practices can be too strong.

These simulations are the natural byproduct of the perverse incentives born out of the Backtest Olympics. The subsequent poor outcomes go underreported as the market doesn't see the full suite of out-of-sample results, but rather a rotating list of expertly modified models. Clients on the receiving end are told that a backtest couldn't have predicted what unfolded out-of-sample (i.e., *that's never happened before*) – and in that much they are right.

Overfitted models present a false veneer of stability and resilience. That facade is difficult to dismantle because robustness is rarely obvious to outside observers. Model creation, like great watchmaking, is a craft only fully understood by practitioners – which is why track record, manager judgement, and brand reputation matter more than durability promises. **With great backtesting power comes great responsibility**.

While the non-fiduciary QIS industry is the most visible area within systematic investing where simulations are commonly compared to out-of-sample results, it's certainly not the only arena where it takes place. Accordingly, this criticism of evaluation practices is not pointed squarely at these practitioners, or any particular team. In fact, we have visible partners in the QIS space for the reason that we see tremendous value in their tools and approach. This practice left unchecked, however, can lead to an abandonment of considering real-world tradeoffs, rewarding hindsight while penalizing out-of-sample results that can't be modified.

A robust approach to risk mitigation categorically refuses to maximize simulated outcomes at the direct cost of future resilience. Specifically, selling volatility to finance defensive positions in a hedging program is the most common way we have observed hedging programs deliver negative convexity during market crises. Unsurprisingly, short convexity is also the most frequent complement for purely hypothetical hedging programs, given the ease with which simulated strategies can be programmed to get out of the way at just the right time.

We favor Charlie Munger's approach – calculate a bit less, think a bit more. Build your models on strong intuitive foundations, and not an overoptimized house of cards.

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Prior to December 2019, the Dynamic Convexity Strategy returns reflect the actual returns of the strategy within a One River managed SPC (Segregated Portfolio Company). Returns for the SPC are available upon request. Prior to December 2019, operating expenses are excluded for the net return calculation. The Dynamic Convexity SP caps expenses at 35 bps if AUM is above USD 250 million.

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