



When Simplicity Met Fragility

October 29, 2018

SUMMARY

- Research suggests that simple heuristics are often far more robust than more complicated, theoretically optimal solutions.
- Taken too far, we believe simplicity can actually introduce significant fragility into an investment process.
- Using trend equity as an example, we demonstrate how using only a single signal to drive portfolio allocations can make a portfolio highly sensitive to the impact of randomness, clouding our ability to determine the difference between skill and luck.
- We demonstrate that a slightly more complicated process that combines signals significantly reduces the portfolio's sensitivity to randomness.
- We believe that the optimal level of simplicity is found at the balance of diversification benefit and introduced estimation risk. When a more complicated process can introduce meaningful diversification gain into a strategy or portfolio with little estimation risk, it should be considered.

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1. Introduction

In the world of finance, simple can be surprisingly robust. DeMiguel, Garlappi, and Uppal (2005)¹, for example, demonstrate that a naïve, equal-weight portfolio frequently delivers higher Sharpe ratios, higher certainty-equivalent returns, and lower turnover out-of-sample than competitive “optimal” allocation policies. In one of our favorite papers, Haldane (2012)² demonstrates that simplified heuristics often outperform more complicated algorithms in a variety of fields.

Yet taken to an extreme, we believe that simplicity can have the opposite effect, introducing extreme fragility into an investment strategy.

As an absurd example, consider a highly simplified portfolio that is 100% allocated to U.S. equities. Introducing bonds into the portfolio may not seem like a large mental leap but consider that this small change introduces an axis of decision making that brings with it a number of considerations. The proportion we allocate between stocks and bonds requires, at the very least, estimates of an investor’s objectives, risk tolerances, market outlook, and confidence levels in these considerations.³

Despite this added complexity, few investors would consider an all-equity portfolio to be more “robust” by almost any reasonable definition of robustness.

Yet this is precisely the type of behavior we see all too often in tactical portfolios – and particularly in trend equity strategies – where investors follow a single signal to make dramatic allocation decisions.

2. So Close and Yet So Far

To demonstrate the potential fragility of simplicity, we will examine several trend-following signals applied to broad U.S. equities:

- Price minus the 10-month moving average
- 12-1 month total return
- 13-minus-34-week exponential moving average cross-over

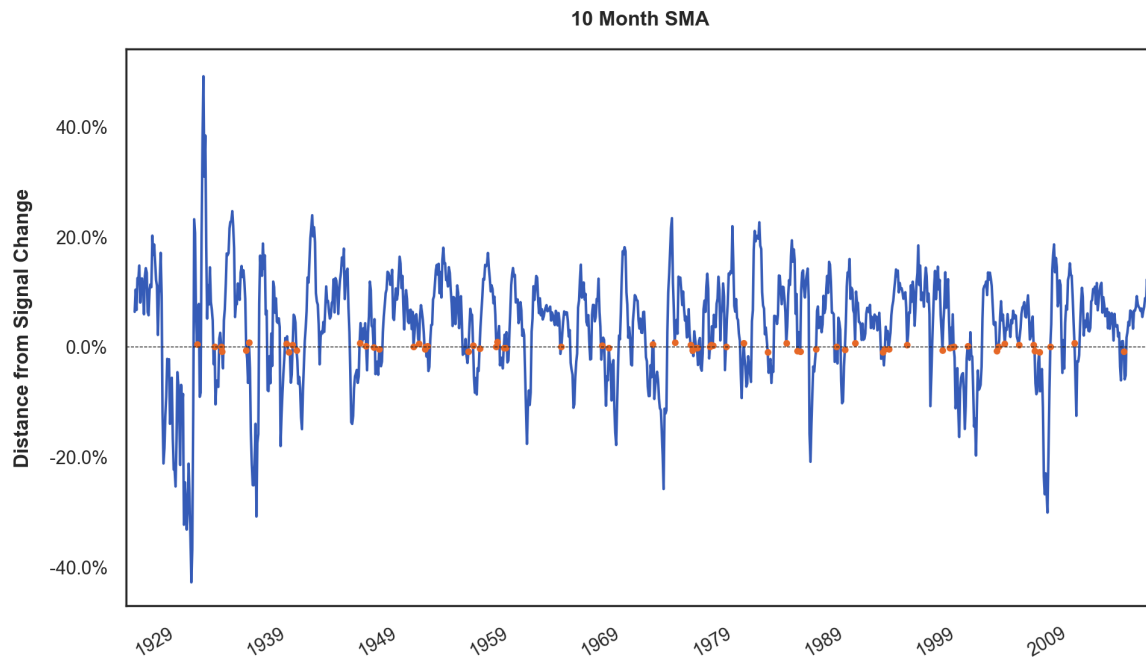
¹ DeMiguel, Victor and Garlappi, Lorenzo and Uppal, Raman, How Inefficient is the 1/N Asset-Allocation Strategy? (July 2005). CEPR Discussion Paper No. 5142. Available at SSRN: <https://ssrn.com/abstract=785164>

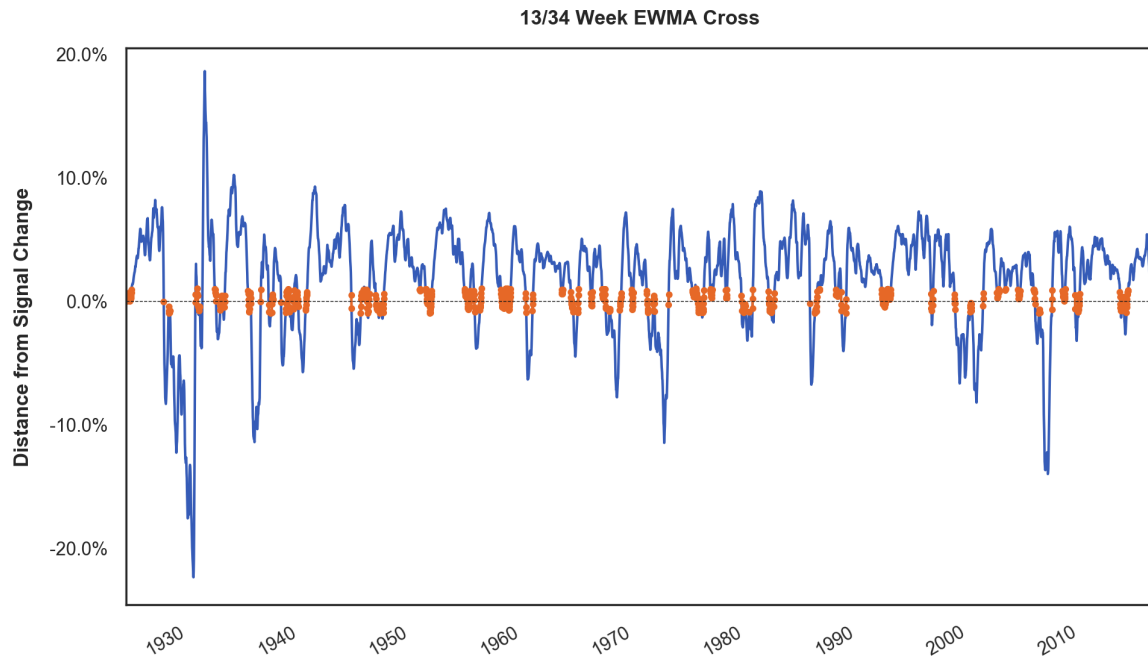
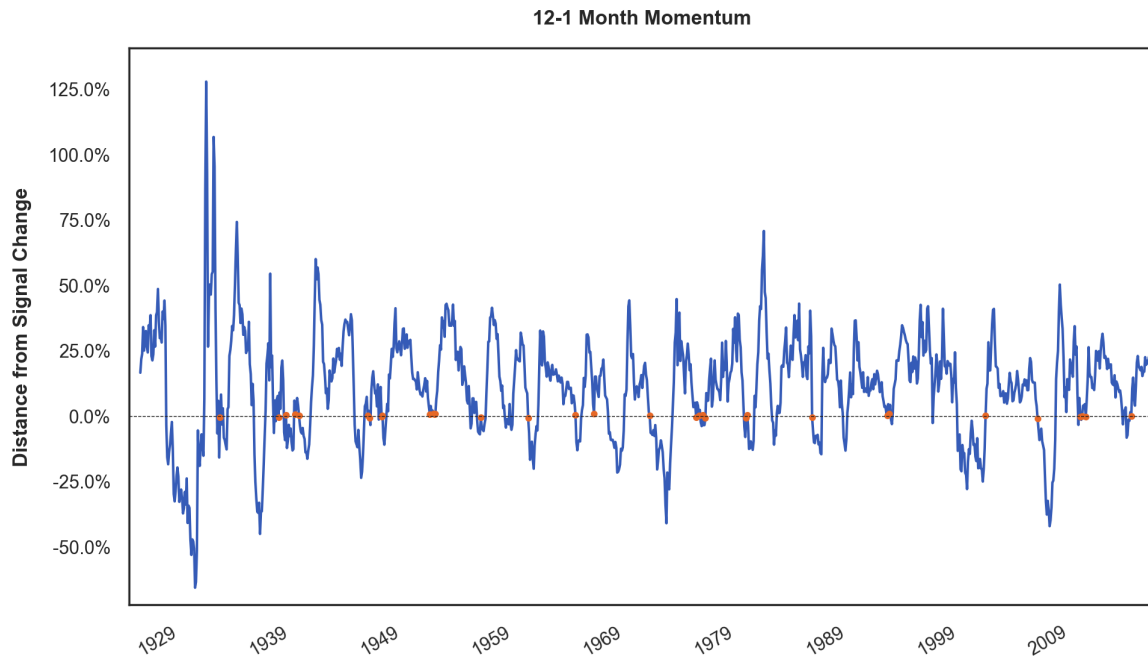
² Haldane, Andrew and Madouros, Vasileios, (2012), The dog and the frisbee, *Proceedings - Economic Policy Symposium - Jackson Hole*, issue , p. 109-159, <https://EconPapers.repec.org/RePEc:fip:fedkpr:y:2012:p:109-159>.

³ It is worth noting that even a static allocation implies a belief about our market outlook (e.g. expected returns and covariances): namely that we have zero confidence in it.

Below we plot over time the distance each of these signals is from turning off. Whenever the line crosses over the 0% threshold, it means the signal has flipped direction, with negative values indicating a sell and positive values indicating a buy.

In orange we highlight those periods where the signal is within 1% of changing direction. We can see that for each signal there are numerous occasions where the signal was within this threshold but avoided flipping direction. Similarly, we can see a number of scenarios where the signal just breaks the 0% threshold only to revert back shortly thereafter. In the former case, the signal has often just managed to avoid whipsaw, while in the latter it has usually become unfortunately subject to it.





Source: Kenneth French Data Library. Calculations by Newfound Research.

Is the avoidance of whipsaw representative of the “skill” of the signals while the realization of whipsaw is just bad luck? Or might it be that the avoidance of whipsaw is often just as much luck as the realization of whipsaw is poor skill? How can we determine what is skill and what is luck when there are so many “close calls” and “just hits”?

What is potentially confusing for investors new to this space is that academic literature and practitioner evidence finds that these highly simplified approaches are surprisingly robust across a variety of investment vehicles, geographies, and time periods. What we must stress, however, is that evidence of general robustness is not evidence of *specific* robustness; i.e. there is little evidence suggesting that a single approach applied to a single instrument over a specific time horizon will be particularly robust.

3. What Randomness Tells Us About Fragility

To emphasize the potential fragility on utilizing a single in-or-out signal to drive our allocation decisions, we run a simple test:

1. Begin with daily market returns
2. Add a small amount of white noise (mean 0%; standard deviation 0.025%) to daily market returns
3. Calculate a long/flat trend equity strategy using 12-1 month momentum signals⁴
4. Calculate the rolling 12-month return of the strategy minus the alternate market history return.
5. Repeat 1,000 times to generate 1,000 slightly alternate histories.

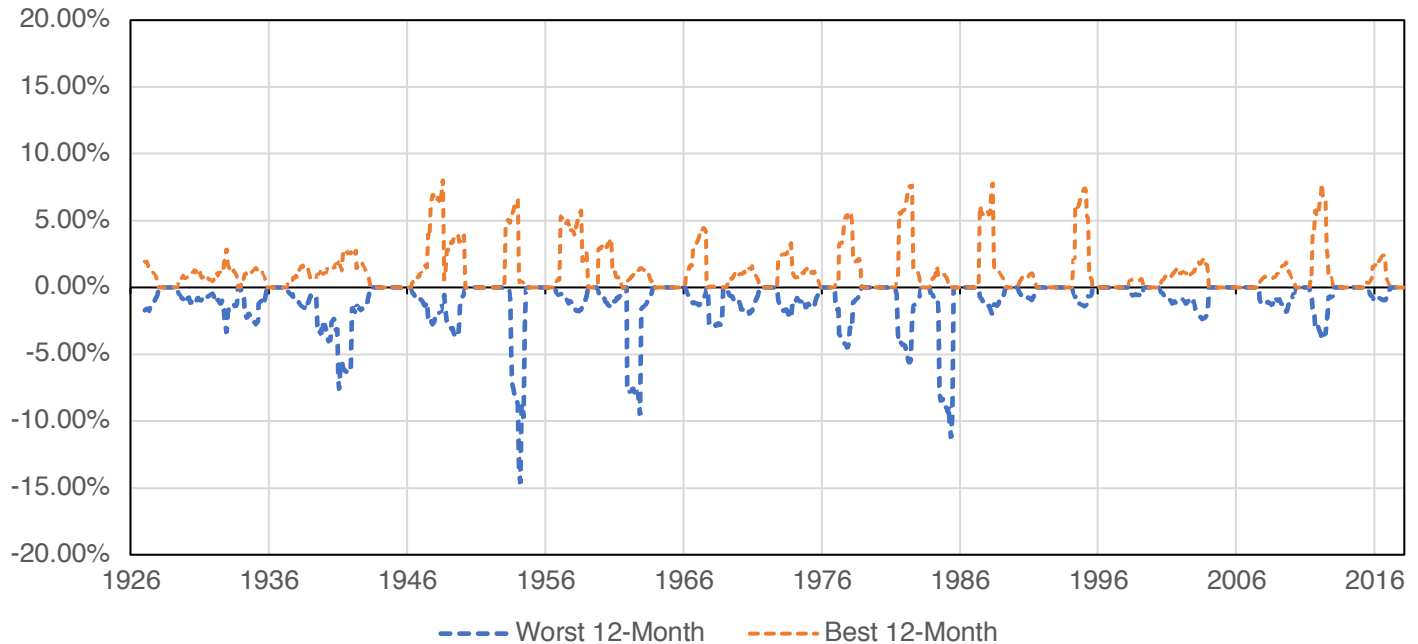
The design of this test aims to deduce how fragile a strategy is via the introduction of randomness. By measuring 12-month rolling relative returns versus the modified benchmarks, we can compare the 1,000 slightly alternate histories to one another in effort to determine the overall stability of the strategy itself.

Now bear with us, because while the next graph is a bit difficult to read, it succinctly captures the thrust of our entire thesis. At each point in time, we first calculate the average 12-month relative return of all 1,000 strategies. This average provides a baseline of expected relative strategy performance.

Next, we calculate the maximum and minimum relative 12-month relative performance and subtract the average. This spread – which is plotted in the graph below – aims to capture the potential return differential around the expected strategy performance due to randomness. Or, put another way, the spread captures the potential impact of luck in strategy results due only to slight changes in market returns.

⁴ When the end-of-month signal is positive, we invest in broad U.S. equities over the next month and in cash otherwise.

Performance of Best and Worst Relative 12-month Return Difference vs. the Average Relative 12-Month Return Difference



Source: Kenneth French Data Library. Calculations by Newfound Research.

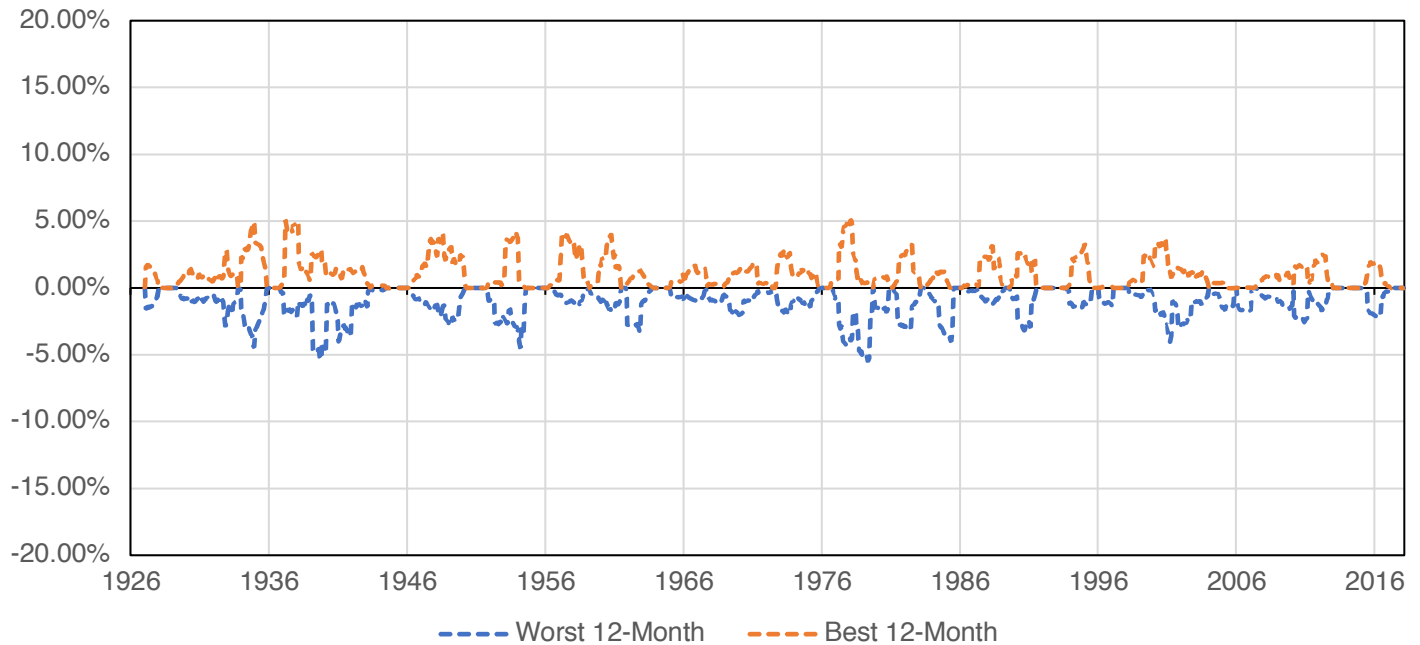
We can see that the spread frequently exceeds 5% and sometimes even exceeds 10. Thus, a tiny bit of injected randomness has a massive effect upon our realized results. Using a single signal to drive our allocation appears particularly fragile and success or failure over the short run can largely be dictated by the direction the random winds blow.

A backtest based upon a single signal may look particularly good, but this evidence suggests we should dampen our confidence as the strategy may actually have just been the accidental beneficiary of good fortune. In this situation, it is nearly impossible to identify skill from luck when in a slightly alternate universe we may have had substantially different results. After all, good luck in the past can easily turn into misfortune in the future.

Now let us perform the same exercise again using the same random sequences we generated. But rather than using a single signal to drive our allocation we will blend the three trend-following approaches above to determine the proportional amount of equities the portfolio should hold.⁵ We plot the results below using the same scale in the y-axis as the prior plot.

⁵ For example, when two of the signals are on and one is off, we will hold $2/3^{\text{rds}}$ of our portfolio in equities and $1/3^{\text{rd}}$ in cash.

Performance of Best and Worst Relative 12-month Return Difference vs. the Average Relative 12-Month Return Difference

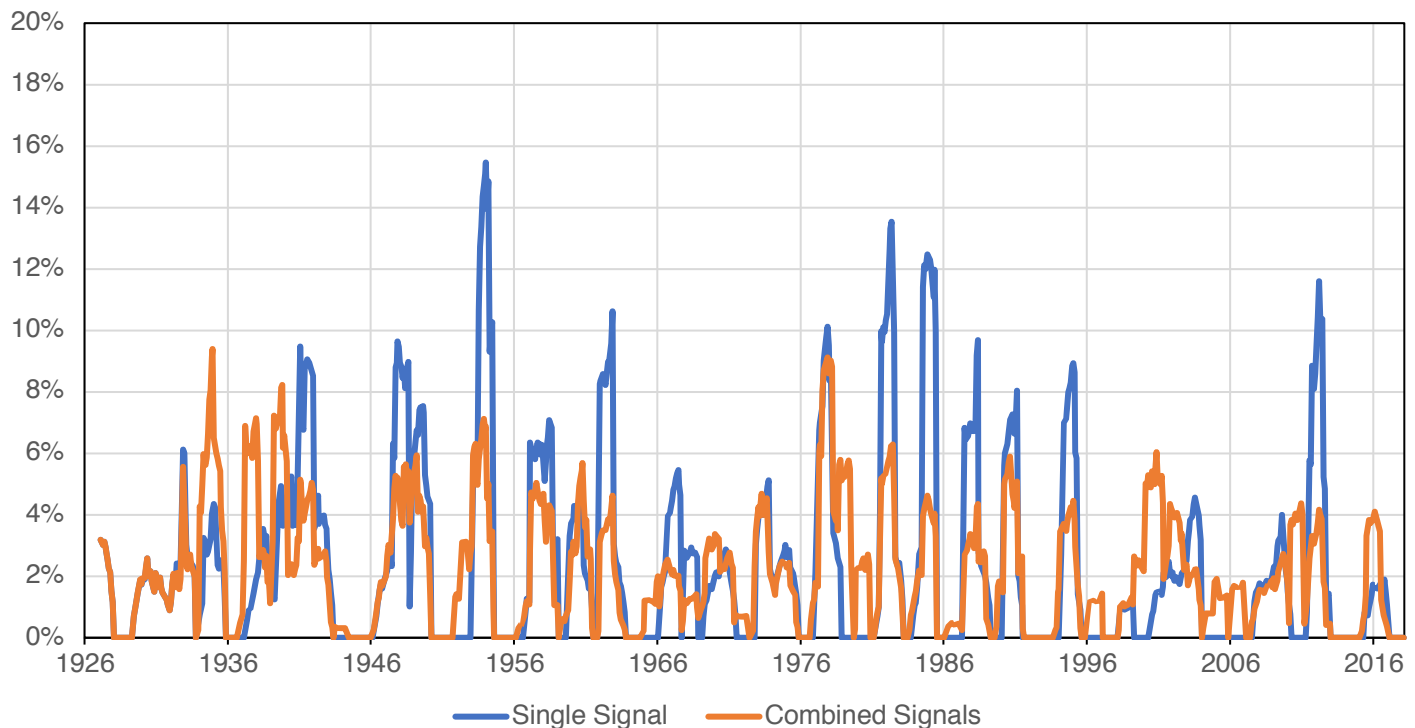


Source: Kenneth French Data Library. Calculations by Newfound Research.

We can see that our more complicated approach actually exhibits a significant reduction in the effects of randomness, with outlier events significantly decreased and far more symmetry in both positive and negative impacts.

Below we plot the actual spreads themselves. We can see that the spread from the combined signal approach is lower than the single signal approach on a fairly consistent basis. In the cases where the spread is larger, it is usually because the sensitivity is arising from either the 10-month SMA or 13-minus-34-week EWMA signals. Were spreads for single signal strategies based upon those approaches plotted, they would likely be larger during those time periods.

Spread Size for Single Signal and Combined Signals Strategies



Source: Kenneth French Data Library. Calculations by Newfound Research.

4. Conclusion

So, where is the balance? How can we tell when simplicity creates robustness and simplicity introduces fragility? As we discussed in our article [A Case Against Overweighting International Equity](#), we believe the answer is *diversification* versus *estimation risk*.

In our case above, each trend signal is just a *model*: an estimate of what the underlying trend is. As with all models, it is imprecise and our confidence level in any individual signal at any point in time being correct may actually be fairly low. We can wrap this all together by simply saying that each signal is actually shrouded in a distribution of estimation risk. But by combining multiple trend signals, we exploit the benefits of diversification in an effort to reduce our overall estimation risk.

Thus, while we may consider a multi-model approach less transparent and more complicated, that added layer of complication serves to increase internal diversification and reduce estimation risk.

It should not go overlooked that the manner in which the signals were blended represents a model with its own estimation risk. Our choice to simply equally-weight the signals indicates a zero-confidence position in views about relative model

accuracy and relative marginal diversification benefits among the models. Had we chosen a more complicated method of combining signals, it is entirely possible that the realized estimation risk could overwhelm the diversification gain we aimed to benefit from in the first place. Or, conversely, that very same added estimation risk could be entirely justified if we could continue to meaningfully improve diversification benefits.

If we return back to our original example of a 100% equity portfolio versus a blended stock-bond mix, the diversification versus estimation risk trade-off becomes obvious. Introducing bonds into our portfolio creates such a significant diversification gain that the estimation risk is often an insignificant consideration. The same might not be true, however, in a tactical equity portfolio.

Research and empirical evidence suggest that simplicity is surprisingly robust. But we should be skeptical of simplicity for the sake of simplicity when it foregoes low-hanging diversification opportunities, lest we make our portfolios and strategies unintentionally fragile.

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