Investors recently have begun to rethink how they take and manage risk in their portfolios, and many have reduced their allocations to managers that use high levels of active risk in favor of index strategies. Those investors taking this approach clearly do not believe they are being appropriately compensated for the risks their active managers are taking, leading them to limit or eliminate active risk from their portfolios. This approach is reflective of the misconception that overall portfolio risk can be managed best by allocating a significant portion of the portfolio to index strategies, while incorporating managers with a high level of active risk is the primary way to generate outperformance. In reality, taking a different approach will often better position investors to generate outperformance and target objectives that are not performance related. How? Using strategies that provide strong risk-adjusted returns by focusing on compensated risk factors, such as value, low volatility and momentum. In fact, strategies that take on high levels of active risk tend to be relatively inefficient and often result in low risk-adjusted performance. The following research reveals a better way to maximize risk-adjusted returns.
The works of the greatest minds in finance reveal a common prescription: *to achieve the best results, investors should maximize risk-adjusted returns*. Harry Markowitz led the way when he showed that a portfolio is only efficient if it has the highest possible return for a given level of risk. William Sharpe formalized the relationship between equilibrium risk and return in the celebrated capital asset pricing model (CAPM), while Eugene Fama and Kenneth French demonstrated ways to improve returns per unit of risk with style factors. The academics' mantra: optimize risk-adjusted returns.

Do investors actually take this advice? When asked, most investors we work with say they do. However, a quick review of their asset and risk allocations often suggests otherwise. The reality is that while investors may want an efficient portfolio and can obtain an efficient portfolio in principle, many obstacles stand in the way of achieving this goal.

**THE BIAS TOWARD ISOLATING RISK**

Research suggests investors may have mental biases that prohibit them from behaving perfectly rationally when allocating risk across their portfolios. Of primary importance is a natural tendency to isolate risk in small pockets of the portfolio, while keeping the remainder for lower risk strategies. Behavioral economist Richard Thaler suggests this cognitive bias is essentially a mental containment strategy that leads to the implicit but ultimately false notion that total risk is somehow reduced if it is concentrated.

The problem is perhaps most acute with active risk, which often is characterized in portfolios by significant concentration. For example, most active investors maintain at least some passive exposure in their portfolios, suggesting a segregation of assets into high and low active risk. Those that don't, typically employ varied levels of active exposure across allocations – also indicating heterogeneity and, thus, relative concentration in the total active risk budget. Indeed, risk isolation and concentration is so pervasive in the active space that it goes by several formal names, such as core-satellite, core-completion or barbell.

No matter what it is called, following this type of strategy immediately causes something of a paradox. In a mental effort to control risk through concentration, investors allocate small portions of their portfolios to risky strategies. However, to meaningfully outperform a benchmark, the active risk taken by this fraction of total assets must be quite high. And managers with such high levels of active risk tend to have lower risk-adjusted returns.

While active risk concentration may be intuitively appealing, the approach ultimately is inefficient and fails to achieve desired investment objectives. Most importantly, it fails to maximize risk-adjusted returns (i.e., information ratios) and, thus, is not consistent with established financial theory.

Instead, an optimal active risk budget should:

1. Target managers with the highest risk-adjusted returns, and
2. Distribute risk relatively evenly throughout the portfolio without distinct concentration.

The result is an investment allocation that meaningfully outperforms a stated benchmark while significantly reducing the probability of underperforming.
DIMINISHING RISK-ADJUSTED RETURNS

A phenomenon firmly established in the financial literature is that the information ratios of long-only managers tend to decrease as their active risk increases. This is the direct result of long-only managers’ limited ability to express negative views on stocks while their expression of positive views is generally unrestricted. This asymmetry becomes more pronounced as active risk increases and causes the managers’ excess return per unit of risk (tracking error) to decline.

For example, active equity managers overweight and underweight stocks based on each stock’s expected excess returns. Managers that have a long-only constraint and, hence, cannot short stocks, are limited in their ability to underweight a specific stock by the stock’s allocation in the benchmark portfolio. At low tracking-error levels, this constraint may not be overly restrictive, and will still allow managers to express a full range of positive and negative views. However, as tracking error increases, the limitation on underweighting securities has a bigger impact and the managers’ active weights will begin to deviate from their forecast of expected excess returns. In other words, long-only managers can overweight their favorite names as much as they like, but can only fully underweight their least favorite names in a few cases where the benchmark weight is large enough to accommodate the desired underweight. Since the overweights and underweights must balance each other out, the no-short constraint effectively hinders a manager’s ability to express a strong bullish or strong bearish view.

This result was demonstrated empirically by Alford, Jones and Winkelmann. Using data on 1,052 large-cap U.S. equity managers over 13 years, they broke managers into two groups based on tracking error. The first group, which they called Structured Managers, contained managers with an annual tracking error between 100 basis points (bps) and 300 bps. The second group, known as Traditional Managers, was composed of managers with an annual tracking error between 500 bps and 1500 bps. The authors ignored managers whose tracking error fell between 300 bps and 500 bps because they felt these managers were too difficult to classify. (According to the authors, the results were not sensitive to the exclusion of these managers.) Their results are shown in Exhibit 1 (on page 4).

DIMINISHING RISK-ADJUSTED RETURNS: THE FUNDAMENTAL LAW OF ACTIVE MANAGEMENT

The concept of diminishing risk-adjusted returns was formally proven in the landmark paper by Clarke, de Silva and Thorley. Their expression for the information ratio is now widely known as the Fundamental Law of Active Management:

\[
    IR = IC \times TC \times \sqrt{N}
\]

\(IR\) is the information ratio, \(IC\) is the information coefficient, \(TC\) is the transfer coefficient and \(N\) is the number of active bets taken.

For an active equity manager the information coefficient \((IC)\) reflects the correlation between forecasted returns and realized returns. This is a measure of the investment manager’s skill in predicting stock returns. More importantly, the transfer coefficient \((TC)\) is the correlation between the portfolio’s active weights and the forecasted returns. The information ratio is maximized when the transfer coefficient (which could be as high as 1 or as low as -1) is as large as possible.

By limiting the manager’s ability to express his or her views, the no-short constraint effectively limits the transfer coefficient. As tracking error increases, the correlation between active weights and expected returns is reduced. Thus, the transfer coefficient is reduced causing total information ratio to decline, all things being equal. (While it is beyond the scope of this paper, hedge funds do not have this “no short” constraint, so they are potentially in a better position to express their views within their long/short portfolios.)
While high tracking-error managers have higher active returns, their risk-adjusted performance clearly lagged that of low tracking-error managers, just as predicted by the fundamental law of active management (see *Diminishing Risk-Adjusted Returns: The Fundamental Law of Active Management*, on page 3). The average information ratio of the low tracking-error group is 0.26 while that of the high tracking-error group is just 0.05. The respective medians are 0.28 and 0.07. Our analysis of data over the last 10 years reaffirms these findings, showing that lower tracking-error managers tend to have higher information ratios than higher tracking-error managers.

Perhaps even more interesting is the dispersion in performance. The top-quartile structured managers had an active return of 92 bps while the bottom quartile had an active return of negative 4 bps. In contrast, the top quartile Traditional Manager outperformed by 201 bps but the bottom quartile underperformed by 120 bps. While these results are consistent with the tracking error classification, it does highlight that manager selection is much more important for high tracking-error Traditional Managers because the range of potential outcomes is much wider. Further, the severity of potential underperformance is clearly reduced with low tracking-error Structured Managers.
It appears the natural tendency to concentrate risk may have led investors down the wrong path. Instead of enhancing the active risk budget, concentration has caused them to pursue investments that do not maximize risk-adjusted returns.

**IMPROVING RETURNS AND REDUCING RISK**

If risk concentration is synonymous with high tracking error and, therefore, low-information-ratio managers, can it possibly be part of an optimal risk budgeting structure? Borrowing from Markowitz’s idea of the efficient frontier, we can look at an optimal risk budget using an efficient frontier of active risk. Each point on this frontier would represent the maximum excess return per unit of tracking error. This would show us the highest information ratio attainable for a given level of risk.

Much like the Markowitz efficient frontier, the active efficient frontier (the grey line in Exhibit 2) is concave due to the Fundamental Law of Active Management and the diminishing information ratio phenomenon discussed previously. As you move up and to the right along the frontier, both expected excess returns and tracking error increase, but the information ratio declines because tracking error increases at a faster rate. For example, in Exhibit 2 the portfolio labeled “A” on the efficient frontier has a lower expected excess return and tracking error than the portfolio labeled “B,” but portfolio A (or any point to the left of portfolio B on the active efficient frontier) has a higher information ratio.

**EXHIBIT 2: EFFICIENT FRONTIER OF ACTIVE MANAGEMENT**

One of Markowitz’s great insights was that managers can use leverage to achieve higher portfolio returns without necessarily increasing risk or, conversely, a portfolio’s risk may be reduced without affecting return. This concept applies equally to the active portfolio, as Exhibit 2 demonstrates. Applying leverage to any portfolio would generate a new linear frontier that connects the origin at the bottom left corner with the portfolio’s point on the original frontier. For example, by applying leverage to portfolio A we obtain a new efficient frontier, as shown in portfolio C, that extends above the original frontier (the green line) as you move to the right of portfolio A. Similarly, portfolio B can be levered so that its new efficient frontier (red line) extends above the original frontier to the right of B.
Note that the new linear efficient frontier formed by leveraging portfolio A, with its high information ratio, always achieves a higher return per unit of risk than the linear frontier formed from the low-information-ratio portfolio B. For example, portfolio A could be levered to achieve portfolio C, which has the same tracking error as portfolio B, but with much higher expected excess returns. Markowitz concluded that if leverage is available, low information ratio portfolios should be expressly avoided because they are inefficient from a risk/return perspective.

Of course, if the modern portfolio theory results are to be anything more than just academic, we must reconcile the use of leverage in its framework with an active risk budgeting approach. If investors cannot use or choose not to use leverage, can they still benefit from this concept?

**Implicit Leverage**

To illustrate the use of implicit leverage in a risk budgeting framework, consider a simple scenario in which we are deciding between two active managers. One has a high information ratio of 0.7, but a lower expected excess return of 2.0% (Manager A). The other has a higher expected excess return of 4.0% but a lower information ratio at 0.4 (Manager B). Which of these managers should we select?

Exhibit 3 (on page 7) details the excess return and tracking error metrics for the two options. Tracking error is the expected tracking error of the total equity allocation relative to the benchmark index. A traditional risk concentration strategy might place 20% of the total equity allocation with the active manager and the remaining 80% in something with less active risk, such as indexing. Manager B’s expected excess return is 0.80%, with an expected total equity allocation tracking error of 2.00%. These results are highlighted under the Low IR section.

However, Manager A can achieve the same expected portfolio excess return with significantly less tracking error by simply increasing the active allocation from 20% to 40% and decreasing the index allocation from 80% to 60%. At this allocation Manager A also provides an expected total equity allocation excess return of 0.80%, but with an expected total equity allocation tracking error of just 1.14% – which is 43% less risk than Manager B’s tracking error of 2.00%. These results are highlighted in the High IR section, in Exhibit 3.

Alternately, suppose we wanted to target the same 2.00% total equity allocation tracking error as Manager B in the first example. What level of excess return could we expect to achieve by using Manager A? As can be seen under the High IR section, a 2.00% total equity allocation tracking error would yield an expected excess return of 1.40%. To achieve this we simply must raise the active allocation from 20% to 70% as shown in the yellow highlight. This increase in excess return from 0.80% (Manager B) to 1.40% (Manager A) represents an increase of 75%.

In short, our allocation decision acts as implicit leverage within our active risk budget. By increasing the active allocation we can effectively “lever up” managers with higher information ratios and lower expected excess returns to obtain higher total equity allocation excess returns and/or a lower tracking error. In this sense we can move up or down along the capital allocation line, achieving better risk adjusted results than with our lower information ratio/higher alpha manager (Manager B).
EXHIBIT 3: INCREASING THE USE OF MANAGERS WITH HIGH INFORMATION RATIOS TO IMPROVE EFFICIENCY

Increasing the portion of the portfolio allocated to the high information ratio strategy and reducing the portion allocated to index strategies has the same effect as levering the high information ratio strategy portion of the portfolio without actually using leverage.

<table>
<thead>
<tr>
<th>ASSET ALLOCATION</th>
<th>HIGH IR (MANAGER A)</th>
<th>LOW IR (MANAGER B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEX</td>
<td>PORTFOLIO EXCESS RETURN</td>
<td>PORTFOLIO TRACKING ERROR</td>
</tr>
<tr>
<td>0%</td>
<td>2.00%</td>
<td>2.86%</td>
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<tr>
<td>10%</td>
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<td>1.40%</td>
<td><strong>2.00%</strong></td>
</tr>
<tr>
<td>40%</td>
<td>1.20%</td>
<td>1.71%</td>
</tr>
<tr>
<td>50%</td>
<td>1.00%</td>
<td>1.43%</td>
</tr>
<tr>
<td>60%</td>
<td><strong>0.80%</strong></td>
<td><strong>1.14%</strong></td>
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<td>70%</td>
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<td>80%</td>
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<td>100%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Source: Northern Trust Quantitative Research

Note these results hold generally. If we assume our two active managers realize an information ratio of 0.4 and 0.7 for this example, then the higher information ratio manager will always be able to generate more efficient results using leverage, whether explicit or implicit. Exhibit 4 (on page 8) details the same total equity allocation spectrum except that we used the data from the Alford, Jones and Winkelman research. Keeping our 20% allocation to active, to Manager B would yield an expected total equity allocation excess return of 0.11% with 1.64% of tracking error. With leverage we could either hold expected total equity allocation excess return constant and reduce tracking error to 0.63% or hold the tracking error constant and increase the expected excess return to 0.34%. This represents a 62% reduction in risk or a 300% increase in expected excess return. Of course, adjusting the allocation between active and passive makes possible other combinations of risk reduction or increased excess return as well.
EXHIBIT 4: EMPIRICAL RESULTS: INCREASED ALLOCATION TO HIGH INFORMATION RATIO MANAGERS

Using data from research by Alford, Jones and Winkelmann in 2003, we see that an increased allocation to the high information ratio manager can improve efficiency without sacrificing excess returns.

EXHIBIT 4: EMPIRICAL RESULTS: INCREASED ALLOCATION TO HIGH INFORMATION RATIO MANAGERS

<table>
<thead>
<tr>
<th>ASSET ALLOCATION</th>
<th>HIGH IR (MANAGER A)</th>
<th>LOW IR (MANAGER B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEX</td>
<td>ACTIVE</td>
<td>PORTFOLIO EXCESS RETURN</td>
</tr>
<tr>
<td>0%</td>
<td>100%</td>
<td>0.43%</td>
</tr>
<tr>
<td>10%</td>
<td>90%</td>
<td>0.39%</td>
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<tr>
<td>100%</td>
<td>0%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Source: Northern Trust Quantitative Research, using data from Alford, Jones and Winkelmann

BENEFITS OF HIGH IR/LOW TRACKING ERROR MANAGERS

Perhaps more importantly, moving toward higher IR managers increases the likelihood of beating the benchmark, which is, after all, most active investors’ stated objective. Using the data from original example of Managers A and B, Exhibit 5 details the probability of underperforming the benchmark across various periods.

EXHIBIT 5: PROBABILITY OF UNDERPERFORMING A BENCHMARK

Using a more efficient portfolio with a high information ratio manager reduces the probability of underperforming over various time periods.

While this analysis does not include the impact of fees, a review of fees likely would only magnify these findings; typically low IR/high alpha managers have materially higher fees than high IR/lower alpha managers.
Note that differences in portfolio tracking error lead to material differences in underperformance probabilities. The higher IR manager has a significantly lower probability of underperforming across all time horizons. For example, at the three-year horizon – the period at which most managers’ performance is evaluated – the lower IR manager has nearly a 25% chance of underperforming the benchmark while the higher IR manager has just a 10% chance. It should also be noted that the analysis above does not include the impact of fees. A review of fees would likely only magnify these findings.

To better understand the dynamics of this underperformance, we prepared a Monte Carlo simulation study – widely used in modeling phenomena with input uncertainty – of both high IR and low IR managers. Using the tracking error, IR and alpha from Managers A (high IR) and B (low IR) in our scenario, we simulated 100,000 return paths spanning 10 years. A sample of these paths is shown in Exhibits 6 and 7. As you can see, a $1 investment at the beginning of the period with Manager A (shown in Exhibit 6) yields a much narrower distribution of outcomes over any period relative to Manager B (shown in Exhibit 7). Most importantly, note that the frequency with which each manager falls below $1 is much lower with Manager A, the higher IR manager, than with Manager B.

**EXHIBIT 6: HIGHER INFORMATION RATIO MANAGERS (MANAGER A) HAVE A NARROWER RANGE OF PROBABLE RESULTS**

**EXHIBIT 7: LOWER INFORMATION RATIO MANAGERS (MANAGER B) HAVE A WIDE DISPERSION OF PROBABLE RESULTS**

Source: Northern Trust Quantitative Research
Again, these results hold generally. Using the data from Alford, Jones and Winkelmann’s research, we computed underperformance probabilities in Exhibit 8. Note that the differences between lower IR managers (Traditional Managers) and higher IR managers (Structured Managers) are even more extreme. At a three-year horizon, the lower IR managers still have more than a 45% probability of underperforming a benchmark while the higher IR managers have slightly more than an 11% likelihood. Note also that while underperformance probabilities decline steadily over time for higher IR managers, the reduction is significantly less extreme for lower IR managers. At the 10-year horizon, lower IR managers still have a 42% chance of underperforming; that probability is reduced to just above 1% for higher IR managers.

**EXHIBIT 8: EMPIRICAL RESULTS: PROBABILITY OF UNDERPERFORMING A BENCHMARK**

![Probability of Underperforming a Benchmark](image)

Source: Northern Trust Quantitative Research using data from Alford, Jones and Winkelmann.

So while many investors believe that risk concentration gives them the best of both worlds – risk control and the opportunity for outperformance – the reality is that it actually produces a portfolio with much higher risk and a significantly lower probability of outperformance than one focusing on higher IR/lower alpha managers. In this sense risk concentration is clearly inefficient and ultimately ineffective at delivering desired investment outcomes.

**PUTTING AN EFFICIENT RISK BUDGET INTO PRACTICE**

So ultimately, the evidence shows that the long-held belief that risk concentration is a viable component of an efficient active risk budget is actually counterproductive. A more effective strategy is for investors to maximize their risk-adjusted returns by creating an efficient active risk budget. By targeting high IR managers and using the natural leverage implicit in the active risk budgeting process, investors can still “dial up” or “dial down” alpha targets to meet their needs.
If the key to achieving an efficient active risk budget is to target high IR managers, how can investors identify these managers? Northern Trust’s research, detailed in the paper “Understanding Factor Tilts” shows that portfolios with tilts toward risk factors such as size, value and momentum, have outperformed their benchmarks in domestic, international and emerging markets, and do so with lower risk. This verifies the results of Carhart’s research, which showed that managers employing portfolio tilts toward compensated risk factors tend to have higher information ratios than other active managers. In particular, Carhart reveals that managers focused on fundamental “stock picking” (i.e., high active share/high conviction strategies that are typical active candidates) commonly have negative alpha and, hence, negative information ratios, while compensated risk factor tilt strategies have consistently positive alpha and, thus, higher information ratios.

**THINK DIFFERENTLY, MAXIMIZE RISK-ADJUSTED RETURN**
While investors may have a natural bias toward strategies that isolate risk, this often leads to portfolios with higher levels of overall risk than many investors realize. At best, it is an inefficient strategy; at worst it can result in portfolios failing to meet their performance goals. Fortunately, research shows that there is a better approach: using an efficient active risk budget.

By stepping outside the comfort zone of a traditional risk-concentration strategy and seeking an efficient active risk budget instead, investors will have a more even distribution of risk across the portfolio. This approach can increase returns, decrease risk and raise the likelihood of outperforming a benchmark – the ultimate goals of any active risk strategy.

**LEARN MORE**
If you would like to learn more about how an efficient active risk budget might benefit your equity portfolio, please contact your local Northern Trust relationship manager or visit northerntrust.com.
Endnotes:

1. Specifically, returns per unit of risk (return/risk).
8. Note that for the total equity allocation to have zero tracking error there would be no active risk taken and, hence, the expected excess return relative to the benchmark would also be zero.
9. Allard, Jones and Winkelmann, 49-60.
10. Annual returns are assumed to be identically and independently normally distributed.