MAREX

Improved CTA Outcomes for Institutional Investors

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In conjunction with

RQSI

Overview

In a previous report[1], Marex Capital Introductions and Advisory collaborated with Linus Nilsson of NilssonHedge to evaluate active alternative investment strategies including CTAs, Risk Premia, and Hedge Funds. In that analysis, we discussed the variability of profile of Risk Premia, particularly when compared to CTAs. We also observed the CTA sector's consistency of correlation to equities (low), and its positive skew. This analysis also showed that both Risk Premia and the Equity markets demonstrate negative skew. We then proposed that should unprecedented government stimulus abate, and should that result in a more challenging equity market and increased volatility, CTAs may again demonstrate their considerable utility in an institutional investment portfolio.

If today's investment backdrop does include a systemic underappreciation for the amount of equity exposure in current portfolios, as we believe, then an improved roadmap to rational inclusion of positively skewed, globally diversified long volatility strategies like CTAs is important to consider.

In this current report, we address institutional investors with varying experiences with CTAs. For current investors in crisis alpha offset and similar equity beta diversifying/hedging strategies, it may be opportune to revisit and even expand this exposure. Next, we encourage CIOs who have not yet embraced CTAs and the managed futures strategies associated with them to due diligence the sector incorporating the methods presented here in. And, for those investors who may have previously exited a CTA program due to unmet expectations or similar rationales, we encourage another look. To each, we think it helpful to consider an updated evaluation on how best to incorporate CTAs into an institutional portfolio.

Our current analysis specifically considers whether it is best to optimize a portfolio of CTAs on a standalone basis (the "Incumbent" approach) or to structure a CTA investment considering diversification and risk-adjusted impact inclusive of an institution's existing portfolio (the "Challenger" approach).[2] This more inclusive Challenger approach requires more sophisticated analytics, broader investment acumen, and even some rational assumption. We've deployed each of these elements and the results offer some surprising and statistically relevant observations.

In addition, allocating to CTAs in-line with our findings may resolve a long-standing misalignment of expectations between, on the one hand, proponent CIOs and CTA managers, and on the other hand the stakeholders who perhaps with the best intentions prefer to avoid such allocations and in so doing risk creating an under-diversified and sub-optimal portfolio for their constituents. Here, we postulate that perceived performance degradation is of critical concern for portfolio construction and modeling. Perceived performance degradation can be a key observation used by detractors of an investment strategy. With a more holistic rationale and method for incorporating CTAs, and with the potential for reduced performance degradation our analysis demonstrates, the methodology herein posits that a more committed CTA investment allocation may ensue.

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[1] A Contemporary Evaluation of Key Alternative Investments: CTAs, Risk Premia and Hedge Funds (link)

[2] The structure of our analysis extends from 'Superstars and teamwork' (Nov. 8, 2007) by Burghardt, Duncan and Liu, and 'A new look at building teamwork portfolios' (Oct. 15, 2009) by Burghardt and Liu.

Our Findings: Improved Outcomes Investing in CTAs

Prioritizing the "complementarity" of a CTA portfolio to an institution's existing portfolio instead of optimizing a portfolio of CTAs based on Sharpe ratio will produce better results for the institution.

- » In the trials we ran, our "Challenger" approach improved an institution's Sharpe ratio by 37% vs 32% for the "Incumbent" approach.

- **Prioritizing complementarity to an existing portfolio can result in reduced performance degradation.**
  - » Specifically, out-of-sample performance degradation (relative to in-sample) of the Incumbent approach was 13% larger than the out-of-sample degradation of our Challenger approach.

Important Observations from our Analysis

- **In general, historical correlations predict future correlations more accurately than historical returns predict future returns.**
- **In general, historical correlations to broad asset classes, for example those cross correlations taken into account when considering an institution's comprehensive investment plan, are more reliable than historical correlations of individual managers, in the context of diversified portfolio construction.**

Definitions and Procedures

Incumbent Approach

Selecting a portfolio of CTAs using a portfolio Sharpe Ratio optimization.

Challenger Approach

Selecting a portfolio of CTAs by ranking managers on their individual Sharpe Ratios and correlation to the institution being considered and selecting the top *k* managers.

Methodology

With the goal of evaluating whether a CTA portfolio should be constructed using the Challenger or Incumbent approach, we ran the following test:

Data Source

Monthly returns for 3,629 CTAs; January 2007 – February 2021 (Source: BarclayHedge). We ran sequential tests using eight-year slices of data (first five years in sample to select managers, last three years out of sample to test managers), and slice every three months:

Slice 1 = January 2007 – December 2014

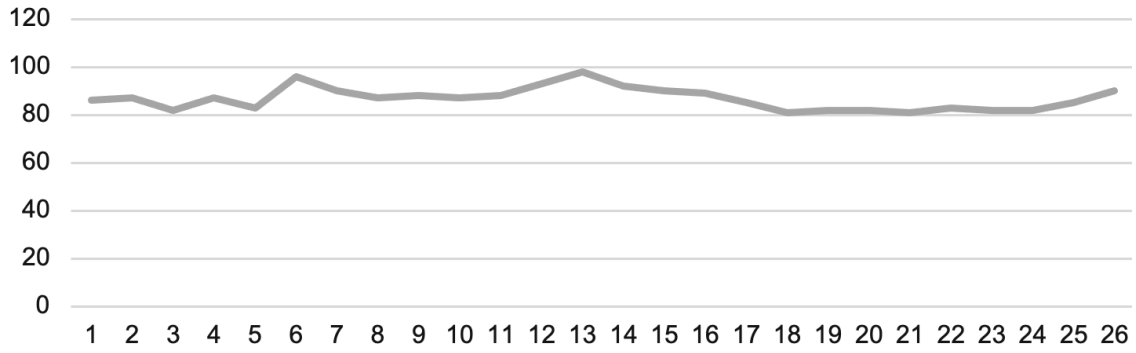
Slice 2 = March 2007 – February 2015

⋮

Slice 26 = March 2013 – February 2021

All managers with complete data for the period were eligible for inclusion. In addition, we implemented an AUM threshold of $100 million; managers that did not have at least $100 million for the entire test period were excluded. After these two filters, each slice had between 81 and 98 managers with complete data and sufficient AUM. Exhibit 1 shows the number of managers considered for each data slice.

Exhibit 1. Size of Selection Universe for each Data Slide



Monthly returns for a sample of 62 institutional investors from January 2007 – February 2021, obtained by applying the asset allocation schemes given in each institution's annual report to RQSI's proprietary SOCIO[3] tool. The institutions included here are all U.S.-based and represent: 28 city, state, and county pension plans, 19 university endowments, 10 family offices, and 5 private foundations. SOCIO uses a combination of publicly available and custom indices we estimated to represent the major asset classes and sub-asset classes that compose most institutional portfolios. We break down allocations between Liquid (Equity, Bond, Liquid Alts, and Cash) and Illiquid (Private Equity, Private Credit, and Real Assets).

To test which CTA selection approach is most appropriate, we performed the following analysis on each of the 62 anonymized institutional portfolios (i), for each of the 26 data slices (j), including between 3 and 12 managers (k) [16,120 total tests]:

[3] For more information on SOCIO, please read RQSI Alpha Integration and SOCIO (link)

1. Select Incumbent portfolio (equally weighted across k managers) by running a binary-constrained optimization[4] maximizing the CTA portfolio Sharpe ratio for the in-sample period (j).
2. Select Challenger portfolio (equally weighted across k managers) by ranking each manager on two criteria: manager Sharpe ratio and correlation to the institutional portfolio (i) in the in-sample period. We take the z-score for each metric and sum them together to get a total score. The k managers with the highest total score are selected.
3. Finally, we add the out-of-sample returns for each resultant portfolio to institution (i) out-of-sample returns, taking 25% of the resultant portfolio's returns and 75% of the institution's returns when combining.

Statistical Outcome

Throughout the exhibits, portfolios that combine the institutional portfolio and the CTA portfolio being considered are referred to as "Challenger +", and "Incumbent +", accordingly.

X1 = Out-of-Sample Sharpe Ratio of Challenger + Institution [1.46]

X2 = Out-of-Sample Sharpe Ratio of Incumbent + Institution [1.40]

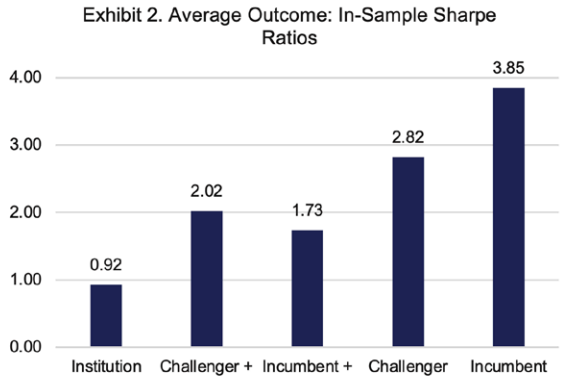
H_0: X1 = X2

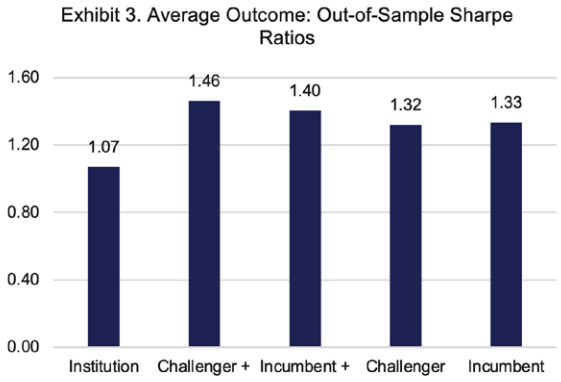
H_A: X1 <> X2, X1 > X2, X1 < X2

T-Stat = 7.51

H_0 rejected

On average, Challenger increased the institution's Sharpe ratio in the out-of-sample period by 37%. Incumbent increased the institution's Sharpe ratio by 32%. The results were statistically significant and clear: Challenger outperforms Incumbent. Exhibits 2 (in sample) and 3 (out of sample) below show the results of the average Sharpe ratios for each group in the in- and out-of-sample periods.





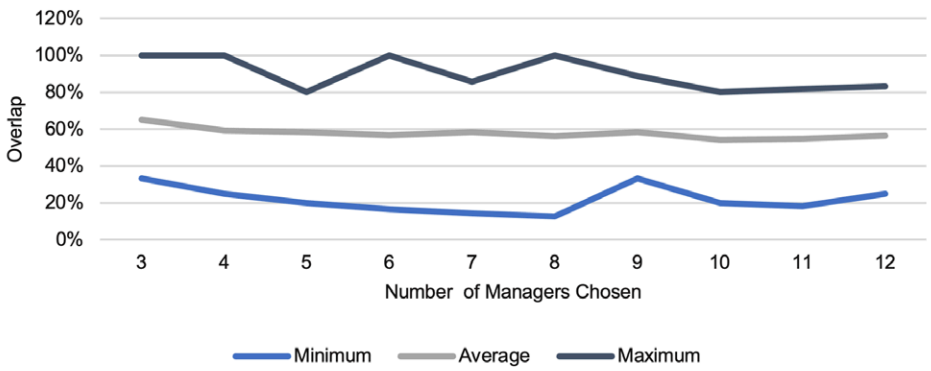
[4] In portfolio terms, optimization is most commonly associated with determining the optimal weight to assign to assets within a portfolio via mean variance optimization. Because our test equally allocates across the managers chosen, we use a binary-constrained optimization where the output is not the optimal weight to assign to managers in the Incumbent portfolio, but rather a simple binary TRUE / FALSE indicating whether including each manager leads to an improved Sharpe ratio for the equal-weighted resultant portfolio.

Evaluating the Managers Chosen

Overlap

Across all 16,120 trials, Challenger and Incumbent portfolios shared 58% of their managers on average. Exhibit 4 shows overlap broken down by number of managers included; the level of overlap remained steady regardless of how many managers were selected. The graph also shows the minimum and maximum levels of overlap. It's interesting to note that there was not a single trial where Challenger and Incumbent portfolios didn't share at least one manager. This indicates that the best one or two managers stand out from the crowd.

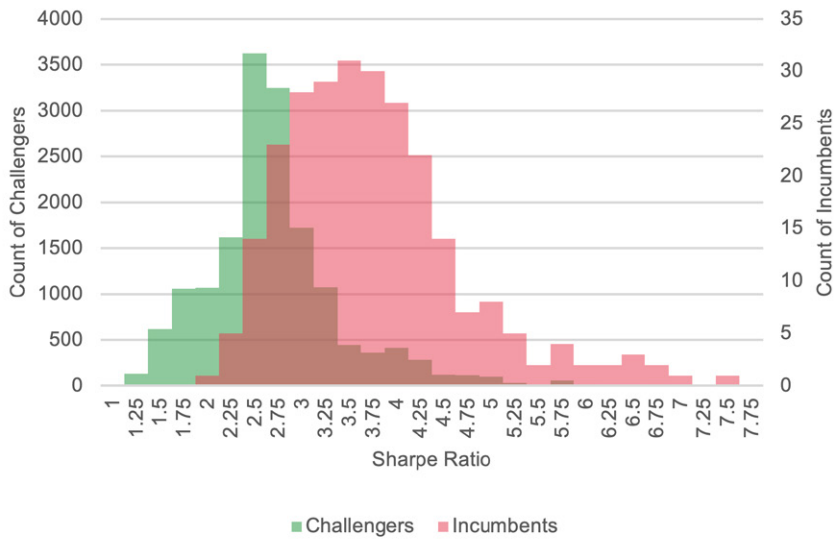
Exhibit 4. Overlap of Managers Chosen by Challengers and Incumbents



Standalone Performance

Despite this overlap, the risk-adjusted returns of Incumbent portfolios for the in-sample period were significantly higher than Challenger portfolios. Exhibit 5 shows the distributions of in-sample Sharpe ratios for Challenger (left axis) and Incumbent (right axis). Note: Challenger selections vary across all three dimensions of analysis (Time Period, Number of Managers Chosen and Institutions), whereas Incumbent selections only vary across Time Period and Number of Managers Chosen. For this reason, the number of distinct Challenger portfolios is 16,120 while there are 260 Incumbent portfolios.

Exhibit 5. Histogram of In-Sample Sharpe Ratios



In Sample vs. Out of Sample

By definition, Incumbent portfolios produce higher in-sample Sharpe ratios than Challenger portfolios; that's how we chose them. But does this outperformance lead to out-of-sample superiority? Out of sample, Challenger portfolios produced a 1.32 Sharpe on average, vs. 1.34 for Incumbent portfolios. The boomerang-like shapes of Exhibits 6 and 7 shown below indicate that the highest Sharpe ratio in-sample portfolio (both Challenger and Incumbent) are unlikely to follow through, which is noteworthy. High in-sample Sharpe ratios that do not follow through in out-of-sample environments may be, in part, the outcome of poor model/portfolio construction, curve-fitting, and other less than robust portfolio management practices.

Exhibit 6. Challenger In-Sample vs. Out-of-Sample Sharpe Ratio Scatter Plot

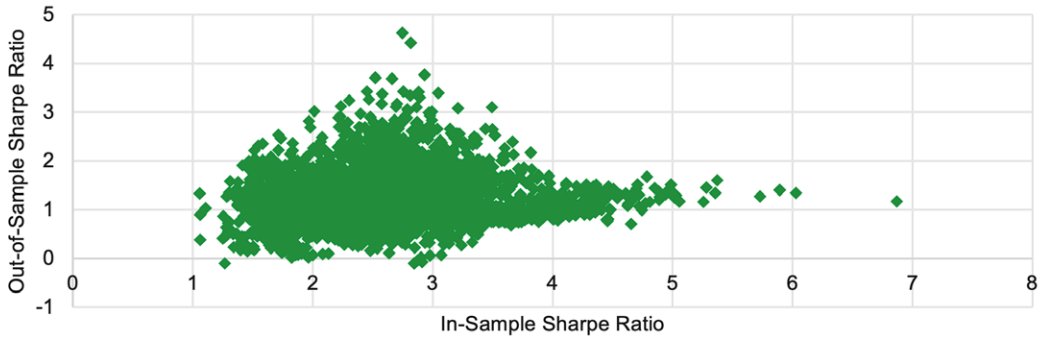
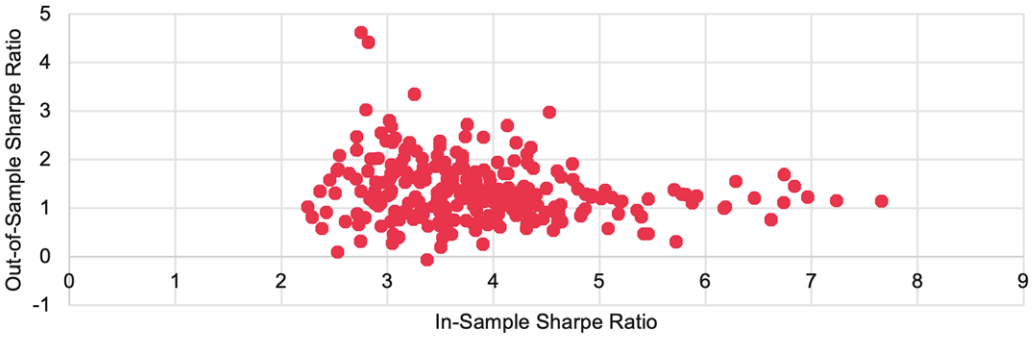


Exhibit 7. Incumbent In-Sample vs. Out-of-Sample Sharpe Ratio Scatter Plot



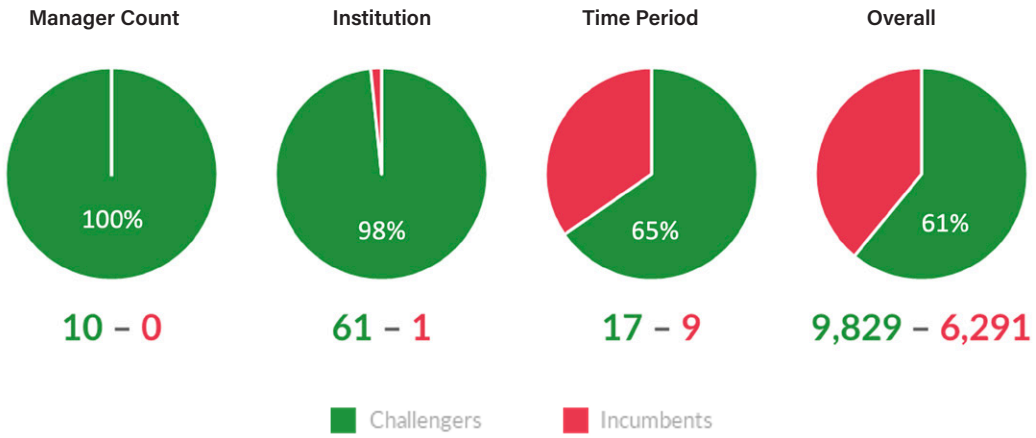
Results

Our ultimate criterion for evaluating the "winner" in this analysis is not the standalone performance of the CTA portfolio. Rather, it is the performance of the institution when Challenger or Incumbent portfolios are added to the portfolio overall.

- **In the aggregate, when included with existing institutional portfolios, Challenger portfolios outperformed portfolios produced using the Incumbent method.**

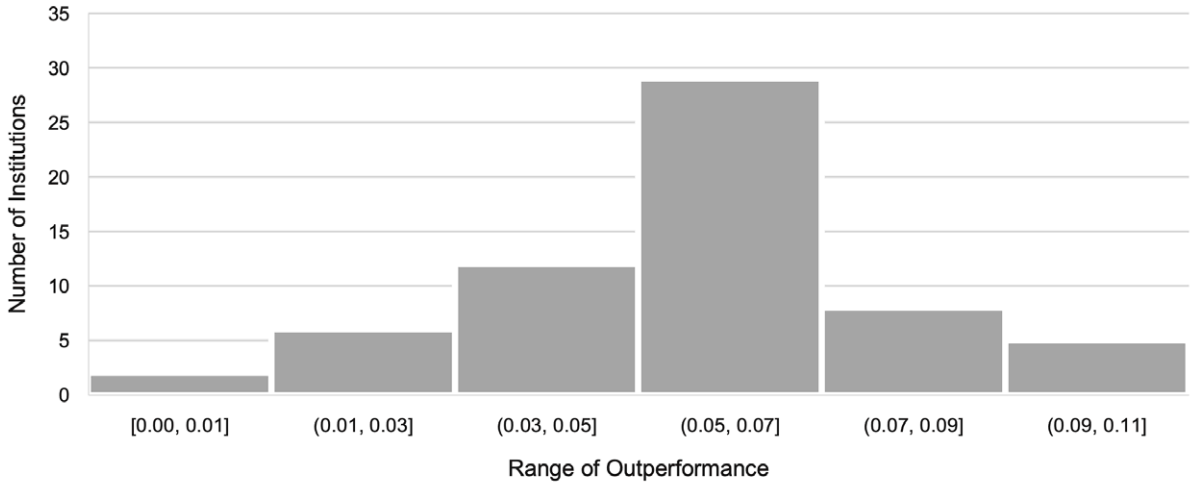
- In more granular terms, **the outperformance can be seen across all the dimensions over which our tests varied;** Exhibit 8 shows this outperformance across manager count (i.e. 3-12), institution, time period and all tests.
- **Challenger portfolios had more beneficial net portfolio effects than Incumbent portfolios most of the time.**

Exhibit 8. Scoreboard of Challenger vs. Incumbent Combined Performance across Dimensions



To get a sense of the magnitude of outperformance of Challenger relative to Incumbent, see Exhibit 9, which shows the histogram of the outperformance of Challenger relative to Incumbent. Specifically, the distribution being plotted is the average Sharpe ratio of combined portfolios using Challenger portfolios minus the average Sharpe ratio of combined portfolios using Incumbent portfolios.

Exhibit 9. Histogram of Challengers Outperformance over Incumbents in Combined Portfolios



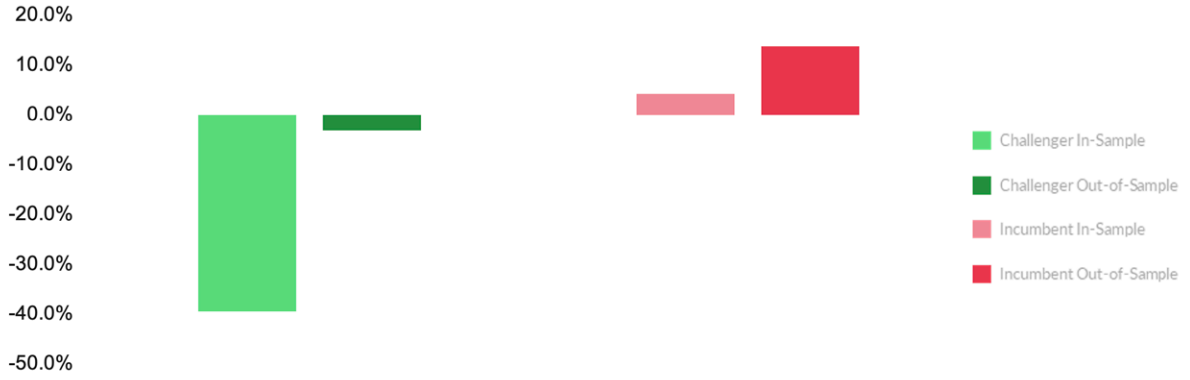
With several dimensions of variation, Challenger portfolios dominated across a large number of tests.

The overlap we referenced between Challenger and Incumbent selections tends to occur more as a result of performance rather than correlation. In other words, if the Challenger and Incumbent portfolios both select a manager for a trial, they do so because the manager had extremely high returns, not because the manager

had very uncorrelated returns. The managers that were selected by the Challenger approach but were ignored by the Incumbent approach tend to have lower Sharpe ratios and lower correlations. As a result, Challenger portfolios may have a lower Sharpe ratio on their own, but their low correlation appears more impactful to the institution.

While Challenger portfolios were not able to uphold their -39% in-sample correlation to institutions' portfolios in the out of sample period, they remained less correlated than the Incumbent portfolios. Exhibit 10 shows the average in and out of sample correlations of Challenger and Incumbent to the institutions tested.

Exhibit 10. Challenger and Incumbent Average Correlation to Institutions



Should We Just Use Correlation?

Given how important correlation estimates are to the combined portfolio performance in the Challenger approach, we attempted to test if correlation on its own is a better way to build Challenger portfolios. We ran two subsequent trials where we shifted the Challenger definition.

First, we used only the z score of each managers' correlation to the institution; the (k) managers with the lowest correlation to the institution were added to the Challenger portfolio. With this criterion, Challengers on average underperform Incumbents (1.38 vs. 1.40 Sharpe); correlation alone is not enough.

In the next trial, we implemented a Sharpe ratio threshold. The (k) managers with the lowest correlation to the institution that also had at least a 0.5 Sharpe ratio in sample were added to the Challenger portfolio. This adjustment made little difference; in fact, Challenger performance became slightly worse. Without the threshold, out of sample combined Sharpe was 1.38; with the threshold, it was 1.37. Exhibits 11 and 12 show the average Sharpe ratio of each portfolio type for the trials where Challenger portfolios used correlation and threshold on Sharpe ratio to select their managers.

Exhibit 11. Sharpe Threshold Trial: In-Sample Sharpe Ratios

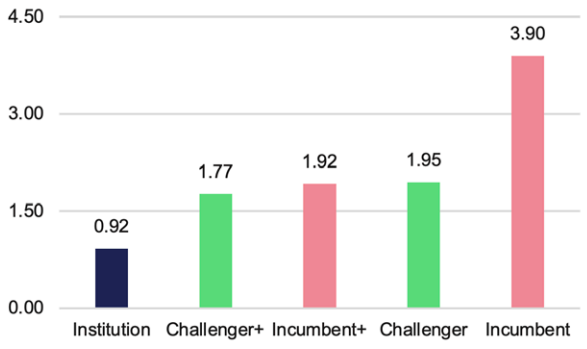
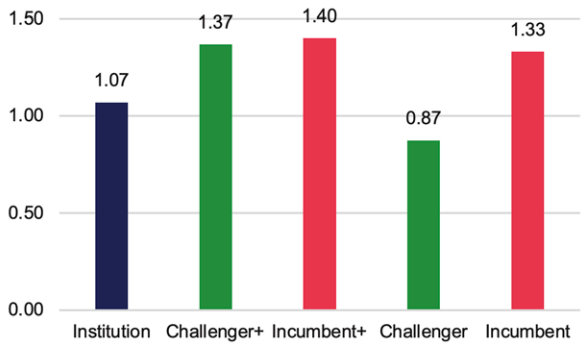


Exhibit 12. Sharpe Threshold Trial: Out-of-Sample Sharpe Ratios



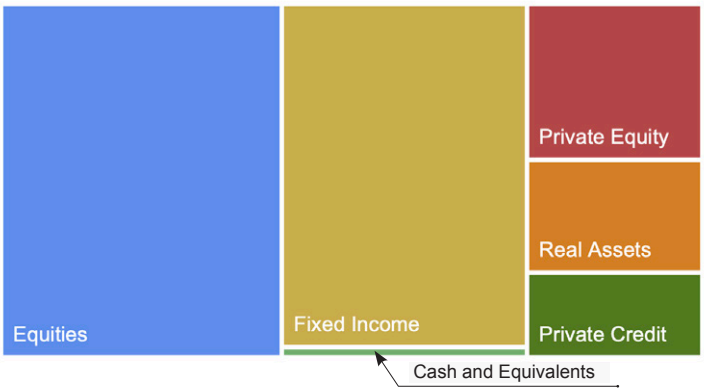
The results of this secondary trial indicate that, while Challengers are able to beat Incumbents mostly because of their low correlation to institutions, they cannot afford to miss out on managers with the strongest out of sample risk adjusted returns.

Case Study

To illustrate both how our research was conducted and how institutional portfolios are impacted by their CTA decisions, here we will investigate the details of the median outcome. The median outcome is determined by taking the trial with the 50th percentile improvement in Sharpe ratio from adding the Challenger portfolio, measured in percentage terms.

The median outcome occurred for Institution 1092 at Period 14 (April 2010-March 2018) with six managers selected. This institution is a large U.S. state pension with approximately $34 billion in assets. Their estimated asset allocation scheme[5] is shown in Exhibit 13; this institution happened not to have any liquid alternatives in their existing portfolio.

Exhibit 13. Case Study: Institutional Portfolio



In this eight-year time slice, there were 92 available managers that satisfied our criteria. The Challenger and Incumbent portfolios used their respective logic to identify six of these 92 as a combined CTA portfolio to add to the institution in question. Exhibit 14 below shows the statistics for a subset of the 92 managers available to

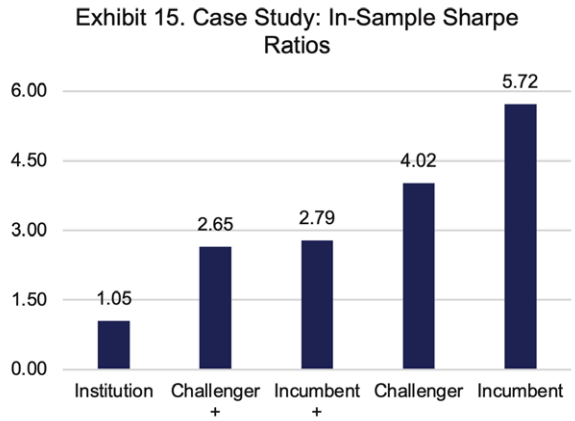
[5] For more information on SOCIO, please read RQSI Alpha Integration and SOCIO (link)

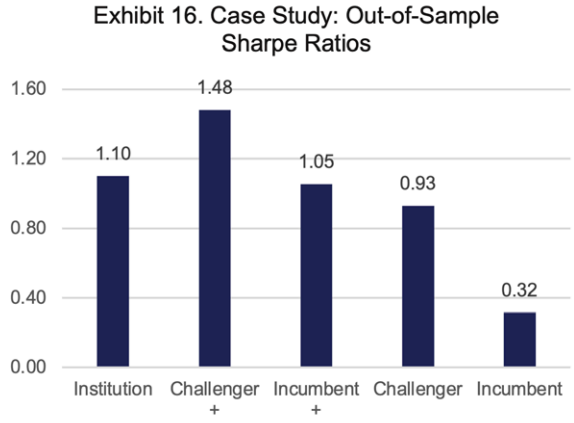
be picked. There was some overlap between Challenger (green) and Incumbent (red) here, with three of the six components being shared (grey). The other three show reasonable dispersion. In fact, the Incumbent portfolio selected a manager that the Challenger logic identified as the 10th **LEAST** attractive of the group.

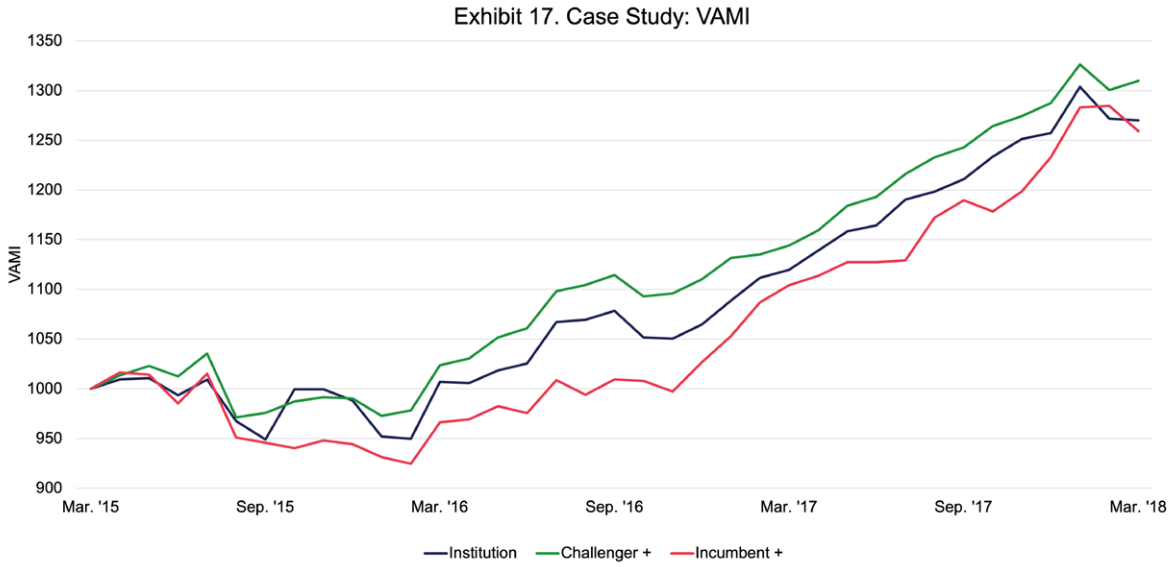
Exhibit 14. Case Study: Manager List

Rank	Manager	Inception	AUM @ 3/2018	Sharpe*	Rho*
1	Manager A	11/1/2009	$200MM	5.80	-14%
2	Manager B	1/1/2006	$131MM	1.90	-38%
3	Manager C	6/1/2003	$131MM	1.53	-28%
4	Manager D	12/1/2005	$205MM	0.94	-32%
5	Manager E	1/1/2010	$130MM	1.67	4%
6	Manager F	9/1/2007	$140MM	0.84	-34%
7	Manager G	12/1/2009	$148MM	1.09	-20%
8	Manager H	1/1/2004	$711MM	0.13	-59%
9	Manager I	10/1/2005	$3.4B	1.45	5%
10	Manager J	10/1/1993	$324MM	1.09	-11%
...					
19	Manager K	12/1/1991	$84.8B	1.62	21%
...					
83	Manager L	7/1/2001	$2.0B	0.46	47%

As we'd expect, the Incumbent in-sample standalone Sharpe was higher than the Challenger: 5.7 vs. 4.0. In fact, the Incumbent even outperformed the Challenger in terms of improving the institution's Sharpe ratio: 2.8 vs. 2.6, in sample. Exhibit 15 shows the in-sample Sharpe ratios of all five portfolios. However, the out-of-sample results were a different story. Incumbent performance deteriorated significantly both on a standalone basis, and as part of the combined institutional portfolio. In fact, the addition of the Incumbent portfolio decreased the institution's Sharpe. Exhibit 16 shows out-of-sample Sharpe ratios for the five portfolios. Exhibit 17 provides the VAMI during the out-of-sample period for the median institution portfolio without the Challenger or Incumbent portfolios (blue), the institution with the Challenger portfolio added (green), and the institution with the Incumbent portfolio added (red).







What Caused In-sample and Out-of-sample Performance to Differ so Substantially?

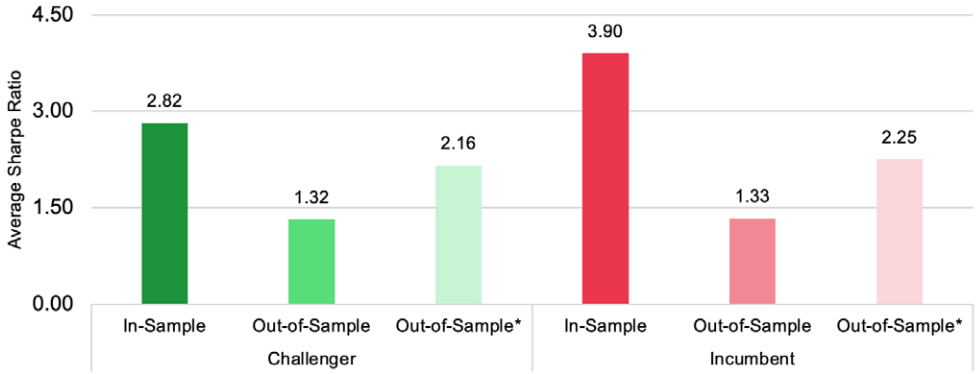
As referenced in the Overview and the previous section, one interesting revelation from our analysis is the difference between in and out-of-sample performance of the CTA portfolios themselves (rather than their performance relative to the institutional portfolios.) Specifically, the erosion of Incumbent outperformance compared to erosion of Challenger, side-by-side. The in-sample Sharpe Ratio of Incumbent portfolios was on average 3.90 vs. 2.82 for Challenger portfolios. Neither was able to maintain these impressive numbers but the outperformance of Incumbent portfolios almost entirely disappeared out-of-sample. Incumbent portfolios had an average out-of-sample Sharpe ratio of 1.34 while Challenger were barely behind at 1.32. Exhibit 18 shows how in sample and out-of-sample performance varied across the number of managers selected in the portfolios.

Exhibit 18. Standalone Performance for Challengers and Incumbents

Part of this degradation occurred due to risk equalization. The volatility equalization that we perform ensures equal risk contribution from each manager in the portfolio for the in-sample period. This is necessary to ensure that we are doing an apples-to-apples comparison between Challenger and Incumbent. It may also be more similar to how an investor would assemble a CTA portfolio in practice. One consequence of this method is that the risk contribution of managers in the out-of-sample period cannot be equal. With more uneven contribution across managers that are in most cases highly uncorrelated, a portfolio loses some of the balance it had during the in-sample period.

To illustrate this fact, we performed a second test in which managers' returns were scaled up or down by a factor that would produce equal volatility out of sample. As Exhibit 19 shows, the question of where volatility equalization will occur was a major contributor to the degradation of Challenger and Incumbent Sharpe ratios.

Exhibit 19. Performance Changes due to Risk Equalization Method



*The test using out-of-sample risk equalization

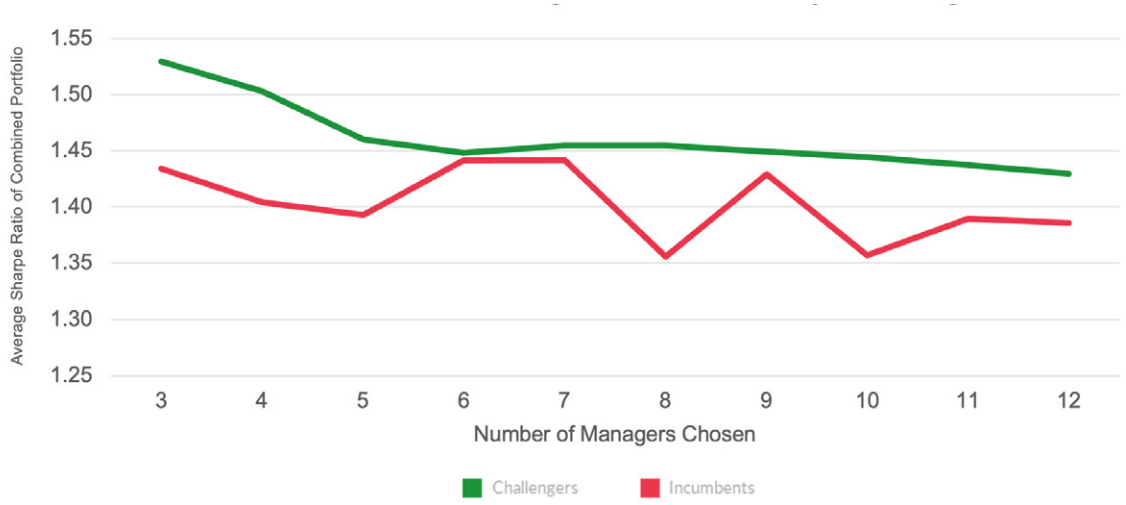
It is important to note that investors can more frequently adjust weightings to manager risk if they use managed accounts[6]. Ultimately, whether we re-weight the manager returns equally in the out-of-sample period or not, Challenger portfolios outperform Incumbent portfolios when added to the institutional portfolio. Using out-of-sample risk equalization, Challengers improved the institutions' portfolios by 65%; Incumbents made a 55% improvement.

[6] Please contact Marex Capital Introductions and Advisory for details on the efficiencies of managed account investing in managed futures strategies

Is there an Optimal Number of Managers to Include?

The results indicate that regardless of how many managers a portfolio comprises, the Challenger portfolio will likely beat the Incumbent portfolio. The outperformance of Challengers does dissipate as more and more managers are included. However, the differences in performance are insignificant across the number of managers chosen. Exhibit 20 shows the Sharpe ratio of the combined portfolios in the out-of-sample period. Based solely on this data, choosing three managers is optimal.

Exhibit 20. Performance for Challengers and Incumbents by number of Managers



Outside the scope of our analysis but important when deciding the correct number of managers to include in a portfolio of CTAs are the due diligence and administrative demands of allocating to more managers. The number of managers chosen must also satisfy the institution's threshold to diversify counterparty risk.

Are Results Dependent on the Size of In- And Out-of-Sample Periods?

To stress test our analysis and ensure the results were robust across time frames, we duplicated the model with different sample sizes. We replaced the 5 year in-sample, 3 year out-of-sample size with 3 year in-sample, 1 year out-of-sample. Challenger outperformance persisted in this secondary test and increased in magnitude. In this test, Challenger portfolios increased the Sharpe ratio of the base institutions' performance by 72% while Incumbent portfolios produced a 55% improvement.

Conclusion

If in fact most institutional portfolios are dominated by equity beta either directly or implied, they are likely more exposed to the natural risks of economic cycles, to known unknowns, and to unknown unknowns than understood or indicated in common investment risk metrics. Nominally distinct asset classes including public stocks, private equity, high yield fixed income and real assets all may have a communion of equity beta that has likely provided outsized returns in the past several years, and that in the future may create considerable concentration and downside concerns.

If an allocator wants to address these concerns by allocating to liquid alternatives like CTAs, they should construct such investments in a manner that best addresses their existing portfolio and overall investment strategy. Simply allocating to an optimized portfolio of CTAs based on that portfolio's stand-alone Sharpe ratio will improve portfolio results less than an allocation strategy to CTAs that considers correlation to the existing investment portfolio. This research suggests quite strongly that a tailored, "Challenger" CTA portfolio is more effective for providing diversification to institutional investors.

This analysis also demonstrates that the out-of-sample robustness described in the Challenger approach is likely superior to selecting individual managers based on portfolio optimization of Sharpe ratios alone.

These findings do not necessarily have a simple univariate explanation. The criteria for Challenger inclusion explicitly recognize risk-adjusted returns and correlation to the institution's portfolio. The criteria for Incumbent inclusion does not. We hypothesize that essentially, the difference between Challenger and Incumbent selection is swapping correlation to other managers for correlation to an institution.

Further, institutional portfolios contain a broad range of assets and operate in a predominantly buy-and-hold manner. Actively managed alternative investment strategies (and in particular globally diversified CTAs that take long and short positions through proprietary algorithms and strategies) have much higher exposure variability than the more static institutional portfolios. At least in part for this reason, we suggest correlation estimates to other CTAs are a less useful parameter on a stand-alone basis than correlation estimates to an institution's overall portfolio.

Aligning all stakeholders at the outset of an institution's allocation to CTAs (or other diversifying asset) is critical to that investment's success. Evaluating which CTAs to include incorporating the Challenger methodology described here may result in improved results compared to other methods. In particular, we observe improved Sharpe ratios and more consistent progression from in sample to out of sample results. The decreased performance degradation of the Challenger approach may result in a sustained allocation to CTAs, better enabling the investor to appreciate both the absolute return and diversification attributes of CTAs over time and across the full range of economic cycles.

* The authors would like to thank Linus Nilsson of NilssonHedge for his helpful comments during drafting of this report.

Appendix A

About Marex

Marex Group is a financial services platform, providing essential liquidity, market access and infrastructure services to clients in the commodities, energy and financial markets.

The Group provides comprehensive breadth and depth of coverage across four core services: Market Making, Commercial Hedging (both on exchange execution and clearing, and OTC derivatives), Price Discovery and Data & Advisory. It has a leading franchise in many major metals, energy and agricultural products, executing around 38 million trades and clearing over 193 million contracts in 2021. The Group provides access to the world's major commodity markets, covering a broad range of clients that include some of the largest commodity producers, consumers and traders, banks, hedge funds and asset managers.

Marex was established in 2005 but through its subsidiaries can trace its roots in the commodity markets back almost 100 years. Headquartered in London with 21 offices worldwide, the Group has over 1,100 employees across Europe, Asia and the Americas.

About RQSI

Ramsey Quantitative Systems, Inc. (RQSI) is a quantitative investment management firm headquartered in Louisville, Kentucky. Founded in 1986, RQSI has been a pioneer in systematic trading for over 34 years. RQSI's current flagship product, the GAA Systematic Global Macro Fund, was launched in 2012 and reflects the firm's expertise in macroeconomic data processing, multidimensional risk diversification, trade execution algorithms, and global market dynamics.

Appendix B - Biographies

Neil Ramsey

Founder and CEO, RQSI

Neil Ramsey founded RQSI, previously Ramsey Financial, Inc. in 1986 and has been involved in the development and execution of all the firm's systematic trading models since then. Neil leads all investment activities at RQSI, including the development of trading strategies, portfolio/risk management, and overall strategic direction. Prior to forming RQSI, Neil was a consultant at the Boston Consulting Group where he worked with domestic and foreign multinational corporations in strategy development. He holds an M.B.A. and a B.E., summa cum laude, in Engineering from Vanderbilt University.

John Ramsey

Portfolio Manager, RQSI

John Ramsey serves as a Portfolio Manager at RQSI, where he is responsible for the development of bespoke systematic global macro products and leads the firm's analysis of institutional portfolio management. In addition, he researches and develops mathematical models for use in systematic trading. Prior to joining RQSI, John worked as an Analytics Consultant for Deloitte, LLP. He received a B.S. in Business Administration with a minor in Mathematical Decision Sciences from the University of North Carolina at Chapel Hill.

Dan Rizzuto, CFA

Head of Capital Introductions and Advisory, Marex

Dan Rizzuto is the Head of Capital Introductions and Advisory at Marex. Dan has been a committed advocate of the alternative asset management industry for over twenty-five years. He has held senior management, business development, analytic, and operational roles in both the asset management and banking industries throughout his career at companies including Société Générale, Graham Capital Management, DKR Capital, and Bear, Stearns. Dan is a CFA Charterholder.

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