2Q21

TOPICS OF INTEREST

Verus

Measuring & budgeting active risk

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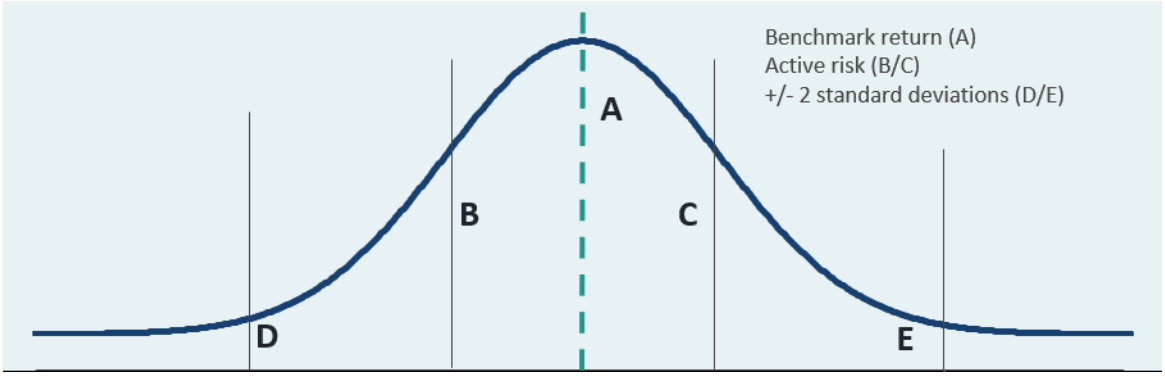
Executive summary

Active risk budgeting is valuable in the construction, monitoring, and overall governance of the investment portfolio. An active risk budget identifies how much risk an investor wants to take in the portfolio and where the investor plans to allocate that risk. In this paper we provide an introduction to active risk and demonstrate how to measure and budget that risk. We also discuss the individual sources that drive active risk and why they're important to identify. Last, we review a practical example of how active risk can inform portfolio construction and demonstrate how the Verus active management environment research can be used to inform active/passive allocations throughout the portfolio.

Back to the basics: What is active risk?

Investors face many different types of risks in their portfolios. Active risk (tracking error) measures the volatility of the return difference (excess return) between a portfolio and its benchmark. If an investor wishes to outperform their benchmark, the portfolio composition must be different than that benchmark. The exhibit below illustrates a simple example of the relationship between excess returns and tracking error. We show a distribution of excess returns around a benchmark return (A)[1]. Tracking error measures the dispersion of the excess returns. Using the figures in the exhibit, excess returns range from B to C in 68% of our observations[2]. To add context, if this manager showed 1% tracking error, this would mean that the manager's return could be expected to land within +1% or -1% from the benchmark return each year, in 68% of years. We should also be aware that there will be times when excess returns vary outside of this expected range (D/E)[3].



For illustrative purposes only

Creating a total active risk budget

Before determining how to allocate active risk across the portfolio, we need to define an overall active risk budget. There are many potential ways to approach this challenge, but we like the simplicity of using the formula below[4], which identifies the required return of the portfolio as the sum of the risk-free rate, beta, and alpha.

REQUIRED RETURN		RISK FREE RATE		BETA		ALPHA
7.0%	=	0.2%	+	5.6%	+	**1.2%**
				Absolute Risk 12.7% / Sharpe Ratio 0.44		Active Risk 2.4% / Information Ratio 0.5

In this example, an investor has a required return of 7%. In today's environment, our capital market expectations are predicting a 0.2% return for the risk-free rate (i.e., the expected return of cash). Beta is the major determinant of risk and return for the overall portfolio and is driven by the strategic asset allocation. It is the product of the total risk of the portfolio and the efficiency with which the return is achieved (often summarized by the Sharpe Ratio). Alpha is driven by active management and is the product of the active risk of the portfolio and the efficiency with which the active returns are achieved (information ratio). For the purposes of active risk budgeting, we are focused on the alpha component. This portfolio should be targeting an active risk level that will achieve 1.2% alpha. If the portfolio can achieve an information ratio of 0.5, this suggests a tracking error budget of 2.4%. An investor can iterate through this exercise to determine what works best for their return needs and risk tolerance.

Combining beta and alpha provides an investor with information surrounding risk and return that is central in designing and monitoring an investment program. Since risk changes through time, both the beta and alpha components will also change. By isolating the alpha

component stakeholders can use this framework to set an appropriate overall tracking error budget—which we believe is best stated as a range (i.e. 2-3%). Investors can improve their chances of meeting return objectives by identifying risk and return targets and monitoring the portfolio to ensure it behaves consistent with those expectations.

Measuring active risk contribution

Measuring active risk is a relatively simple exercise if an investor is measuring one portfolio to one benchmark. In this instance, tracking error is simply the standard deviation of the excess return. In the case where there are multiple active managers and the investor wants to understand how each manager contributes to overall tracking error, this exercise becomes more complex. We can simplify the process by leveraging the *X, Sigma, Rho* mathematical framework[5]. The product of these three figures allows an investor to understand how each underlying component affects overall risk. An exposure's tracking error contribution to the portfolio can be broken down into three components:

$$Contribution\ to\ portfolio\ tracking\ error = X * \sigma * \rho$$

Where...

$$X = exposure\ in\ the\ portfolio$$
$$\sigma = tracking\ error\ of\ that\ exposure$$
$$\rho = Correlation\ of\ exposure\ excess\ return\ to\ total\ excess\ return$$

The key to active risk budgeting is having the ability to measure how each manager and asset class contributes to overall portfolio tracking error. Once we can measure and monitor these components, we can construct budgets to better achieve our goals. These budgets ensure appropriate risk taking and improve communication throughout the organization.

Understanding the sources of active risk

It is common practice to set tracking error using a bottom-up approach, meaning that active managers are selected within each asset class to provide an expected level of alpha within that asset class. This process is repeated across each asset class in the portfolio. If this process results in total portfolio active risk that is perceived to be too high, then individual managers are adjusted in an informal way. Because active risk is a limited resource (assuming the investor is risk-sensitive), this bottom-up approach might prove suboptimal. Instead, we believe a top-down approach can deliver better results. An investor may decide which areas of the portfolio are likely to provide the best hunting ground for alpha, per unit of risk, and will likely decide to take on greater active risk in those areas using a top-down approach. Active risk is therefore optimized across the portfolio by allowing managers to pursue this type of risk in asset classes with the greatest chance of success.

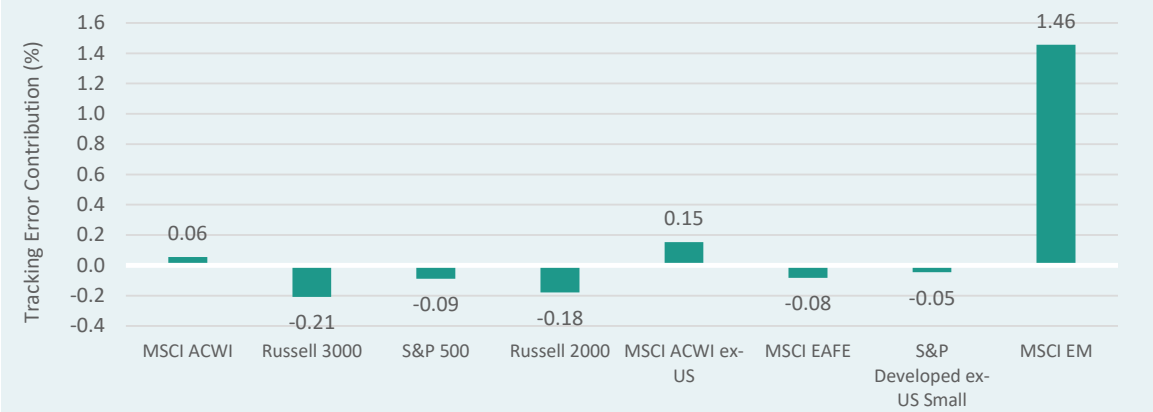
Three potential sources contribute to active risk[6]:

1. **Allocation risk**: Asset class/manager allocation weights that are different than the investor's benchmark target weights.
2. **Benchmark mismatch risk**: Benchmarks in the portfolio that are different than the benchmarks in the investor's investment policy.
3. **Active manager risk**: Active management (managers who intentionally deviate from their benchmark target).

Allocation risk

If an investor holds a positive or negative view on certain broad asset classes, this investor might increase or decrease their exposure to an asset class. This creates a disparity between the amount the investor holds of that asset class relative to the investor's strategic asset allocation (SAA). Alternatively, if an investor has not recently rebalanced their portfolio back to the policy weights, this can also create a disparity between the amount the investor holds of that asset class relative to the investor's SAA. Each of these situations create tracking error that we call "Allocation Risk". The chart below illustrates this type of tracking error for a sample portfolio, by the exposures that contribute to that tracking error. In this sample portfolio, the investor possesses the greatest allocation disparity in their exposure to emerging market equities. In other words, the investor's exposure to emerging market equities is different than the weight of this asset class in their policy index, which creates tracking error.

ALLOCATION RISK DECOMPOSITION



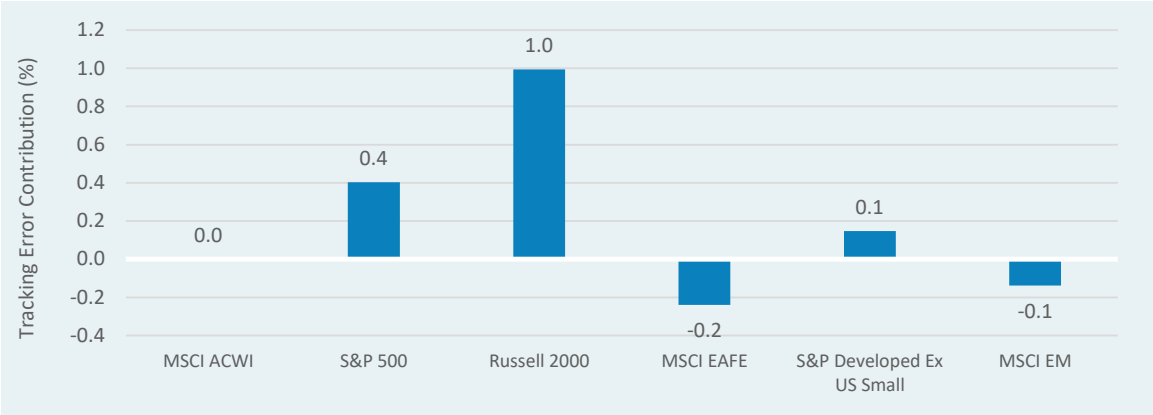
Source: Verus, MPI – for illustrative purposes only

Benchmark mismatch risk

If an investor hires active managers who manage to benchmarks that are different than the benchmarks in this investor's policy index, this results in tracking error. For example, if the

investor has designed their SAA with S&P 500 representing their U.S. public equity exposure, but one of their active managers is investing to a Russell 3000 Index benchmark, tracking error will exist between these two benchmarks. We refer to this type of risk as "Benchmark Mismatch Risk".

BENCHMARK MISMATCH RISK DECOMPOSITION

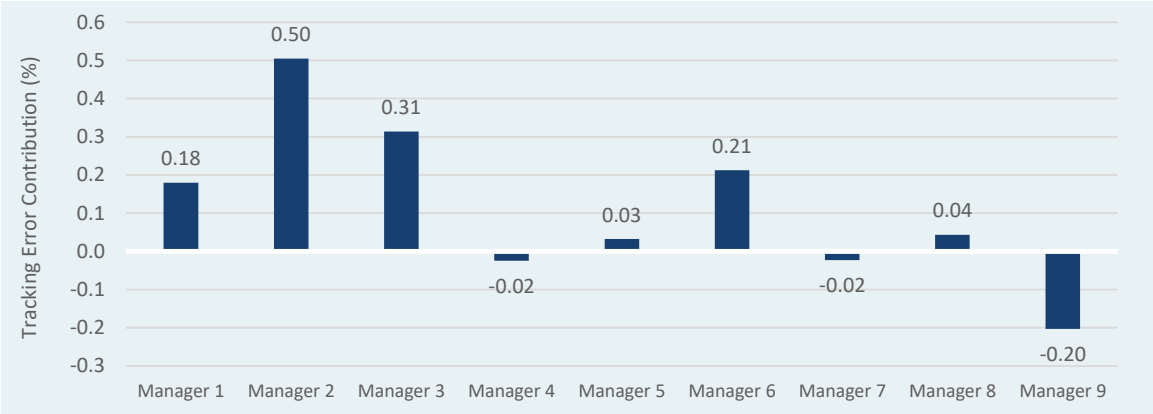


Source: Verus, MPI – for illustrative purposes only

Active manager risk

When thinking about "tracking error" or "active risk", most investors likely have in mind the risk that comes from active manager decisions. We refer to this risk as "Active Manager Risk". This is the third source of active risk in the portfolio.

ACTIVE MANAGER RISK DECOMPOSITION

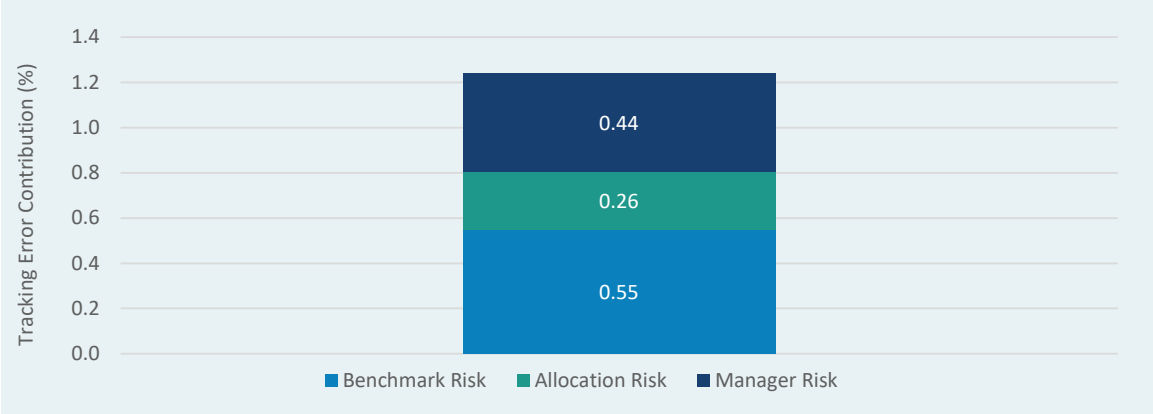


Source: Verus, MPI – illustrative purposes only

Thinking about the 3 sources of active risk

Once an investor has measured the magnitude of tracking error that is being generated across each of the three sources above, a useful next step is to calculate how each of these sources contribute to the Total Portfolio Active Risk[7].

THE 3 SOURCES OF ACTIVE RISK



Source: Verus, MPI – for illustrative purposes only

This analysis will likely lead to some useful conclusions. Investors may find that their portfolio tracking error is being fueled by sources that they spend less time thinking about or discussing. Benchmark Mismatch Risk, for example, is a risk that most investors do not expect to receive any compensation for taking on. Investors may strive to eliminate Benchmark Mismatch Risk for this reason. Another observation from this analysis might be that Allocation Risk is a larger (or smaller) source of active risk than previously assumed. Is Allocation Risk a result of an investor's expressed shorter-term asset class views? Or is it the result of the investor's rebalancing policy? If the amount of Allocation Risk is a surprise, and/or if its size relative to Active Manager Risk is not preferable, this may suggest portfolio changes are warranted.

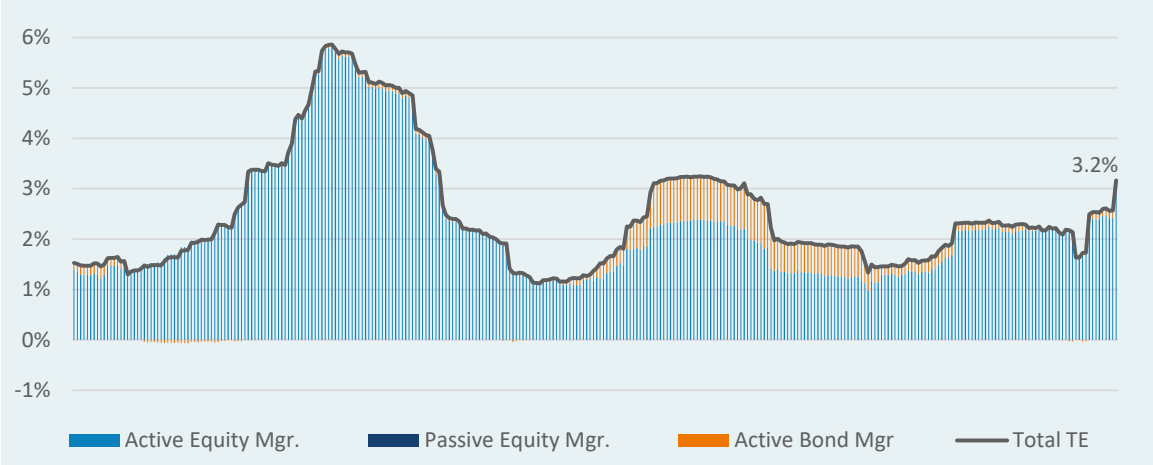
Example: Using active risk to inform portfolio construction

Active risk budgeting can be used to inform portfolio construction. It can aid in determining the appropriate blend of active and passive management as well as the number of managers that should be hired across the portfolio[8]. In this example we will assume the board prefers a portfolio with 1-3% tracking error to its benchmark[9]. There are two asset classes to invest in: Equities and Bonds. And the investor can hire active or passive managers in each asset class (so there are four total investment products the investor can select). The investor begins creating different proposed combinations of investment managers to find the best portfolio to achieve their goals. The table below[10] analyzes these proposed mixes.

Portfolio Mix	End of Period Tracking Error	Tracking Error range	% of results in Tracking Error budget	Average Alpha	Average Information Ratio
Mix 1	4.7%	7.1%	43.9%	2.3%	0.62
Mix 2	3.9%	5.9%	64.7%	2.0%	0.65
Mix 3	3.2%	4.7%	72.4%	1.7%	0.69
Mix 4	2.4%	3.6%	79.2%	1.5%	0.75
Mix 5	1.7%	2.4%	67.9%	1.2%	0.84
Mix 6	0.9%	1.2%	27.6%	0.9%	1.00
Mix 7	0.3%	0.9%	10.3%	0.5%	1.08
Mix 8	0.2%	0.5%	0.0%	0.3%	1.09
Mix 9	0.0%	0.0%	0.0%	0.0%	NA

Since the board has a stated goal of constructing a portfolio with tracking error of 1-3%, mixes 3 through 5 appear to be the most appropriate as 65-80% of their tracking error observations fall within the stated range. It is important to consider how risk changes through time when constructing portfolios. If we only look at this analysis for a single point-in-time, we exclude some valuable information in the decision-making process. We can further analyze the historical behavior of the mixes selected to identify how each manager would have contributed to overall tracking error throughout the observed periods:

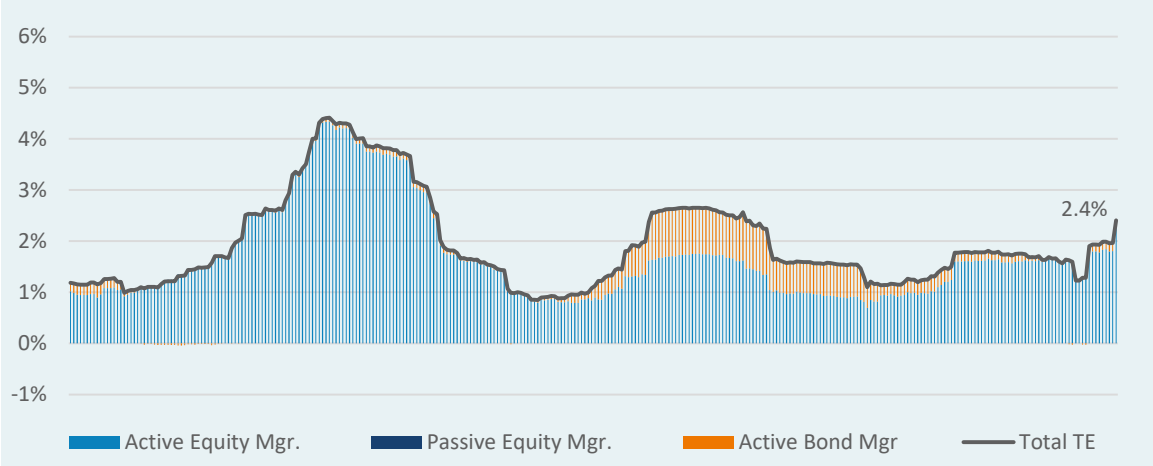
MIX 3: TRACKING ERROR CONTRIBUTION



We observe that tracking error would have varied quite a bit through time, ranging from 5.9% down to 1.1%. This highlights the potential flaw of using a single point-in-time measurement for this exercise. We can also see that while the active equity manager consistently demonstrated a large positive contribution to tracking error, the active bond manager's contribution was close to zero for more than half of the series, predominantly due to the manager's low correlation. Comparing Mix 3 to our original tracking error budget of 1-3%, we see that the average tracking error of this portfolio would have been 2.5%, which is within

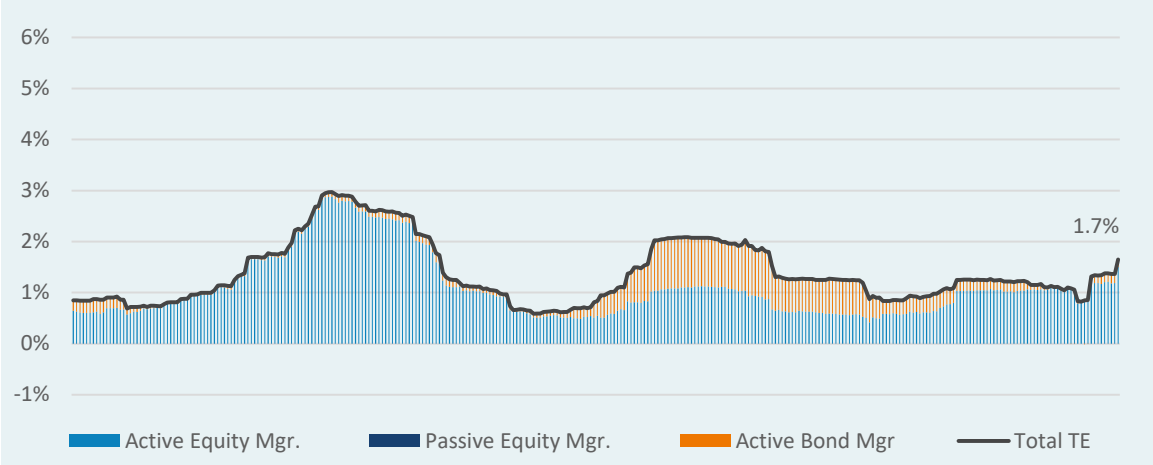
that target range. And if we calculate the number of observations that rest within the 1-3% range, we find that it was 72%. This appears promising, but we may be able to increase that figure.

MIX 4: TRACKING ERROR CONTRIBUTION



Analyzing mix 4, we see that tracking error varied through time from 4.4% down to 0.8%. We observe a similar tracking error contribution dynamic across the managers: the active equity manager had a large positive tracking error contribution throughout the series, whereas the active bond manager varied, and the passive equity manager had zero contribution. Going back to our original tracking error budget of 1-3%, the average result of this portfolio construction would have been 1.9%, which is within the target range. And if we look at the number of observations in the 1-3% range, it was 79%, which is an improvement over mix 3.

MIX 5: TRACKING ERROR CONTRIBUTION



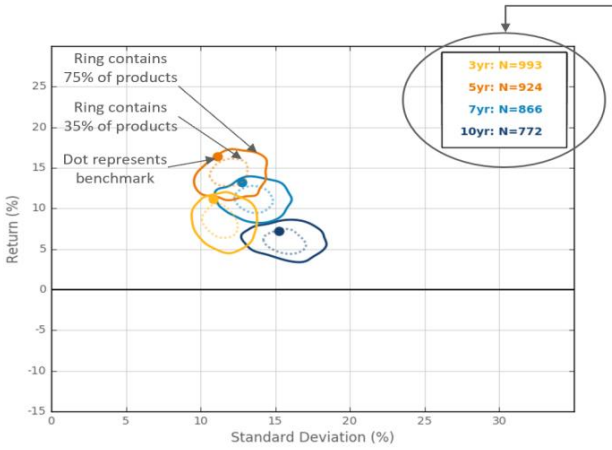
Analyzing mix 5, we see that tracking error varied through time from 3.0% down to 0.6%. We observe the same tracking error contribution dynamic as the prior mixes. Going back to our budget of 1-3%, the average result of this portfolio construction would have been 1.4%. Looking at the number of observations in the 1-3% range, 68% fell within this range, which is the lowest among the three mixes considered.

Mix 3 and 4 appear to be the most appropriate as tracking error would have stayed within the target range more than 70% of the time. At this point the stakeholders will then need to determine the best tradeoff between staying in the tracking error range with greater frequency or pursing additional alpha.

A closer look at active manager risk

As discussed above, Active Manager Risk is one of the three sources of active risk in portfolios. Investors incur Active Manager Risk as the managers they have hired make active bets relative to their respective benchmarks. Verus produces an annual Active Management Environment research piece which illustrates the efficiency of each major public asset class[11]. In this research we analyze the risk and return characteristics of *every active manager in a universe* to calculate the properties of the universe as a whole. This data is used to generate a plot of the universe through time. For more information, the 2021 edition of this research can be accessed by clicking here. A quick illustration of the data in this research is also provided below.

The movement of the universe, the change in shape and of size all provide information about product behavior.

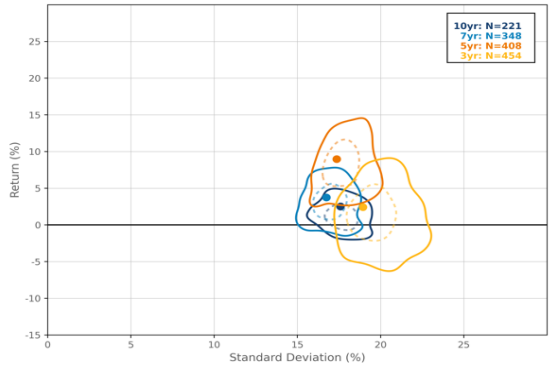


The number of products included in the analysis provides insight into the robustness of the analysis.

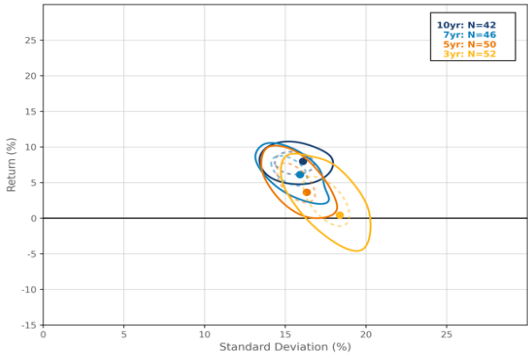
The position of the benchmark relative to the universe may also change through time, representing dynamic structure changes.

Generally, active management is a more attractive proposition in less efficient asset classes which provide skilled active managers greater opportunity to create value. Below are specific examples from the Verus 2021 Active Management Environment:

EQUITIES: EMERGING MARKETS



REAL ESTATE: U.S. REITS



Source: eVestment, as of 9/30/20. Universe returns have been adjusted for fees and survivorship bias. Equities benchmark displayed is MSCI Emerging Markets Index. Real estate benchmark displayed is Wilshire REIT.

In the context of the emerging market equity universe above, active management is more appealing when a greater number of active managers have exceeded the benchmark return (more of the "circle" is above the benchmark return "dot"). It appears that less than half of managers have outperformed the benchmark in this universe. We also observe that the dispersion between the strongest and weakest performing managers is fairly large. This might suggest greater opportunity for skilled managers to deliver strong performance above and beyond the benchmark, though it may also mean greater consequences for investing with managers who perform poorly. Lastly, most managers appear to be taking on more risk than the benchmark, but have not necessarily been compensated for that additional risk, on average.

In the context of the U.S. REIT universe above, most active managers have in fact outperformed the benchmark, which suggests active management has been attractive in this asset class. Interestingly, some of the strongest performing active REIT managers have taken less risk than the benchmark. With this information, an investor might decide to seek a manager with the ability to take less risk than the benchmark while delivering greater-than-benchmark returns.

Using the Verus Active Management Environment as a guide, this exercise can be performed across the entire portfolio, informing a proposed active/passive allocation.

Risk budgeting challenges

There are many challenges in defining and creating an active risk budget. Since risk changes through time, it is important to think about budgeting as an evolutionary process. If budgets are too tight, they will be violated too frequently and if budgets are too loose, they will never be enforced and lose their value. Institutions should fine-tune budgets as conditions change. Active risk can be decomposed in many different ways. A manager selecting stocks will likely

want to know how individual securities contribute to active risk across allocation and selection dimensions. An investment officer may want to know how managers contribute to tracking error within a specific asset class. An investment committee may be most concerned with understanding how each asset class or manager contributes to total portfolio active risk. And a board may be most concerned with setting and revisiting the total active risk budget. It's important to clearly define the purpose and objective of risk budgeting in order to establish how the analysis is conducted and communicated throughout the organization.

Conclusion

Active risk budgeting is valuable in the construction, monitoring, and overall governance of the investment portfolio. An active risk budget identifies how much risk an investor wants to take in the portfolio and where the investor plans to allocate that risk. We believe risk budgeting can improve portfolio results by more closely integrating alpha targets, tracking error, active/passive considerations, manager selection decisions, and overall portfolio construction. It is valuable in monitoring investment structure and can improve the overall governance of the investment program as investors can communicate the purpose and objective of many underlying decisions in the context of the overall portfolio. For additional information regarding approaches to active risk budgeting, please reach out to your Verus consultant.

Notes & Disclosures

1 *We assume here an expected excess return of 0%.*

2 *68% of the data falls within one standard deviation (B/C) and 95% percent within two standard deviations (D/E).*

3 *Excess returns are sometimes not normally distributed. In this case, excess returns could come in outside of the expected range more often than what is implied by the distribution shown. Occasional very large losses or gains may occur with non-normal performance.*

4 *Sullivan, Danny. The Investment Golden Rule. Verus Topic of Interest. October 2019.*

5 *Davis, Ben and Menchero, Jose. Risk Contribution is Exposure times Volatility times Correlation. 2010. MSCI Barra Research Insights.*

6 *It is important to note that often the largest source of active risk in portfolios is private markets and alternative assets. Private equity performance, for example, should reasonably be expected to vary substantially from the benchmark, resulting in larger tracking error, as these strategies tend to be concentrated (fewer underlying investments), exposed to more factor risk (size and value factors in particular), with notable amounts of leverage employed. Although we do not go into those details in this research piece, we believe investors should make an effort to estimate tracking error of their private markets and alternative asset exposure, despite these estimates being trickier to gauge relative to the public markets.*

7 *Miller, Whit and Rao, Anil. Manager Risk Contribution: Attributing Risk in a Multi-manager Portfolio. Consultant Insight. MSCI. February 2014.*

8 *We are intentionally excluding the due diligence process for individual managers in this piece for the sake of brevity, but this is an essential component of constructing portfolios.*

9 *The level of tracking error that is taken in the portfolio should be related to the amount of alpha being targeted. It's generally better to select a range of acceptable tracking error and information ratios to target given how these observations can change through time.*

10 *The end of period tracking error measure the last observation using 3-year rolling tracking error. The Tracking error range provides a range of the maximum observation minus the minimum, highlighting how these observations can change through time. The column % of results in Tracking Error budget look at each period historically and measure the number of observations that exist in the stated range. The average alpha calculates the annualized average alpha over the entire period. And the average information ratio measures the annualized alpha divided by the average tracking error.*

11 *"Efficiency" is referred to here as the broad ability of active managers in each asset class to create value for their investors. Adding value might be accomplished through delivering benchmark-like returns but at less risk than the benchmark, or delivering higher return than the benchmark but with a more attractive risk profile, etc.*

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