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Smart Beta—Here's where you can put it…

One of the most common questions we field about smart beta strategies is how they fit into a portfolio. Investors wonder whether to evaluate such strategies as a subset of passive exposure, as systematic (rules-based) active funds, or as an entirely new approach to investing.

Overview

This paper discusses what we consider to be the most useful way to evaluate any decision to go off-benchmark. We make the case that simple tools can be used to quantify the decision-making process.

Specifically, we will argue that:
- The efficacy of any off-benchmark investment strategy is determined by a meaningful and significant alpha.
- Such alpha must be evaluated against the "cost" to achieve it—namely, the **Tracking Error** (TE) between the portfolio and the benchmark.
- The **Information Ratio** (which we will define as alpha over tracking error) is an absolutely critical way of combining these two numbers, and is arguably the most important single number used to determine whether moves away from benchmark were justified.
- It is necessary to determine if a strategy has been able to achieve alpha in the past before questioning its likelihood of doing so in the future.
- The alpha/tracking error pairing can be used to provide simple, probabilistic insights into the likelihood that a strategy outperforms its benchmark over a given timeframe.

Finally, we will end with:
- A discussion of why not all Information Ratios are the same, and how investors should care about the number's composition as well.
- Some comments on combining portfolios with benchmarks, with an emphasis on how different weightings can result in different characteristics.

1 | The most important question in off-benchmark investing

How to become blunt, cold, and complex

Imagine a strategy that started by replicating a particular index, and then moved away from market capitalization weightings. In other words, a shift into active allocations. What is the single most important piece of information required from the manager before deciding whether to invest?

In our opinion, the most critical hurdle that any off-benchmark investment manager must clear is: "Net of all fees, have you generated an economically meaningful, and statistically significant, positive alpha to your benchmark?"

You may not like it (it's blunt, cold, and complex) but, it seems to us, that this question crystallizes what successful investment management is all about.

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And the reason is that it invokes a very powerful, almost inarguable focus on the one metric—alpha—that was the ultimate reason for going off benchmark. What we are asking with this one question is:

- Has the portfolio manager been justified in their decision to shift away from an index, i.e. have they generated a positive alpha?
- Is the alpha worth capturing?
- Is it a "genuine" alpha, at least as far as the standard tools of statistical analysis allow us to gauge?
- Has it been achieved after all expenses have been accounted for?

These questions, we would argue, should be answered affirmatively before even considering a deviation from a benchmark exposure.

Alpha is worth focusing on because it forces us to measure only return that has been generated once risk has been accounted for, as the below example demonstrates. For simplicity, let's assume that the risk free rate is 0% (which is not only simple, but in fact close to reality today). Under this assumption, we can think of alpha as the difference between the return of the portfolio [R(p)] and the beta-adjusted return on the market [R(m)]:

$$\text{Alpha} = R(p) - \text{Beta}(p) * R(m) \quad (1)$$

Let's suppose a hypothetical example where:

- There are only two states of the world: the market is up +10%, or down –10%.
- There are only two portfolios: with betas of 1.2 or 0.8.
- The returns to these portfolios are as indicated in Figure 1.

It is impossible to tell whether a fund has done well by simply comparing its performance to the market. You also need to know how much systematic risk was present. Highlighted in the table, there are a number of counterintuitive situations where investors need to exercise caution. For instance, a high-beta portfolio may have beaten the market but generated negative alpha, and similarly, a low beta portfolio may have underperformed the market but generated positive alpha.

Is the juice worth the squeeze?

So far we have focused on the alpha generation side of the equation (the "juice") but, as is so often the case in investing, there is a trade-off. Alpha is only possible if a fund's performance deviates from that of the benchmark. The extent that portfolio return deviates from benchmark and non-benchmark returns can be quantified by using tracking error (TE, the "squeeze") which is defined as the standard deviation of the portfolio's excess returns over benchmark returns.

Though tracking error is a well-known metric, it is still worth reminding ourselves of a few important features:

- It will always be positive.
- It is likely to be considerably lower than the risk of either the portfolio or the benchmark.
- It scales linearly (as we explain later).

Armed with both alpha and tracking error we can finally compile the Information Ratio, the all—encompassing ratio of the two. The Information Ratio details the alpha achieved and the risk taken to get it, similar to how the Sharpe Ratio exhibits an investment's risk-adjusted performance.

Figure 1: Quantifying portfolio performance under various scenarios

Market Was…	Portfolio Beta Was…	Your Return Was…	Did You Beat the Market?	Your Result Was…
Up+10%	1.2	13%	Yes	Great: Alpha = +1%
		11%	Yes	Poor: Alpha = –1%
	0.8	9%	No	Great: Alpha = +1%
		7%	No	Poor: Alpha = –1%
Down–10%	1.2	–11%	No	Great: Alpha = +1%
		–13%	No	Poor: Alpha = –1%
	0.8	–7%	Yes	Great: Alpha = +1%
		–9%	Yes	Poor: Alpha = –1%

Source: FTSE Russell for the period of 10/31/2001 through 4/28/2017. **Past performance may not be indicative of future results. For illustrative purposes only and is not meant to represent the Funds. The most recent Fund performance is available at (855)329-3837.**

When it comes to Information Ratios, the higher the better. (Note it is sometimes defined slightly differently. We have seen both alpha and excess return in the numerator. For portfolios with betas close to one, the distinction won't matter.)

Alpha = R(p) – R(m), when R(f) = 0% and Beta = 1 **(2)**

Therefore, one key point to remember here is that, for investors who care about tracking error, higher alphas do not necessarily indicate preferred investments. Investors must compare the information ratios of investments to determine whether higher alpha comes at the expense of higher risk (TE), and therefore whether the juice is indeed worth the squeeze. Choosing the lower-alpha strategy is better only if its information ratio is higher than a comparable higher-alpha strategy, because it achieves more alpha per unit of risk. In other words, a higher information ratio shows "more bang for your buck", regardless of the level of alpha.

2 | Learning to love alpha

Hmm, you weren't just lucky were you?

Any reported alpha number, as well as being economically meaningful, has to be statistically significant. Alpha represents the point at which a trend line crosses the y-axis in a scatterplot of benchmark and portfolio (i.e. an off-benchmark asset) returns. When alpha is positive, as we want it to be, this means that a zero benchmark return corresponds with positive portfolio return on average. The trend line in Figure 2 below demonstrates alpha, because the trend line crosses the Y axis slightly above zero.

Figure 2 illustrates a scatterplot of the monthly returns of a FTSE Russell 1000 multifactor index on the y-axis (a smart beta index with factor exposures) and the standard market-cap weighted Russell 1000 index on the x-axis. The former is the portfolio, and the latter the benchmark. This example is purely illustrative.

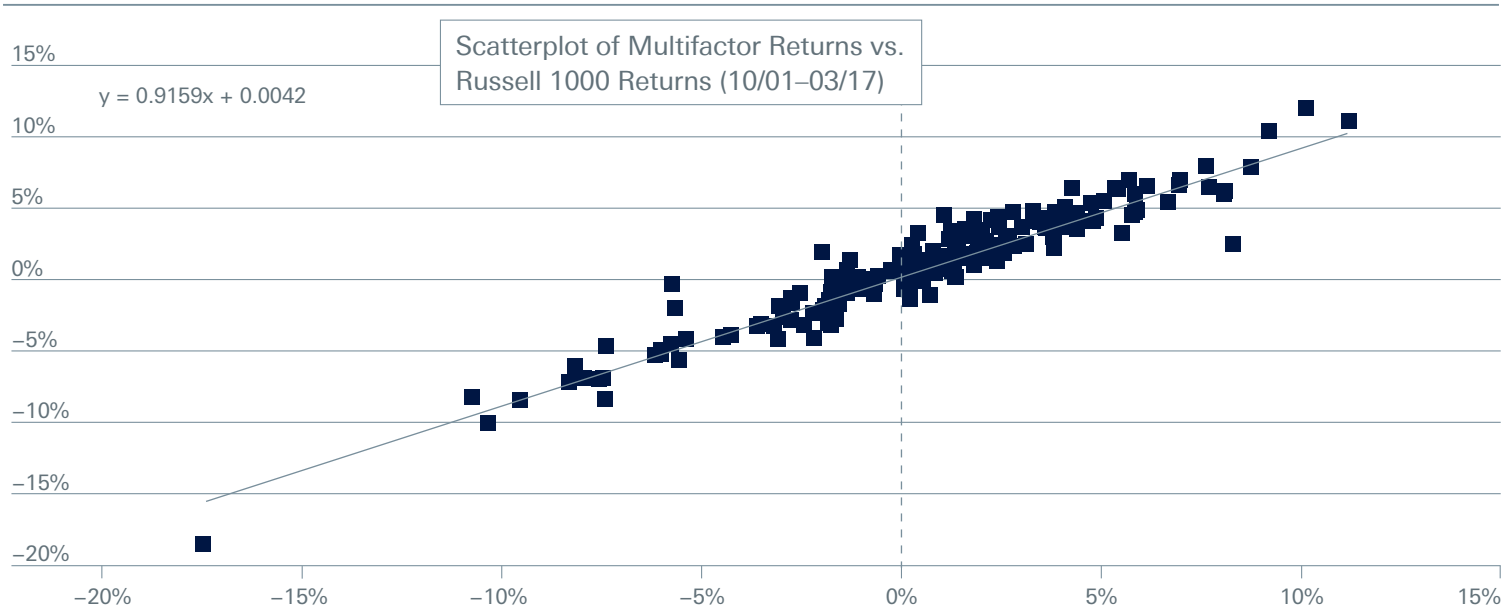
The equation in the upper left of the chart is for the line of best fit, and can be interpreted as follows. It says that, in any given month, the best model of the multifactor index's returns will be 0.42% plus 0.92 multiplied by the return of the Russell 1000. In other words, the multifactor index has had a beta of 0.92 to the Russell 1000 and a monthly alpha of ~0.42%.

Investors must ask, "how confident can I be in that alpha number?—Is there a risk that it is positive just by chance?" The simple way to address that question is by estimating (or, better yet, asking the fund manager to provide!) the t-stat for the alpha. As a rule of thumb, if the t-stat is greater than 2, that is generally accepted as evidence (at around the 95% confidence level) that the alpha is genuine (statistically significant). For the above data, the alpha's t-stat is 4.7, well above the required threshold and strong evidence of genuine risk adjusted outperformance, albeit on a simulated strategy.

An analogy may help. Suppose we claim to be the world's best coin-tossers, and can throw heads at will. The natural skeptic that you are, you would ask us to prove this. After determining that the coin is indeed fair, you witness us throw a head. You likely would not accept one toss as proof of coin tossing ability. Presumably, you would need to see the feat repeated. If we threw another head, would you now be happy? Even a terrible coin-tosser would get two heads in a row a quarter of the time. At a certain point, however, you would be satisfied that we are indeed able to throw heads at will. As we toss more heads, the probability that we are just lucky decreases, and the probability that we are skillful increases.

Alpha generation operates in a similar way. Anyone can beat the market by chance, but ensuring that an alpha is meaningful (t-stat greater than 2) helps to discern luck from skill. This is why track record is important and why bigger sample sizes matter.

Figure 2: Scatterplot of Monthly Returns of the FTSE Russell 1000 Comprehensive Factor Index vs. the Russell 1000 Index (10/01–03/17)



Source: FTSE Russell for the period of 10/31/2001 through 4/28/2017. **Past performance may not be indicative of future results. For illustrative purposes only and is not meant to represent the Funds. The most recent Fund performance is available at (855)329-3837.**

Dialing it up and down

One of the nice properties of alpha and tracking error is that they dial up and down in an intuitive, linear way when portfolios are combined with benchmarks. To demonstrate this, we used the same data set to create five portfolios with varying degrees of movement away from the benchmark. Some of the key portfolio metrics are presented in Figure 3.

Note that the return goes up as more of the portfolio is included (this makes sense, given it was an alpha–generative strategy as we established before) but the risk remains relatively stable. However, the Information Ratio is effectively constant. Why? It's because the Information Ratio uses a different measure of "cost" than the standard portfolio volatility. It specifies the degree of deviation from the benchmark, the tracking error, which was required in order to generate the alpha. As more clips of the portfolio replace the benchmark, then clearly the resulting overall portfolio becomes more differentiated from the benchmark. In other words, the Information Ratio recognizes a different type of penalty paid for outperformance.

Though it's easy to understand why alpha, a "return-like" metric, should scale linearly as the weight of the portfolio is increased, it's not quite so obvious why that should be the case with tracking error. Consider that the benchmark is effectively a risk-free asset if risk is defined as tracking error. If one recalls combinations of a risky asset and a risk-free asset in Capital Asset Pricing Model (CAPM) terms, then the same point applies here—that clips of the asset (or, here, portfolio) that don't have risk (volatility in CAPM, tracking error here) will combine linearly.

Figure 3: Key metrics of five portfolios with varying combinations of benchmark and portfolio weights

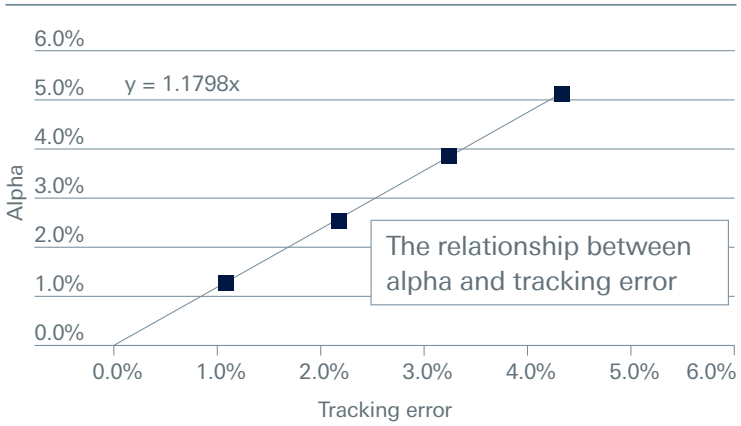
	A	B	C	D	E
Benchmark weight	100%	75%	50%	25%	0%
Portfolio weight	0%	25%	50%	75%	100%
Return	7.90%	9.09%	10.28%	11.46%	12.65%
Risk	14.44%	14.17%	13.98%	13.88%	13.86%
Reward-to-risk	0.55	0.64	0.73	0.83	0.91
Alpha	0.00%	1.25%	2.52%	3.81%	5.11%
Tracking error	0.00%	1.08%	2.16%	3.23%	4.31%
Information ratio	N/A	1.16	1.17	1.18	1.18

Source: FTSE Russell for the period of 10/31/2001 through 4/28/2017. **Past performance may not be indicative of future results. For illustrative purposes only and is not meant to represent the Funds. The most recent Fund performance is available at (855)329-3837.**

Figure 4 makes the point even more explicit, showing the relationship between the alpha and tracking error of these five portfolios. Again, and not to labor the point, it can be seen that there is a linear relationship between the two. The Information Ratio itself is the slope of the line of best fit on the plot, which here is about 1.18. The increase of the ratio across portfolios A to E reflects that higher alphas have a slightly higher degree of compounding built in.

For now, consider an investor who uses the Information Ratio as his or her main method of evaluation. In theory, this investor should be indifferent to being invested anywhere on this line. The tradeoff between alpha and tracking error, after all, is the same at each point. In practice that won't be the case, as investors may have specific tracking error limits or prefer higher alpha portfolios.

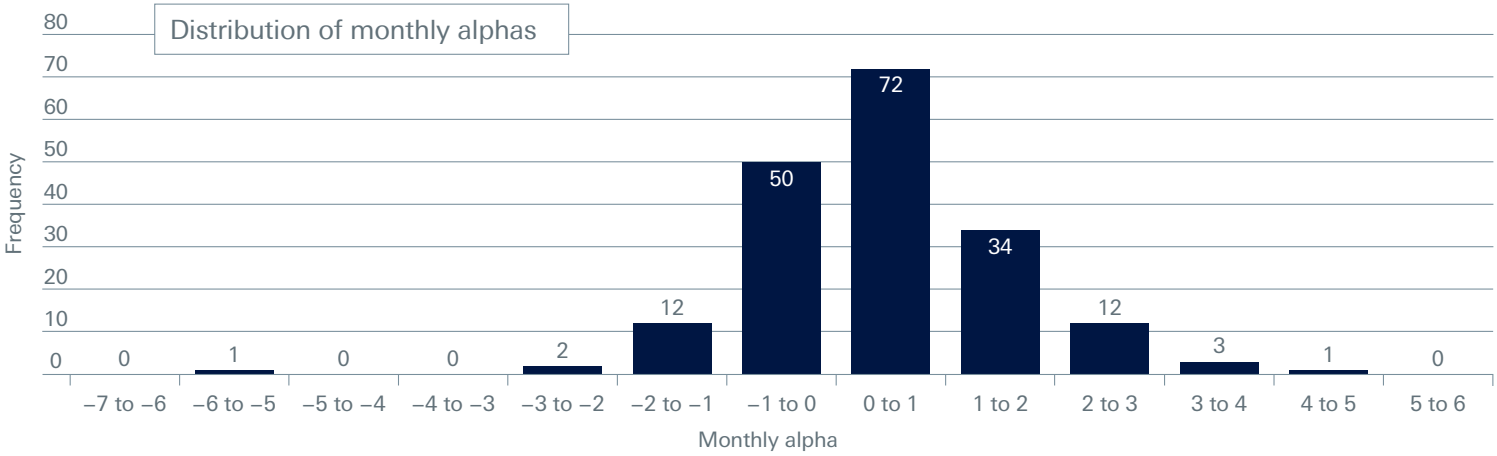
Figure 4: The linear relationship between alpha and tracking error



Source: FTSE Russell for the period of 10/31/2001 through 4/28/2017. **Past performance may not be indicative of future results. For illustrative purposes only and is not meant to represent the Funds. The most recent Fund performance is available at (855)329-3837.**

The final point we'd like to make about the combination of alpha and tracking error is that it can be used to approximate probabilistic estimates of the chance of outperformance in a given period. Figure 5 (it wouldn't be a white paper without a bell curve) shows the distribution of the monthly alphas of the FTSE Russell Comprehensive Factor Index to the Russell 1000.

Figure 5: The distribution of monthly alphas of the FTSE Russell Comprehensive Factor Index and the Russell 1000 (10/01–03/17)



Source: FTSE Russell for the period of 10/31/2001 through 4/28/2017. **Past performance may not be indicative of future results. For illustrative purposes only and is not meant to represent the Funds. The most recent Fund performance is available at (855)329-3837.**

These alphas were estimated by using the beta of the regression of the multifactor index on the market cap index. That regression results in a beta for the multifactor index of 0.92 (which is significantly lower than one, its 95% confidence interval is 0.87–0.96). Each monthly market return was multiplied by the beta and then the difference was taken between the return on the multifactor index and the beta adjusted return on the market to generate a series of monthly alphas.

As can be seen visually, the distribution is approximately normal with a mean of ~0.42% and a standard deviation of 1.19%. Annualized equivalents would be a mean of 5.11% and a standard deviation of 4.13%. Note how close this risk number is to the tracking error we cited in Figure 3. As we said earlier, when beta is one, the excess return and the alpha will be the same.

Using the normality of the alphas, investors can use the standard interpretation of a normal distribution to draw conclusions about the likely ranges and probabilities of their alphas. Figure 6 shows how close theory and practice were in this case.

Figure 6: Theoretical and Empirical Monthly Alpha Ranges and Results

	Theoretically implied probability for a normal distribution	Empirically observed probability, seen in our data
One standard deviation band (–0.77% to 1.61%)	68.3%	75.4%
Two standard deviation band (–1.96% to 2.80%)	95.4%	95.7%
Three standard deviation band (–3.55% to 3.99%)	96.7%	98.9%
Negative monthly alpha	36.2%	34.8%
Positive monthly alpha	63.8%	65.2%

Source: FTSE Russell for the period of 10/31/2001 through 4/28/2017. **Past performance may not be indicative of future results. For illustrative purposes only and is not meant to represent the Funds. The most recent Fund performance is available at (855)329-3837.**

3 | Not all ratios that are the same, are the same

When we learn finance, we're taught that higher Sharpe ratios are strictly preferable. And that makes a lot of sense. A portfolio with higher return for a given level of risk should be preferred, as should one with a lower level of risk for the same return. Indeed, we have gone to some pains in this paper to describe why we believe similar thinking holds true for the Information Ratio.

However, is this necessarily true? To what extent might an information ratio of 1 achieved from an alpha of 2% and a TE of 2%, differ from a separate Information Ratio of 1 that is instead achieved from an alpha of 4% and TE of 4%? the next section talks about some of the practical combinations of these "alpha vehicles" with a benchmark.

Figure 7 illustrates that assets which generate different alphas, but have the same information ratio (i.e. 1) can be combined with a benchmark in various proportions to produce the same alpha. For example, as shown in the table, for a given TE budget of 2%, a 50% allocation to the asset that has a 4% alpha and a 50% allocation to the benchmark will yield an overall portfolio alpha of 2%, which matches a 100% allocation to the 2% alpha asset.

The table also illustrates that across all TE budgets, higher Information Ratio assets strictly dominate (in terms of providing higher alpha) those assets whose information ratios are lower.

Lastly, the table illustrates that investors who are willing and able to take on more risk (i.e. have a higher TE budget) are able to achieve higher alpha vis-à-vis investors who have a lower TE budget.

Figure 7: Combining an alpha generating vehicle with its benchmark

IR	Alpha	TE	Weight in the alpha vehicle (portfolio alpha)				
1.00	4%	4%	0% (0%)	25% (1%)	50% (2%)	75% (3%)	100% (4%)
0.50	2%	4%	0% (0%)	25% (0.5%)	50% (1%)	75% (1.5%)	100% (2%)
1.00	2%	2%	0% (0%)	50% (1%)	100% (2%)	100% (2%)	100% (2%)
0.50	1%	2%	0% (0%)	50% (0.5%)	100% (1%)	100% (1%)	100% (1%)
			0%	1%	2%	3%	4%
					TE budget		

Source: FTSE Russell for the period of 10/31/2001 through 4/28/2017. **Past performance may not be indicative of future results. For illustrative purposes only and is not meant to represent the Funds. The most recent Fund performance is available at (855)329-3837.**

Conclusions

In summary, investors cannot generate alpha in an investment portfolio that merely replicates the benchmark. Anyone reaching for alpha will have to deviate from their benchmark. In analyzing performance, they must account for how their risk-adjusted return compares to that of the benchmark's by using both the Sharpe Ratio and the Information Ratio.

Investors must take a portfolio-level perspective to determine how a given alpha-generating strategy can enhance overall returns. Essential to this way of thinking, they must determine the optimal percentage of a portfolio that they allocate to an alpha-generating strategy given the level of tracking error that they are willing and able to accept.

Our view is that investors should prefer higher Information Ratios over lower ones in general. For an investor who is not constrained by a particular tracking error target, higher alpha-generating strategies even with the same Information Ratio could be preferred. These two guidelines enable investors to maximize portfolio alpha on a risk adjusted basis when they invest in strategies that have generated statistically significant alpha.

Below we have provided you with a brief framework for the steps needed to evaluate whether or not to include smart beta in your portfolio and to what extent.

Making investments using a smart beta framework:

- Determine an investment's historical net of fee returns.
- Assign an appropriate benchmark.
- Estimate alpha.
- Is alpha positive, statistically significant and economically significant?
- What did it cost to achieve this alpha, i.e. what is the Tracking Error?
- What is the investment's information ratio?
- Screen for investments with high information Ratios.
- Determine your Tracking Error budget to decide the proportion by which you combine the benchmark and the alpha-generating asset.

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Glossary

Alpha—a measure of the active return on an investment. An investment's alpha is the excess return relative to the beta-adjusted market return.

Beta—the measure of the volatility or systematic risk of a security or a portfolio in comparison to the market as a whole and is used in the capital asset pricing model (CAPM).

Capital Asset Pricing Model (CAPM)—describes the relationship between risk and expected return and is used in the pricing of risky securities.

Regression—a statistical measure of the relation between the mean value of one variable (output) and corresponding values of other variables (such as time and cost).

Standard Deviation—often used to represent the volatility of an investment. It depicts how widely an investment's returns vary from the investment's average return over a certain period.

T-statistic—used to test hypotheses. It is a ratio of the departure of an estimated parameter from its notional value (total value of a leveraged position's assets) and its standard deviation (volatility).

Tracking Error—a divergence between the price behavior of a position or a portfolio and the price behavior of a benchmark.

FTSE Russell 1000 Index—tracks the performance of the 1,000 largest stocks in the Russell 3000 Index, which consists of the 3,000 largest U.S. companies as measured by market capitalization.

FTSE Russell 1000 Comprehensive Factor Index—a benchmark designed to capture exposure to five factors—Quality, Value, Momentum, Low Volatility and Size. These factors represent common factor characteristics for which there is a broad academic and practitioner consensus, supported by a body of empirical evidence across different geographies and time periods.

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