A Framework for Analyzing Multifactor Funds

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Executive Summary

The case for multifactor funds is essentially the case for diversification, which Nobel Memorial Prize-winning economist Harry Markowitz has described as the only "free lunch" in investing. Investors shouldn't put all their "eggs" in one factor. But just because the argument for factor diversification is simple doesn't mean that selecting and sticking with a multifactor strategy is easy. In fact, in light of the proliferation of multifactor funds, choosing from the now-expansive menu is becoming more difficult by the day. In this paper, we take a closer look at the case for spreading factor bets, provide a framework to help investors navigate the multitude of multifactor funds, and profile a select set of the funds to bring this checklist to life.
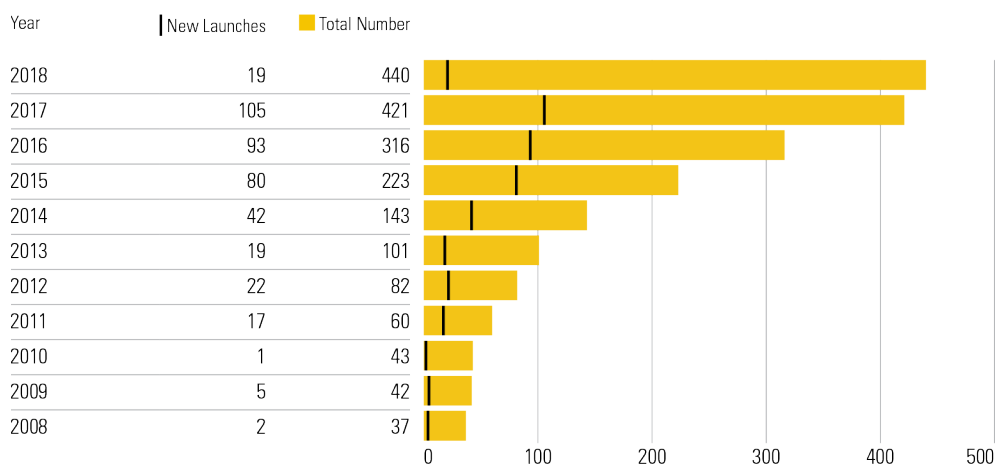
Key Takeaways

▶ The number of multifactor funds has mushroomed. As of April 30, 2018, there were 440 index mutual funds and exchange-traded funds that were assigned the multifactor strategic-beta attribute in Morningstar's global funds database. A total of 351 of those 440 were launched during the preceding five years.

▶ The case for multifactor funds is straightforward; fund selection is far less so.

▶ Portfolio construction matters. It is vital that investors parse the specifics of these strategies to understand their selection universe, their stock-selection process, their weighting decisions, and their constraints.

▶ Costs matter. Many of these funds, while competitively priced versus actively managed peers, are more expensive relative to ETFs tracking broad, cap-weighted benchmarks. High fees will ultimately erode long-term gains and should be examined carefully.

▶ Expectations might matter most. These funds are no magic elixir. Investors' ability to reap the prospective rewards the funds might offer depends on their ability to stick with them through inevitable ups and downs.

▶ The framework for evaluating multifactor funds outlined in this paper allows investors to focus on the features of these funds' different approaches to portfolio construction that will have the greatest influence on their factor exposures and ultimately their return and risk profiles.

▶ We animate this framework by profiling several multifactor funds that we have sampled from the global menu.

The Expanding Menu of Multifactor Funds

The number of multifactor funds has mushroomed. As of April 30, 2018, there were 440 index mutual funds and ETFs that were assigned the multifactor strategic-beta attribute in Morningstar's global funds database[1]. A total of 351 of those 440 were launched during the preceding five years.

Assets in these funds have grown commensurately. As of the end of April 2018, their collective assets under management stood at $74 billion. Ten years ago, this collection of funds collectively held just $2.5 billion of investors' money. Much of this growth has been organic. Over the decade through April 2018, these funds amassed an estimated $58.3 billion in net new flows.

Exhibit 1 The Number of Multifactor Funds Is Multiplying

Year	New Launches	Total Number
2018	19	440
2017	105	421
2016	93	316
2015	80	223
2014	42	143
2013	19	101
2012	22	82
2011	17	60
2010	1	43
2009	5	42
2008	2	37

Source: Morningstar Direct. Data as of April 30, 2018.

[1] This figure represents the global universe of index-tracking multifactor mutual funds and exchange-traded funds and does not include quantitative active equity funds, some of which are profiled later in the report.

Exhibit 2 Assets Invested in Multifactor ETFs and Index Funds Are Mushrooming
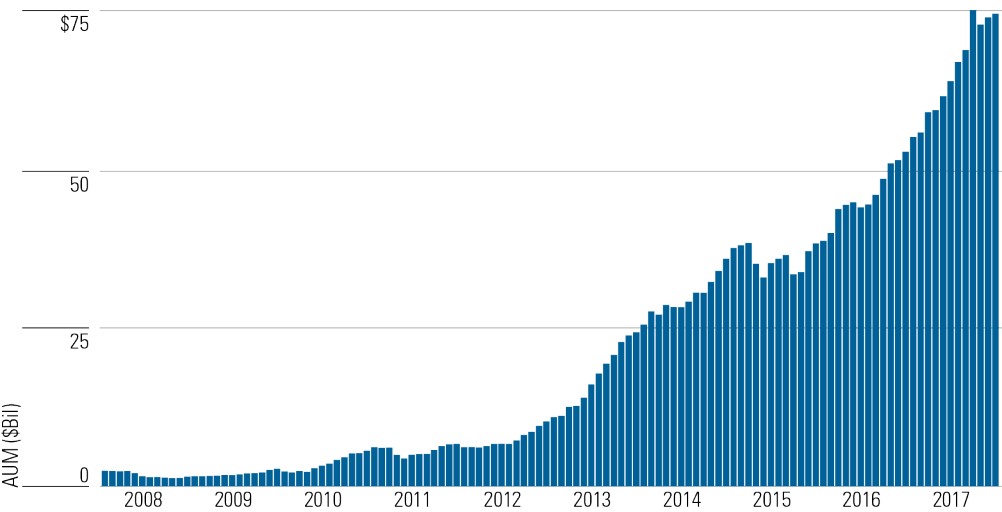
Source: Morningstar Direct. Data as of April 30, 2018.

Exhibit 3 Net New Flows Have Been Driving Growth
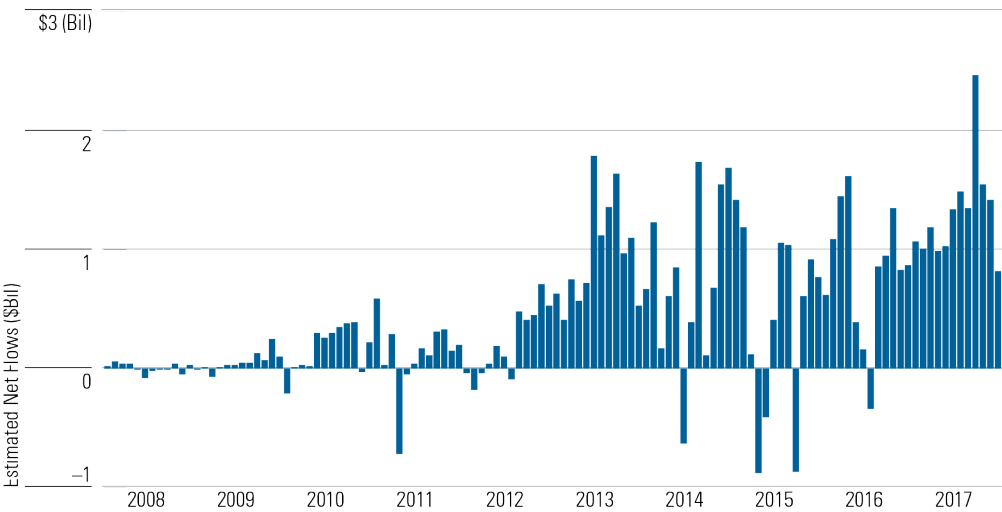
Source: Morningstar Direct. Data as of April 30, 2018.

The Case for Multifactor Funds

The case for multifactor funds is essentially the case for diversification, which Nobel Memorial Prize-winning economist Harry Markowitz has described as the only "free lunch" in investing. Investors shouldn't put all their "eggs" in one factor.

All by Myself

Academics and practitioners have documented hundreds of individual factors, though few are widely accepted as being credible.[2] By our count, the ones that best hold water amount to five: value, momentum, size, quality, and low volatility. Each of these factors has been vetted by multiple scholars and professional investors. Many are present across asset classes and in different markets around the world. They have been subsequently tested out of sample and still pass muster. They are, in a word, legit.

Exhibit 4 shows the performance of some of these factors in a long-only implementation as represented by their corresponding variants of the MSCI World Index over the past 15 years. Over this span, each of these indexes has outperformed its market-cap-weighted parent. Furthermore, all but one of them also produced superior risk-adjusted returns, as measured by Sharpe ratio. Are these factors a "free lunch"? Hardly.

Exhibit 4　Trailing 15-Year Returns for MSCI World Index and Factor Variants
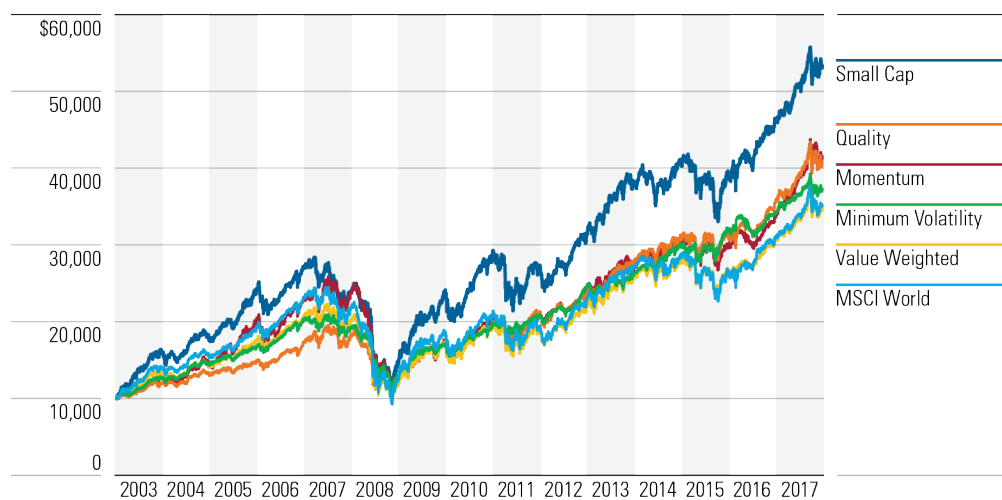
Source: Morningstar Direct. Data as of April 30, 2018.

What Exhibit 4 doesn't adequately depict is the cyclicality of these factors' performance. While each of the factor variants of the MSCI World Index delivered better absolute—and in most cases risk-adjusted—performance relative to their parent benchmark during the period in question, it was not

2　Harvey, C.R., Liu, Y., & Zhu, C. 2015. "…and the Cross-Section of Expected Returns." Feb. 3. https://ssrn.com/abstract=2249314 or http://dx.doi.org/10.2139/ssrn.2249314

smooth sailing. This is apparent in Exhibit 5, which is a "quilt" of these factor indexes' calendar-year returns over the past 10 years.

Exhibit 5 "Factor Quilt" — Annual Returns for MSCI World Index and Factor Variants

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
−29.68	44.12	26.13	7.29	17.55	32.38	11.37	5.16	12.71	30.04
−33.84	34.26	14.55	3.84	16.34	27.92	8.45	3.71	11.44	25.96
−40.71	32.56	12.03	2.50	15.83	27.46	5.16	2.96	7.51	22.66
−41.12	29.99	11.76	−5.54	13.05	27.06	4.94	−0.31	7.47	22.40
−41.88	16.43	11.27	−8.73	12.07	26.68	2.36	−0.87	4.55	21.38
−42.95	12.27	10.70	−9.06	8.06	18.61	1.90	−4.11	2.35	17.32

Legend:
- MSCI World Small Cap
- MSCI World Minimum Vol
- MSCI World
- MSCI World Quality
- MSCI World Value Weighted
- MSCI World Momentum

Source: Morningstar Direct. Data as of April 30, 2018.

Each of these factors has and will continue to experience its own unique cycles. Stretches of market-beating performance will invariably be followed by prolonged droughts. For example, value — as defined here by the corresponding variant of the MSCI World Index — is in the midst of a decade-long dry spell during which it has lagged the market by a wide margin.

One piece of data that is also useful as a crude proxy for this cyclicality is each factor's tracking error relative to its parent index. The further, on average, the performance of each factor index strays from that of its parent, the more discomfort an investor might experience. If past behavior is any guide (we think it is), then discomfort will often lead investors to abandon sound strategies at precisely the wrong time.

Owning a proven factor on a stand-alone basis has the potential to deliver better risk-adjusted returns relative to owning the market, but it is hardly a free lunch. Bouts of underperformance can lead to buyer's remorse, which in turn can create the risk of bad investor behavior.

Better Together

Value, momentum, size, quality, and low volatility are members of the factor "A-Team." In our minds, value and momentum are the John "Hannibal" Smith and Bosco Albert "B.A." Baracus of factors. The former is the battle-tested leader of the group, cool under pressure and known to enjoy "cigar butts." The latter is known for being unpredictable and having a short fuse. Each member of this factor A-Team contributes its own unique and complementary talents in a team setting. The key to getting the chemistry right is sensible diversification—pairing factors that zig with teammates that zag under a given set of market conditions.

Exhibit 6 is a correlation matrix that shows the correlations of the excess returns among the factor variants of the MSCI World Index that are also featured in Exhibit 4 and Exhibit 5. It is apparent that some factors, measured strictly in terms of their historical correlations, are better complements than others. Value and momentum are like peanut butter and jelly. Meanwhile, quality and minimum volatility are like peanut butter and cashew butter.

Exhibit 6 Correlations of Excess Returns

Name	Value Weighted	Minimum Volatility	Quality	Momentum	Small Cap
MSCI World Value Weighted	1.00	—	—	—	—
MSCI World Minimum Vol	−0.49	1.00	—	—	—
MSCI World Quality	−0.72	0.51	1.00	—	—
MSCI World Momentum	−0.59	0.26	0.36	1.00	—
MSCI World Small Cap	0.27	−0.32	−0.48	−0.02	1.00

Source: Morningstar Direct. Data from May 2003 through April 2018. Excess return calculated versus MSCI World Index.

Diversifying across complementary factors makes sense. Doing so will mitigate the aforementioned cyclicality associated with owning any one factor in isolation. While this could result in inferior long-term results relative to owning the best-performing factors in isolation, no one knows what those factors will be on an ex-ante basis and few have the stomach to stick with them for decades. Perhaps the single most compelling reason to opt for a multifactor strategy is that it will minimize the biggest risk of all— that investors will bail on a factor, manager, or strategy when it experiences an inevitable period of underperformance.

What Matters

For most investors, owning a multifactor ETF is preferable to trying to build a do-it-yourself multifactor model, combining single factors on one's own. The "do-it-for-me" approach will likely be more efficient from a cost, tax, and behavioral perspective.

Combining stand-alone factors in a multifactor format is a sensible strategy to the extent that the factors in consideration are 1) credible, 2) well-constructed, and 3) combined in such a way as to improve the overall risk/reward profile of the resulting portfolio relative to owning any of the factors in a stand-alone format. Portfolio construction matters. It is vital that investors parse the specifics of these strategies to

understand their selection universe, how they choose stocks, how they weight them, and the constraints they put in place. Simplicity is likely to trump complexity. The more opaque and overwrought the process, the more likely it is a product of back-testing alchemy and the more likely it may be tweaked should its live performance not live up to its back-tested track record — a record that never looks bad.

Costs also matter. Many of these funds, while competitively priced versus actively managed peers, are more expensive relative to ETFs tracking broad, cap-weighted benchmarks. High fees will ultimately erode long-term gains and should be examined carefully.

Expectations might matter most. These funds are no magic elixir. Many have limited track records. No matter how sensible their process may seem, nor how low their fees, there's no guarantee they will deliver better risk-adjusted returns than a plain-vanilla cap-weighted index fund over a full market cycle. Much like single factors or good active managers, these funds will experience their own performance cycles (albeit potentially more-muted ones). Ultimately, investors' ability to reap the prospective rewards these funds might offer is positively correlated to their ability to stick with them through their inescapable ups and downs.

A Framework for Evaluating Multifactor Funds' Processes

Again, portfolio construction matters. When it comes to multifactor funds, the devil is in the details. Often, the details are many and they are nuanced. Here, we present a framework that will help investors to parse these funds' approaches to portfolio construction. This framework will help investors better understand these funds and (we hope) better manage their own expectation—which is critical to using them well.

1. What is the fund's selection universe?

The selection universe, also referred to as a *parent index*, is the collection of potential stocks that a fund whittles down to build its investment portfolio. This is typically a broad index, like the Russell 1000. The selection universe should serve as a benchmark for the fund's performance. It may also offer insight into the fund's potential to outperform its parent index and/or category peers. For example, the payoff to most investment factors has historically been the greatest among the smallest stocks. This may be because they are more likely to be mispriced than larger stocks. So—all else equal—funds that start with a universe of large- and mid-cap stocks (as most multifactor funds do) likely have less potential to outperform than those that start with an all-cap universe or a group of small-cap stocks.

2. Which factors does the fund target?

There are only a handful of investment factors that truly matter. These include:

Factors that may enhance returns

► Value
► Dividend yield is arguably a subset of value, though some break it out as a separate factor
► Small size
► Momentum
► Quality/profitability

Factors that may reduce risk

► Low volatility

Each of these factors has been extensively and independently vetted in academic research and has tended to pay off in nearly every geographic market studied over the long term. But more important, there are reasonable economic explanations for why each of these factors has worked and will likely continue to pay off. These include compensation for risk, behaviorally driven mispricing, and institutional frictions.

In contrast to the other four factors, low volatility doesn't aim to deliver higher returns than the market, but rather reduce risk and, in turn, potentially deliver better risk-adjusted performance than the market. While the low volatility factor can help diversify the others, it can disproportionately affect a fund's performance (unless the fund explicitly limits active risk from this factor). It can also reduce the fund's long-term return potential.

While there are myriad other factors, they either are not widely accepted, are not investable at scale (like illiquidity), or just repackage one or more of these core factors. It is best to stick to funds that target a combination of the core factors.[3]

3. How does the fund measure its targeted factors?

There are many ways to measure stocks' exposure to each factor. For example, a fund could measure value based on each stock's price/book, price/earnings, or enterprise value/EBITDA ratios, dividend yield, or some combination of those metrics. Sometimes one metric, or a set of metrics, will work better than another, but it isn't clear that there is an optimal way to define value. What matters is that the chosen metrics are:

► Simple, so as to reduce the risk of data mining (where the strategies' developers cherry-pick selection criteria to make a back-test look good)
► Transparent, so that investors understand what they are getting
► Clearly representative of the investment style to ensure the fund can achieve what it sets out to do

The specific metrics chosen tend to move the needle less than whether the fund measures each stock's factor characteristics relative to its sector peers or the entire universe. There is a trade-off between these two approaches. A sector-relative approach leads to less pronounced sector biases than the universe-relative approach. Sector bias can be a source of uncompensated active risk that often isn't necessary to capture the targeted factor.[4,5] A sector-relative approach can also improve comparability across stocks (particularly for the value and quality factors), as firms in the same sector tend to have

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3 While the market risk factor, or beta, is an important driver of returns, we excluded it from this list because stocks with a lot of exposure to market risk have not historically offered attractive compensation for this risk.

4 Bryan, A. & McCullough, A. 2017. "The Impact of Industry Tilts on Factor Performance." March 15, 2017. http://corporate1.morningstar.com/ResearchArticle.aspx?documentId=796630

5 Bryan, A. 2017. "Quality and Value Without the Sector Side Bets." July 19, 2017. http://www.morningstar.com/articles/816011/quality-and-value-without-the-side-sector-bets.html

more similar balance sheets and profitability than firms in different sectors. The drawback is that it may reduce the fund's factor purity, causing it to own stocks with weaker absolute factor characteristics than it would if it measured each stock against the entire universe.

One approach isn't clearly better than the other, but funds that don't control for sector differences would likely benefit from sector constraints, which can help improve diversification. After all, diversification is one of the core reasons to own a multifactor fund.

4. How does the fund combine its targeted factors?

There are two main approaches to combining multiple factors in a portfolio: mixing and integration. Funds that follow the mixing approach split their portfolios into individual sleeves that each target a distinct factor. For example, if a fund uses the mixing approach to combine value and momentum, it might dedicate half the portfolio to targeting value stocks (ignoring their momentum characteristics) and the other half to momentum (ignoring value). This approach is similar to combining individual factor funds, but it offers the advantage of lower turnover by allowing trades to partially offset as stocks move across sleeves.

The mixing approach is simple, transparent, and facilitates clean performance attribution, making it easy to gauge the impact of each factor on the fund's performance. That said, it can dilute the fund's overall factor exposures because there is usually little overlap between the holdings in the different sleeves. For instance, stocks with strong value characteristics often have negative momentum, causing these factor exposures to partially offset in the combined portfolio.

Funds that use the integration approach can achieve stronger factor exposures. They don't necessarily target the stocks that score the best on any single factor. Rather, they pursue stocks with the best overall combination of factor characteristics. This allows them to allocate the entire portfolio to stocks with exposure to the targeted factors. Sticking with the pairing of value and momentum described earlier, if the fund uses an integration approach to combine these factors, it will allocate the entire portfolio to stocks with both strong value and momentum characteristics. These may not be the cheapest stocks in the market or those that have the strongest momentum, but overall, the integrated portfolio should exhibit stronger value and momentum factor tilts than the mixed version of the same factor pairing.

The downside of the integration approach is that it can lead to greater active risk, which increases both the potential for outperformance as well as underperformance. It is also more complex, and in some cases less transparent, than the mixing approach, making it harder to attribute portfolio performance to distinct factors.

There are a few ways for funds to implement the integration approach, and they are all valid. These include:

► Portfolio optimization – an optimizer allows a fund to target stocks with multiple desired factor traits, while controlling for many types of risk. Complexity and lack of transparency are the main downsides.
► Composite scoring and ranking – these funds rank each stock in the selection universe on its overall factor characteristics and target the highest-ranking stocks.
► Factor-tilting weighting approach — this can be used to emphasize stocks with desired factor characteristics.

5. How aggressively does the fund pursue its targeted factors?

Funds with greater exposure to their targeted factors have greater potential to outperform the market than their less aggressive counterparts when those factors are in favor and greater risk of underperformance when they are not. Just as stocks don't always outperform bonds, even though they tend to do so over the long term, factors experience their own unique cycles of out- and underperformance versus one another and the broader market. The risk of underperformance is a necessary trade-off to capture the performance advantages factors might offer.

Investors who are comfortable with the risk of underperforming a benchmark (active risk) to capture those potential return advantages should favor funds with pronounced exposure to their targeted factors. Funds with smaller factor exposures are probably more suitable for those who prefer to limit active risk, while keeping the door open to the potential for modest outperformance.

The strength of a multifactor fund's factor exposures is driven by its:

► Stock-selection threshold
► Weighting approach
► Portfolio constraints
► Rebalancing frequency
► Factor timing adjustments (if applicable)

Portfolios with higher thresholds for stock selection should have higher factor exposures and more compactness than those with less demanding criteria. For example, if a fund assigns composite factor scores to all stocks in its selection universe and targets the highest-ranking third, it should have greater exposure to its targeted factors than a fund that filters out the lowest-ranking third.

Funds can also strengthen their factor exposures through their stock-weighting approach. Those that incorporate the strength of each holding's factor characteristics into their weightings tend to have more-pronounced factor exposures than funds that don't.

Constraints on sector, country, and stock weightings, turnover, and risk are often beneficial (more on that later), but they can also reduce the strength of a fund's factor exposures by causing it to own stocks with weaker absolute factor characteristics than it otherwise would.

More-frequent portfolio rebalancing tends to strengthen a fund's factor exposures. Quickly removing stocks whose factor characteristics have weakened and replacing them with stocks that look better on those metrics can help keep these funds homed in on their targeted factors. However, more turnover also leads to higher transaction costs, so it is important to understand how the index balances these considerations.

Some funds explicitly seek to time their factor exposures based on forecasts of how each factor is expected to perform going forward. The larger these tactical adjustments are, the more aggressive the fund tends to be.

Measuring How Aggressively a Fund Pursues Targeted Factors

To get a better handle on how aggressively a fund pursues its targeted factors, it is useful to evaluate its active risk. Funds with greater active risk tend to be more aggressive. There are two ways to measure a fund's active risk relative to its starting universe:

► Tracking error
► Active share

Of these two metrics, tracking error relative to the starting universe is more useful because it shows how the fund's construction approach has affected its performance. The downside is that this is a backward-looking metric — though it is predictive of future active risk.[6] It is best to use at least three years of data to measure tracking error. The table below illustrates how to interpret the data.

Tracking Error	0-2.5%	2.5-5%	5%+
Active Risk	Low	Medium	High

In contrast, active share is a forward-looking gauge of active risk. It shows how different the fund's holdings are from its starting universe. Funds with higher active share deviate from their starting universe more, likely because of a more demanding threshold for stock inclusion or a weighting approach that emphasizes stocks with strong factor characteristics.

Directionally, active share tends to line up with tracking error, though factor funds with low active share can still exhibit a fair bit of tracking error. When these signals conflict, tracking error is usually more informative. Tracking error also tends to be a more reliable indicator for funds with higher turnover, where the current holdings may not reflect what the fund will own in the future.

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6 To test this, we evaluated the relationship between tracking error against the Russell 1000 Index from April 2012 through March 2015 and tracking error over the next three years for all mutual funds and ETFs in the large-blend Morningstar Category. A regression analysis revealed a strong and statistically significant positive relationship between those two variables.

While active risk is a good proxy for the strength of a fund's factor tilts, it does not directly measure them. There are two ways to directly measure the strength of a fund's factor exposures:

► Holdings-based analysis
► Returns-based analysis (factor regression)

Holdings-Based Analysis

The Morningstar Style Box is a good starting point for holdings-based analysis. It graphically illustrates a fund's value and size factor exposures, which have a big impact on fund performance. Comparing the asset-weighted average valuation ratios (P/B and P/E) and market capitalization of the fund's holdings against its parent benchmark also shows the magnitude of its value/growth and size tilts.

While size and value are important, they aren't the only factors that matter. Morningstar offers a risk model that shows a more comprehensive set of factor exposures for each equity fund based on its holdings. The factors from the risk model that allow investors to gauge a fund's exposure to the rewarded equity style factors include:

► Value-Growth (negative exposure to this factor indicates that a fund is value-oriented)
► Size
► Momentum
► Volatility (negative exposure to this factor aligns with low volatility)
► Financial health (this quality-oriented metric is based on financial leverage, cash flow/long-term debt, and cash/assets)
► Economic moat (this quality metric indicates whether a firm enjoys a durable competitive advantage, which is highly correlated with profitability)

To put a fund's factor exposures in context, it is useful to compare them with the parent index's. Morningstar's risk model isn't the only way to measure funds' exposure to each factor based on the makeup of its current portfolio. BlackRock offers a tool called The Factor Box[7], which defines each factor a little differently but uses a similar holdings-based analysis. It allows users to easily view a fund's core factor exposures relative to its peers.

A few caveats are in order. The strength of a fund's apparent factor exposures can vary based on the metrics used to measure the exposure, though different metrics often tell a similar story. If a fund uses different metrics than the ones Morningstar or BlackRock use to define each factor, it may appear to have weaker factor exposures than if they used the same metrics. It is perfectly acceptable to substitute one set of metrics for another. However, it is best to use a common set of metrics to compare different funds.

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7 https://www.ishares.com/us/lp/factor-box

Second, smaller stocks tend to be less profitable than larger stocks. So, a fund that targets both the small size and quality factors may not appear to have much of a quality tilt compared with its starting universe. But it could still favor higher-quality companies than a broad market-cap-weighted portfolio with a similar size orientation.

Finally, holdings-based analysis only provides a snapshot in time, which may not be representative of how the portfolio looked in the past or may look in the future. It is useful to compare the fund's portfolio at different points in time to evaluate the consistency of its factor exposures.

Funds that rely on a risk-constrained optimizer or target a specific tracking error are especially prone to inconsistent factor exposures. That's because the riskiness of each factor tends to change over time, so these funds may have to reduce their exposure to certain factors as their risk increases. Funds that do not directly link their holdings' weightings to the factors they target are also less likely to have consistent factor exposures than those that do.

Inconsistent factor exposure isn't necessarily a bad thing, particularly if the fund is trimming exposure to a factor as it becomes riskier or explicitly tries to time its factor exposures. Understanding the consistency of a fund's factor exposures helps shed light on whether the current portfolio and performance record represent what the fund might deliver going forward.

Returns-Based Analysis
Returns-based factor-regression analysis offers a few advantages over holdings-based analysis.
► It requires less data (only investment returns)
► It is based on how funds actually behaved over time
► It measures each factor exposure after controlling for the other factors in the model. This allows it to better detect whether a fund with a small-cap tilt also exhibits a quality tilt, for example.

A factor regression analysis requires at least three years (preferably more) of monthly return data for the fund in question (or its benchmark). The regression uses the returns on a few factors, like the market-risk factor, value, size, momentum, and so on, to explain the fund's excess returns over the risk-free rate. For example, a factor regression may look like this:

(Fund Return − Risk-free return) = α + β_1(Market Risk Premium) + β_2(Value Premium) + β_3(Size Premium)
Where:
• α represents the fund's returns that the model can't explain
• β_1, β_2, and β_3 are the coefficients in the regression. They represent how much the fund's performance was affected by the market-risk, value, and size factors, respectively.

The coefficients from the regression show how much a fund's performance was affected by a 1-percentage-point change in a given factor's performance. For example, a 0.3 coefficient for the value

factor would suggest that for every 1 percentage point that value stocks outperformed growth stocks (as defined in the regression factor), the fund tended to outperform by 30 basis points.

Before reading too much into the results, it is important to make sure that the coefficients are statistically significant, with a P-value of 0.05 or less. This indicates that there is less than a 5% probability that the observed relationship is due to chance and not meaningful. If the coefficients on the factors the fund targets are not statistically significant, the fund likely has limited exposure to those factors. This could be by design, for funds with low active risk, or because its targeted factor exposures partially offset.

While it is possible to use any factor for these regressions, it is probably best to include the market-risk factor, value, size, plus any other factors the fund targets, though it is not necessary to include low volatility. This is because a fund's exposure to the market-risk premium can indicate whether it has exposure to defensive stocks. (A market beta of less than 1.0 indicates that the fund is more defensive.) It is prudent to use standard factors from an independent source, such as the French Data Library. While these factors are usually not defined the exact way a fund defines them, they are constructed in a manner that has been thoroughly vetted in the academic literature. Using standard factor definitions also facilitates consistent comparisons across funds.

While a single-factor regression summarizes a fund's factor exposures over a fixed horizon, a series of rolling regressions shows how the fund's factor exposures have changed over time. This serves the same purpose as comparing several portfolios in the holdings-based factor analysis.

This type of analysis is easier to run than it may appear. There is a free third-party website, Portfolio Visualizer[8], that allows users to select the fund, period, market, and factors of interest (from the French Data Library or AQR) and run the regression with the click of a button. However, this tool only works well for U.S.-listed funds. Alternatively, investors could download the factor data directly from the French Data Library and run the regression in Excel. Instructions for both methods are presented in the appendix.

6. Do the fund's factor tilts wash out, or does one factor dominate?

The results of the holdings- and returns-based factor-exposure analysis should help answer this question. A fund's factor tilts could partially offset because they often have low correlations with one another. If they largely offset, the fund probably won't benefit much when any one of those factors pays off. On the flip side, it won't lag as much when those factors underperform. Offsetting is more likely if the fund follows the mixing approach to combining factors, has a low threshold for stock inclusion, and takes low active risk. However, differences between how a fund defines the factors and how investors measure them could also make those exposures appear smaller than they really are.

8 https://www.portfoliovisualizer.com/

It is rare that all a fund's factor exposures offset. But often, one or two factors have greater influence on the portfolio than the others. If that is the case, the portfolio may not be as well-diversified as it first appears. Small size and low volatility often have greater sway on a portfolio than other factors for funds that include them.

7. Are there any constraints on the portfolio?

The most common portfolio constraints applied by multifactor funds include limits on:

► Sector weightings
► Stock weightings
► Country weightings
► Risk
► Turnover

These constraints can help improve diversification, reduce risk, and reduce transaction costs. However, they also reduce a portfolio's exposure to the factors it targets by causing it to own stocks with weaker factor exposures than it otherwise would to stay within the limits set by the constraints.

Not all multifactor funds apply such constraints, though it is typically preferable to put limits on sector and country weightings. These are sources of active risk that often are not necessary to capture the targeted factors, and historically they have not been well compensated (unless they were driven by momentum)[9, 10].

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9 Bryan, A. & McCullough, A. 2017. "The Impact of Industry Tilts on Factor Performance." March 15, 2017.
   http://corporate1.morningstar.com/ResearchArticle.aspx?documentId=796630

10 Bryan, A. 2017. "Quality and Value Without the Sector Side Bets." July 19, 2017.
   http://www.morningstar.com/articles/816011/quality-and-value-without-the-side-sector-bets.html

Fund Profiles

Some examples will help to bring to life the framework outlined above. Here, we examine a selection of multifactor strategies, looking closely at each of the facets that form our framework and applying a variety of lenses.

AQR Large Cap Multi-Style

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
QCELX	US Fund Large Blend	0.45%	1,946	3/26/2013	🛡 Bronze

Morningstar Take

This well-crafted strategy effectively targets stocks with strong momentum, low valuations, and strong quality characteristics, which gives it a good chance to beat the market over the long term. While this portfolio is actively managed, the strategy is entirely rules-based and reasonably priced. And unlike many of its peers, this fund directly considers transaction costs when deciding whether to trade. However, it has not yet distinguished itself. It earns a Morningstar Analyst Rating of Bronze.

Selection Universe: Russell 1000 Index

Selection Universe Description: This index includes the 1,000 largest U.S. stocks by market capitalization

Number of Stocks in Selection Universe: 1,000

Number of Fund Holdings: 249

Index Name: N/A, actively managed

Index Inception Date: N/A

Index Pre-Inception Performance Start Date: N/A

Targeted Factors & Factor Measurement

	Momentum	Value	Quality/ Profitability	Low Volatility	Size	Other
Metrics	Price Momentum (total return and residual returns) (75%)	Book/Price (20%)	Profitability (gross profits, margin, cash flow) (25%)	N/A	N/A	N/A
	Fundamental Momentum (Earnings Momentum, Analyst Revisions, Margin Growth) (25%)	Earnings/Price (20%)	Earnings Quality (accruals and inventory changes) (25%)			
		Forecasted Earnings/ Price (20%)	Distance to Default (25%)			
		Cash Flow/Enterprise Value (20%)	Earnings and cash flow volatility (25%)			
		Sales/Enterprise Value (20%)				
Sector-Relative?	Yes (most weight is put on sector-relative momentum)	Yes	Yes (most weight is put on sector-relative quality)			

Weighting Approach: Optimization weighted

Factor Combination: Integrated

Factor Combination Approach: The fund creates an expected return estimate for each stock in the selection universe based on its overall factor exposures, giving a 40% weighting to value, 40% to momentum, and 20% to quality. It then feeds that information into an optimizer, which builds a portfolio designed to maximize the portfolio's expected return, subject to a series of constraints.

Constraints:

▶ Limit sector tilts to within 3% of the selection universe

▶ Target similar market risk (beta) to the selection universe
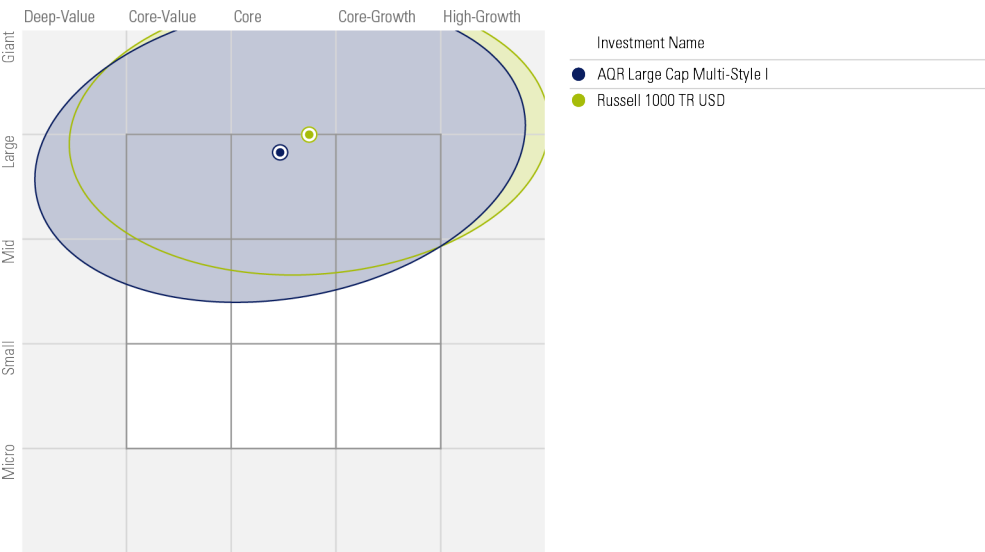
▶ Limit tracking error to the selection universe

Rebalancing: Monthly, rebalancing to the average of the target weightings over the past three months
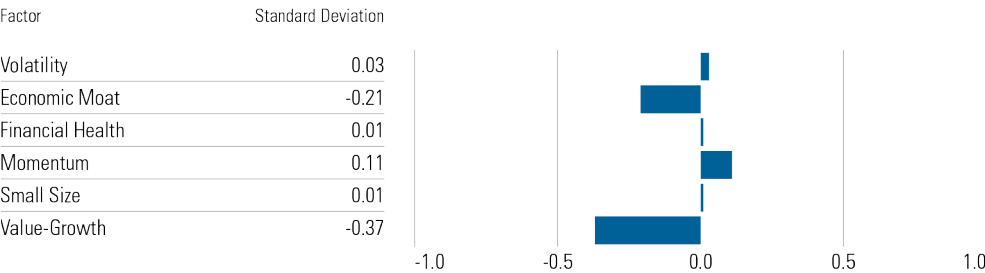
Portfolio Snapshot

Portfolio Characteristics		
	QCELX	**Russell 1000 Index**
Value		
Forward P/E	14.8	17.0
P/B	2.8	3.1
Size		
Market Cap ($ Bil)	57.7	74.1

Active Risk	
Tracking Error	2.4%
Active Share	52.8%

Morningstar Style Box

Investment Name
● AQR Large Cap Multi-Style I
● Russell 1000 TR USD

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between QCELX and Russell 1000

Factor	Standard Deviation	
Volatility	0.03	
Economic Moat	-0.21	
Financial Health	0.01	
Momentum	0.11	
Small Size	0.01	
Value-Growth	-0.37	

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (April 2013 - March 2018)

Factor	Coefficient
Beta	**1.05**
Size	-0.01
Value	0.07
Momentum	**0.16**
Profitability	0.07

Analysis of Fund's Factor Exposures

The fund offers moderate exposure to its targeted factors. Its market beta was higher than 1.0, partially because it didn't start constraining that risk until 2016. The holdings-based analysis suggests that the fund has a meaningful value tilt, while the factor regression suggests that this exposure hasn't been significant. In contrast, the fund's momentum exposure looks more pronounced relative to the other factors in the regression than in the holdings-based analysis. The regression analysis also suggests the fund has a small, but not statistically significant, exposure to the profitability factor, even though it has less exposure to stocks with economic moats.

Footnotes
1) Portfolio holdings data is as of March 2018.
2) Active risk data is calculated against the Russell 1000 Index.
3) Tracking error is calculated over the trailing three years through April 2018.
4) Bolded figures in the regression table are significant at the 5% level.
5) The raw data for the factor regression is from the French Data Library.

Xtrackers Russell 1000 Comprehensive Factor ETF

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
DEUS	US Fund Mid-Cap Blend	0.17%	146	11/24/2015	N/A

Morningstar Take

This is a solid choice to own a broadly diversified U.S. stock portfolio that tilts toward stocks that score well on five distinct factors. The fund's weighting approach leads to a stronger small-cap tilt than most of its peers that select stocks from large-cap parent indexes. It lands in Morningstar's mid-cap blend category. The fund's low fee adds to its allure, but its small-cap and profitability tilts have overwhelmed other factor exposures.

Selection Universe: Russell 1000 Index

Selection Universe Description: The Russell 1000 Index covers about 90% of the U.S. equity market by market capitalization

Number of Stocks in Selection Universe: 1,000

Number of Fund Holdings: 813

Index Name: Russell 1000 Comprehensive Factor Index

Index Inception Date: Sept. 28, 2015

Index Pre-Inception Performance Start Date: June 29, 2001

Targeted Factors & Factor Measurement

	Momentum	Value	Quality/ Profitability	Low Volatility	Size	Other
Metrics	11-month total return, lagged 1 month	Cash flow yield	Return on assets	Std dev of weekly returns over five years	Log of market capitalization	N/A
		Earnings yield	Change in asset turnover			
		Sales to price	Accruals			
			Leverage ratio			
Sector-Relative?	No	No	No	No	No	

Weighting Approach: FTSE assigns scores to stocks for each targeted factor and normalizes those scores from 0 to 1. Next, it multiplies stocks' market-cap weighting in the Russell 1000 Index by each of the normalized targeted factor scores to assign a final index weighting. Stocks that exhibit the highest factor characteristics will score closer to 1.

Factor Combination: Integrated

Factor Combination Approach: Simple average of normalized factor scores.

Constraints:

► Maximum holding is 20 times its weighting in the Russell 1000 Index

► Minimum holding weight is 0.5 basis points

► Maximum industry weightings capped at 120% of Russell 1000 Index industry weightings plus a 5% buffer

► Minimum industry weightings have floor of 80% of Russell 1000 index industry weightings minus 5% buffer

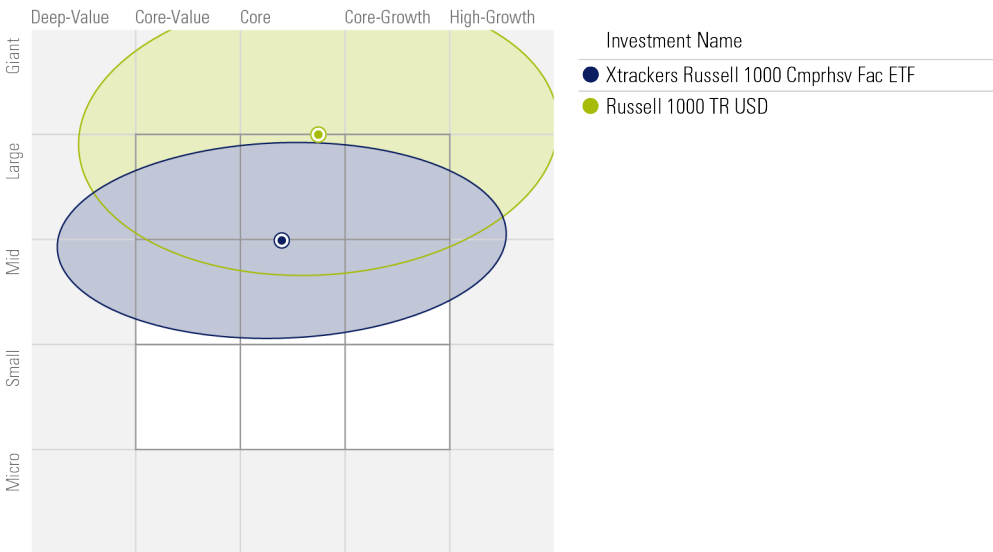**Rebalancing:** Semiannually on last Friday in June and third Friday in December

Portfolio Snapshot

Portfolio Characteristics		

	DEUS	Russell 1000 Index
Value		
Forward P/E	16.2	16.9
P/B	2.9	2.8
Size		
Market Cap ($ Bil)	15.9	74.1
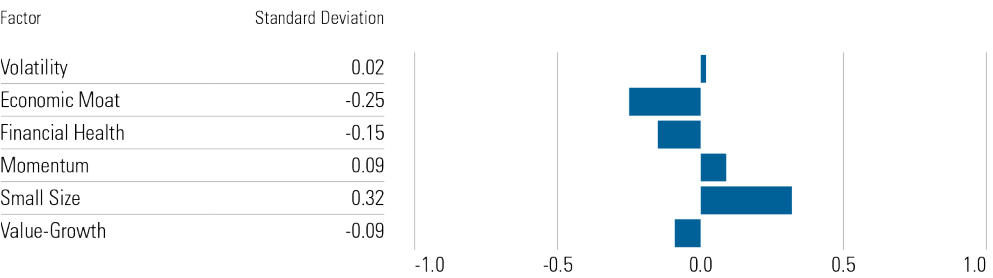
Active Risk	
Tracking Error	2.8%
Active Share	61.2%

Morningstar Style Box

Investment Name
● Xtrackers Russell 1000 Cmprhsv Fac ETF
● Russell 1000 TR USD

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between DEUS and Russell 1000 Index

Factor	Standard Deviation
Volatility	0.02
Economic Moat	-0.25
Financial Health	-0.15
Momentum	0.09
Small Size	0.32
Value-Growth	-0.09

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (April 2013 - March 2018)

Factor	Coefficient
Beta	**0.90**
Size	**0.16**
Value	0.02
Momentum	**0.11**
Profitability	**0.27**

Analysis of Fund's Factor Exposures

The fund's holdings-based analysis and returns-based analysis are largely consistent with the exception of its profitability factor loading. The holdings-based analysis suggests that the fund doesn't have strong exposure to profitability, as measured by Morningstar's estimate of its holdings' financial health and economic moats, but the returns-based analysis shows a large and statistically significant profitability exposure. The fund's small size exposure is strong and evident in both analyses. Similarly, its value and momentum factor exposure are weaker, and this finding is consistent across both analyses.

Footnotes
1) Portfolio holdings data is as of April 2018.
2) Active risk data is calculated against the Russell 1000 Index.
3) Tracking error is calculated from December 2015 through April 2018.
4) The regression analysis is based on the fund's index.
5) Bolded figures in the regression table are significant at the 5% level.
6) The raw data for the factor regression is from the French Data Library.

Dimensional Global Core Equity C Acc

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
N/A	EAA Fund Global Large-Cap Blend Equity	0.36%	2,873	9/3/2008	Silver

Morningstar Take

The Dimensional Global Core Equity Fund is a representative and well-diversified strategy that consists of nearly 7,400 holdings with a tilt toward smaller, cheaper, and more profitable companies. In addition, the weighting approach limits turnover, trades are executed efficiently, and the fees (0.36%) are among the lowest relative to rival active peers. With these attributes, we can expect the fund to continue producing superior risk-adjusted returns relative to peers. We have therefore awarded it a Morningstar Analyst Rating of Silver.

Selection Universe: DFA uses proprietary database; MSCI World IMI Index is the closest to the selection universe
Selection Universe Description: The MSCI World Index covers about 99% of the global developed equity market by market capitalization
Number of Fund Holdings: 7,392
Number of Stocks in Selection Universe: 5,921
Index Name: N/A
Index Inception Date: N/A
Index Pre-Inception Performance Start Date: N/A

Targeted Factors & Factor Measurement

	Momentum	Value	Quality/ Profitability	Low Volatility	Size	Other
Metrics	n/a	Price to Book Value	Operating income before depreciation and amortization minus interest expense to book value	n/a	Market Capitalization	n/a
Sector-Relative?		No	No		No	

Weighting Approach: DFA uses market-cap multipliers to increase or decrease a holding's weighting based on its exposure to the targeted factors and market capitalization.

Factor Combination: Integrated

Factor Combination Approach: The portfolio managers use market-cap multipliers to increase the fund's exposure to stocks with attractive characteristics and tilt it away from stocks that don't–while maintaining broad diversification and low turnover.

Constraints:

▶ Sector weights are capped at the market weight +10% at the time of purchase
▶ Excludes real estate investment trusts from this portfolio
▶ Delays buying securities with strong negative price momentum
▶ Delays selling securities with strong positive price momentum

Rebalancing: DFA rebalances the portfolio as it sees fit. This fund doesn't track an index, so there is not a defined rebalance date.
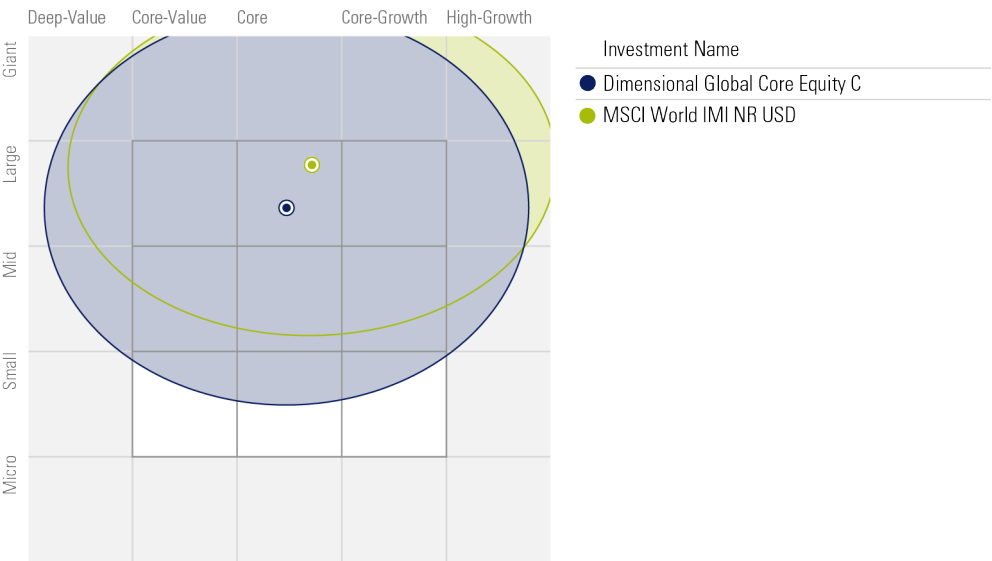
Portfolio Snapshot

Portfolio Characteristics		

	Dimensional Global Core	MSCI World IMI Index
Value		
Forward P/E	13.2	15.8
P/B	2.0	2.3
Size		
Market Cap ($ Bil)	23.5	39.6
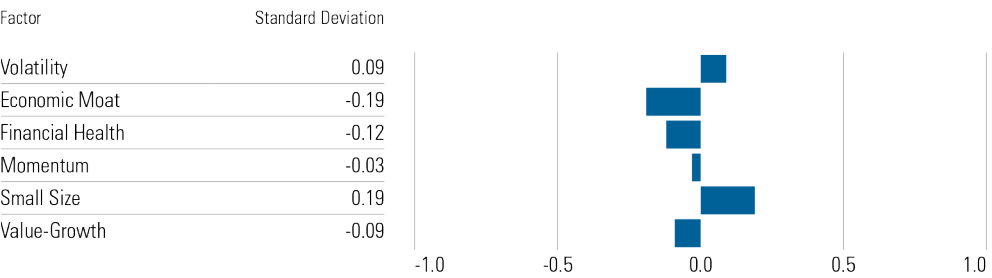
Active Risk	
Tracking Error	4.4%
Active Share	32.0%

Morningstar Style Box

Investment Name
● Dimensional Global Core Equity C
● MSCI World IMI NR USD

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between Dimensional Global Core and MSCI World IMI

Factor	Standard Deviation	
Volatility	0.09	
Economic Moat	-0.19	
Financial Health	-0.12	
Momentum	-0.03	
Small Size	0.19	
Value-Growth	-0.09	

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (May 2015 - April 2018)

Factor	Coefficient
Beta	**1.01**
Size	**0.11**
Value	0.06
Momentum	-0.02
Profitability	0.12

Analysis of Fund's Factor Exposures

The fund's factor exposures are moderate, despite the large number of stock holdings, owing to its integrated factor combination approach. The fund has a beta of 1, which is not surprising considering that it represents the broad market well. The fund has positive exposure to smaller companies, according to both the returns-based analysis and the Morningstar Global Risk Model. Quality characteristics, as expressed by the Risk Model's Economic Moat and Financial Health factor, are lower than the market and come at the expense of the positive value and small-size tilts.

Footnotes
1) Portfolio holdings data is as of April 2018.
2) Active risk data is calculated against the MSCI World IMI Index.
3) Tracking error is calculated from March 2015 through April 2018.
4) The regression analysis is based on the fund's index.
5) Bolded figures in the regression table are significant at the 5% level.
6) The raw data for the factor regression is from the French Data Library.

DFA U.S. Core Equity 1 Portfolio Institutional Class
Dimensional US Core Equity USD Acc

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
DFEOX	US Fund Large Blend	0.19%	23,053	9/15/2008	⛨ Silver
N/A	EAA Fund US Flex-Cap Equity	0.20%	28	9/28/2015	N/A

Morningstar Take

This is a great choice to own a broadly diversified U.S. stock portfolio that moderately tilts toward stocks with attractive characteristics. DFA's flexible trading approach and the fund's low fee add to the fund's enduring edge over its peers. It earns a Morningstar Analyst Rating of Silver.

Selection Universe: Russell 3000 Index

Selection Universe Description: The Russell 3000 Index covers about 98% of the U.S. equity market by market capitalization.

Number of Stocks in Selection Universe: 3,000

Number of Fund Holdings: 2,667

Index Name: N/A

Index Inception Date: N/A

Index Pre-Inception Performance Start Date: N/A

Targeted Factors & Factor Measurement

	Momentum	Value	Quality/ Profitability	Low Volatility	Size	Other
Metrics	N/A	Price to Book Value	Operating income before depreciation and amortization minus interest expense to book value	N/A	Market Capitalization	N/A
Sector-Relative?		No	No		No	

Weighting Approach: DFA uses market-cap multipliers to increase or decrease a holding's weighting based on its exposure to the targeted factors and market capitalization.

Factor Combination: Integrated

Factor Combination Approach: The portfolio managers use market-cap multipliers to increase the fund's exposure to stocks with attractive characteristics and tilt it away from stocks that don't–while maintaining broad diversification and low turnover.

Constraints:

▶ Excludes real estate investment trusts from this portfolio
▶ Delays buying securities with strong negative price momentum
▶ Delays selling securities with strong positive price momentum

Rebalancing: DFA rebalances the portfolio as it sees fit. This fund doesn't track an index, so there is not a defined rebalance date.
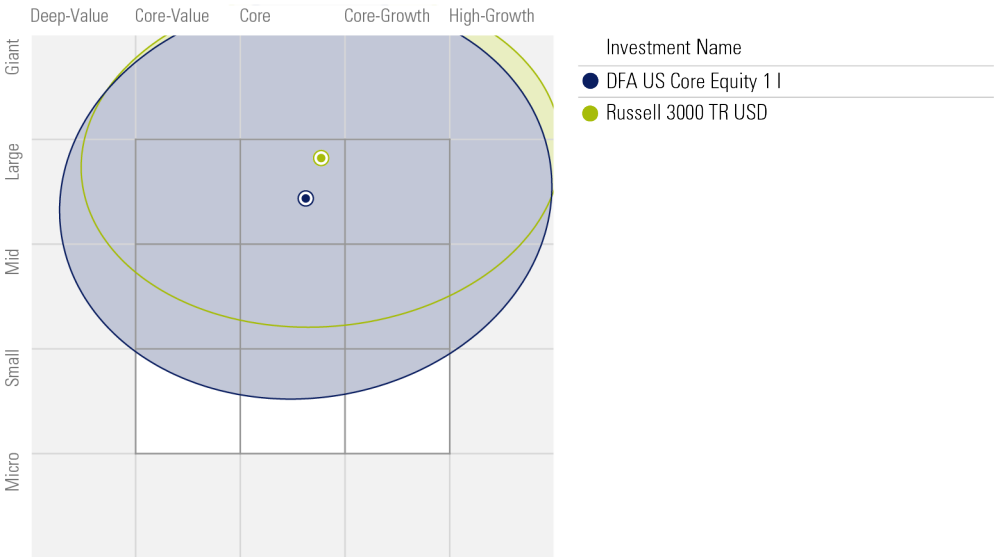
Portfolio Snapshot

Portfolio Characteristics

	DFEOX	Russell 3000 Index
Value		
Forward P/E	16.1	17.0
P/B	2.6	2.7
Size		
Market Cap ($ Bil)	31.7	55.9
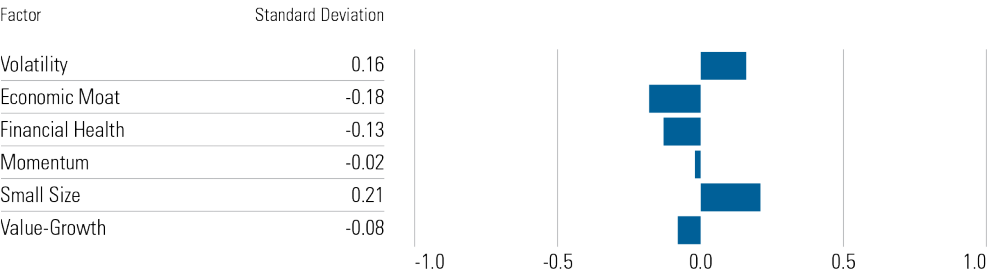
Active Risk	
Tracking Error	1.7%
Active Share	22.9%

Morningstar Style Box

Investment Name
- DFA US Core Equity 1 I
- Russell 3000 TR USD

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between DFEOX and Russell 3000 Index

Factor	Standard Deviation
Volatility	0.16
Economic Moat	-0.18
Financial Health	-0.13
Momentum	-0.02
Small Size	0.21
Value-Growth	-0.08

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (April 2013 - March 2018)

Factor	Coefficient
Beta	**1.00**
Size	**0.13**
Value	**0.07**
Momentum	-0.01
Profitability	**0.07**

Analysis of Fund's Factor Exposures

The fund has modest exposure to its targeted factor exposure. The holdings-based analysis suggests that the fund doesn't have strong exposure to quality, as measured by Morningstar's estimate of its holdings' financial health and economic moats. This is likely due to the fund's smaller-cap orientation. Small-cap stocks tend to score worse on these metrics. The factor regression better isolates each factor tilt by controlling for the others. It demonstrates that the portfolio has favored stocks with lower valuations, smaller size, and higher profitability at a statistically significant level.

Footnotes
1) Portfolio holdings data is as of March 2018.
2) Active risk data is calculated against the Russell 3000 Index.
3) Tracking error is calculated over the trailing three years through April 2018.
4) Bolded figures in the regression table are significant at the 5% level.
5) The raw data for the factor regression is from the French Data Library.

Goldman Sachs ActiveBeta US Large Cap Equity ETF

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
GSLC	US Fund Large Blend	0.09%	3,031	9/17/2015	🛡 Bronze

Morningstar Take

The fund offers similar exposure to the S&P 500 but tilts toward stocks with characteristics that have historically been associated with market-beating performance. These include low valuations, strong momentum, high profitability, and low volatility. This approach diversifies risk because each factor tends to work well at a different time. While the fund's factor tilts are modest, it has a low expense ratio to match, which gives it a reasonable chance to beat the market over the long term. But because of its limited record, the fund earns a Morningstar Analyst Rating of Bronze.

Selection Universe: Solactive US Large Cap Index
Selection Universe Description: This index includes the 500 largest U.S. stocks by market capitalization
Number of Stocks in Selection Universe: 500
Number of Fund Holdings: 449
Index Name: Goldman Sachs ActiveBeta U.S. Large Cap Equity Index
Index Inception Date: Aug. 19, 2015
Index Pre-Inception Performance Start Date: Nov. 4, 1999

Targeted Factors & Factor Measurement

	Momentum	Value	Quality/ Profitability	Low Volatility	Size	Other
Metrics	t-statistic of the CAPM alpha over the past year, excluding the most recent month	Free Cash Flow/Price (Earnings to Price for Financial Stocks)	Gross Profit/ Assets (Return on Equity for Financial Stocks)	Inverse of standard deviation over the past 12 months	N/A	N/A
		Sales/Price				
		Book Value/Price				
Sector-Relative?	No	No	No	No		

Weighting Approach: Factor strength weighted, with size of tilts scaled to achieve a targeted tracking error.

Factor Combination: Isolation

Factor Combination Approach: The fund allocates 25% of its assets to each of its four factor subportfolios.

Constraints:

► Maximum holding weight restricted to 20 times its weighting in the selection universe
► The value sleeve is sector-neutral
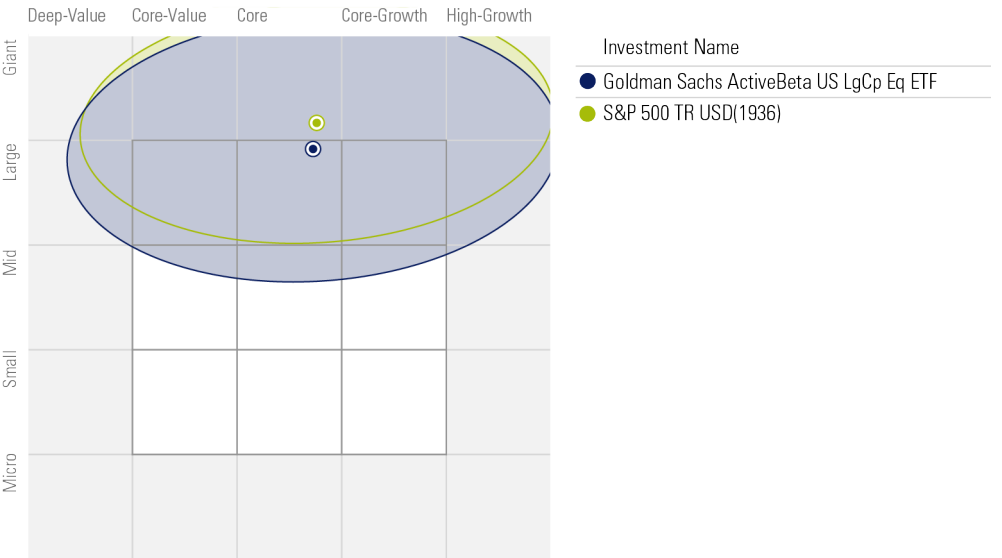► Sector weightings are capped at 25% of the portfolio

Rebalancing: Quarterly

Portfolio Snapshot

Portfolio Characteristics

	GSLC	S&P 500
Value		
Forward P/E	16.6	16.9
P/B	3.3	3.1
Size		
Market Cap ($ Bil)	65.7	96
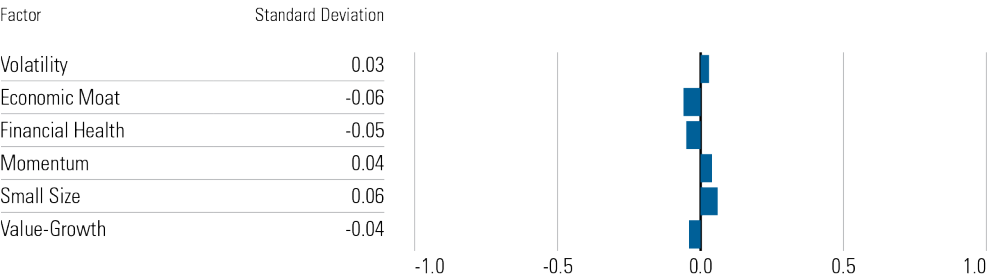
Active Risk	
Tracking Error	1.6%
Active Share	26.6%

Morningstar Style Box

Investment Name
- ● Goldman Sachs ActiveBeta US LgCp Eq ETF
- ● S&P 500 TR USD(1936)

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between GSLC and S&P 500

Factor	Standard Deviation
Volatility	0.03
Economic Moat	-0.06
Financial Health	-0.05
Momentum	0.04
Small Size	0.06
Value-Growth	-0.04

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (April 2013 - March 2018)

Factor	Coefficient
Beta	**0.95**
Size	**-0.06**
Value	**-0.06**
Momentum	**0.07**
Profitability	**0.16**

Analysis of Fund's Factor Exposures

The fund's factor tilts are small, owing to its isolation factor combination approach, coupled with its low active share and tracking error target. As expected, the fund has a beta of less than 1 (partially due to its low volatility sleeve) and significant positive exposure to the profitability factor. It has modest positive exposure to momentum. Surprisingly, it appears to have a slight growth bias, which may be because the momentum and profitability sleeves are offsetting the value sleeve.

Footnotes
1) Portfolio holdings data is as of April 2018.
2) Active risk data is calculated against the S&P 500.
3) Tracking error is calculated from October 2015 through April 2018.
4) The regression analysis is based on the fund's index.
5) Bolded figures in the regression table are significant at the 5% level.
6) The raw data for the factor regression is from the French Data Library.

iShares Edge MSCI Multifactor USA ETF
iShares Edge MSCI USA Multifactor ETF USD (Acc)

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
LRGF	US Fund Large Value	0.20%	970	4/28/2015	🛡 Bronze
IFSU	EAA Fund US Large-Cap Blend Equity	0.35%	137	9/4/2015	🛡 Bronze

Morningstar Take

This fund targets U.S. stocks that have higher-than-average exposure to time-tested factors that have historically been associated with market-topping performance. Its factor tilts are stronger than most of its peers, but its portfolio construction is opaque and complex. The fund's low fee and stringent risk management should contribute to its edge over the long run, but its short live track record limits its Morningstar Analyst Rating to Bronze.

Selection Universe: MSCI USA Index

Selection Universe Description: The MSCI USA Index covers about 85% of the U.S. equity market by market capitalization

Number of Stocks in Selection Universe: 630

Number of Fund Holdings: 149

Index Name: MSCI USA Diversified Multi-Factor Index

Index Inception Date: Feb. 17, 2015

Index Pre-Inception Performance Start Date: Nov. 30, 1998

Targeted Factors & Factor Measurement

	Momentum	Value	Quality/ Profitability	Low Volatility	Size	Other
Metrics	12-month relative strength (25.0%)	Forward Price to Earnings (33.3%)	Return on Equity (33.3%)	N/A	Log of Market Capitalization	N/A
	6-month relative strength (37.5%)	Enterprise Value/ Operating Cash Flow (33.3%)	Debt to Equity (33.3%)			
	Historical alpha: 2-year excess returns (37.5%)	Price to Book Value (33.3%)	Earnings Variability (33.3%)			
Sector-Relative?	No	Yes	Yes		No	

Weighting Approach: Factor scores equally weighted with contribution of factor weighting adjusted relative to its risk.

Factor Combination: Integrated

Factor Combination Approach: An optimizer maximizes aggregate factor exposure and limits turnover, exposure to nontargeted factors, individual stock and sector tilts, and tracking error relative to its parent index. This approach reduces the portfolio's exposure to a factor as its risk increases because it strives to match the risk level of its parent index.

Constraints:

▶ Maximum holding weight restricted to the lower of the security's weight in MSCI USA Index +2% or 10 times its weight in MSCI USA Index

▶ Minimum holding weight restricted to the higher of the security's weight in MSCI USA Index -1% or 0

▶ Exposure to nontargeted factors such as volatility and growth restricted to +/- 0.25 standard deviations relative to the MSCI USA Index

▶ Sector weights restricted to +/- 5% from the MSCI USA Index sector weights

▶ One-way turnover restricted to a 20% maximum at each semiannual index review

Rebalancing: Index reconstitutes semiannually at the end of May and November
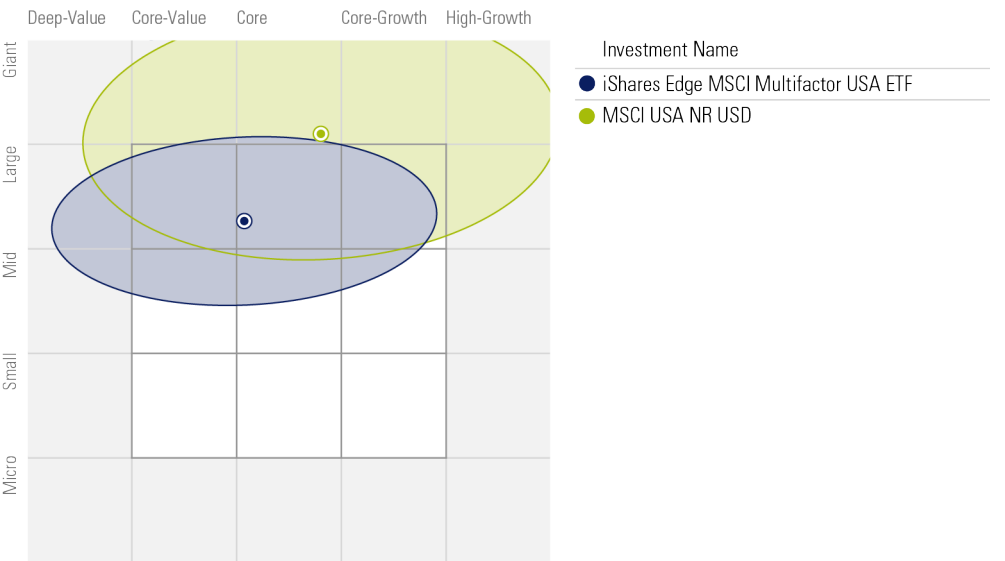
Portfolio Snapshot

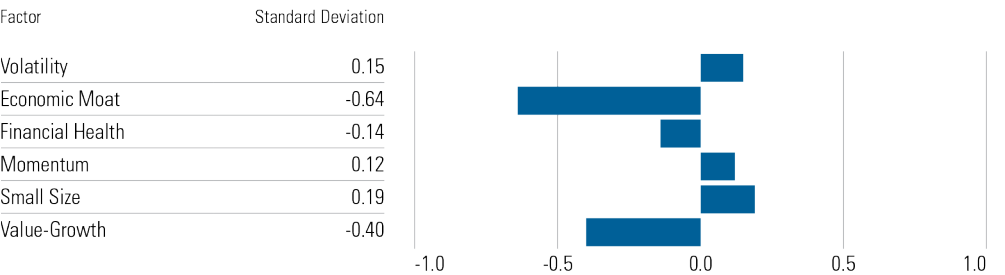| Portfolio Characteristics		
	iShares Edge MSCI Multifactor USA	MSCI USA Index
Value		
Forward P/E	15.2	17.0
P/B	2.4	2.9
Size		
Market Cap ($ Bil)	24.7	86.1

Active Risk	
Tracking Error	3.2%
Active Share	85.9%

Morningstar Style Box

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between LRGF and MSCI USA Index

Factor	Standard Deviation	
Volatility	0.15	
Economic Moat	-0.64	
Financial Health	-0.14	
Momentum	0.12	
Small Size	0.19	
Value-Growth	-0.40	

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (May 2015 – April 2018)

Factor	Coefficient
Beta	**0.97**
Size	**0.15**
Value	**0.09**
Momentum	**0.11**
Profitability	**0.29**

Analysis of Fund's Factor Exposures

Overall, the fund has moderate-to-strong exposure to its targeted factors. While the holdings-based analysis suggests that it doesn't have strong exposure to quality, as measured by Morningstar's estimate of its holdings' financial health and economic moats, this is largely due to the fund's smaller-cap orientation. Smaller stocks tend to score worse on these metrics. The factor regression better isolates each factor tilt by controlling for the others. It demonstrates that the portfolio has tended to favor more-profitable companies, which is an important dimension of quality.

Footnotes
1) Portfolio holdings data is as of April 2018.
2) Active risk data is calculated against MSCI USA Index.
3) Tracking error is calculated from May 2015 through April 2018.
4) The regression analysis is based on the fund's index.
5) Bolded figures in the regression table are significant at the 5% level.
6) The raw data for the factor regression is from the French Data Library.

iShares Edge MSCI World Multifactor ETF (Acc)

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
IFSW	EAA Fund Global Large-Cap Blend Equity	0.20%	970	9/4/2015	🛡 Bronze

Morningstar Take

IShares Edge MSCI World Multifactor ETF targets stocks that have higher-than-average exposure to time-tested factors that have historically been associated with market-topping performance. The fund's factor tilts are stronger than most of its peers, but its portfolio construction is opaque and complex. The fund's relatively low fee and stringent risk management should contribute to its edge over the long run, but its short live track record limits its Morningstar Analyst Rating to Bronze.

Selection Universe: MSCI World Index

Selection Universe Description: The MSCI World Index covers about 85% of the global developed equity market by market capitalization

Number of Stocks in Selection Universe: 1,648

Number of Fund Holdings: 385

Index Name: MSCI World Diversified Multi-Factor Index

Index Inception Date: March 19, 2015

Index Pre-Inception Performance Start Date: Nov. 30, 1998

Targeted Factors & Factor Measurement

Momentum	Value	Quality/ Profitability	Low Volatil- ity	Size	Other
Measured across sector	Measured within sector	Measured within sector	N/A	Measured across sector	N/A
12-month relative strength (25.0%)	Forward Price to Earnings (33.3%)	Return on Equity (33.3%)		Log of Market Capitalization	
6-month relative strength (37.5%)	Enterprise Value/Operat- ing Cash Flow (33.3%)	Debt to Equity (33.3%)			
Historical alpha: 2-year excess returns (37.5%)	Price to Book Value (33.3%)	Earnings Variability (33.3%)			

Weighting Approach: Factor scores equally weighted with contribution of factor weighting adjusted relative to its risk.

Factor Combination: Integrated

Factor Combination Approach: An optimizer maximizes aggregate factor exposure and limits turnover, exposure to nontargeted factors, individual stock and sector tilts, and tracking error relative to its parent index. This approach reduces the portfolio's exposure to a factor as its risk increases because it strives to match the risk level of its parent index.
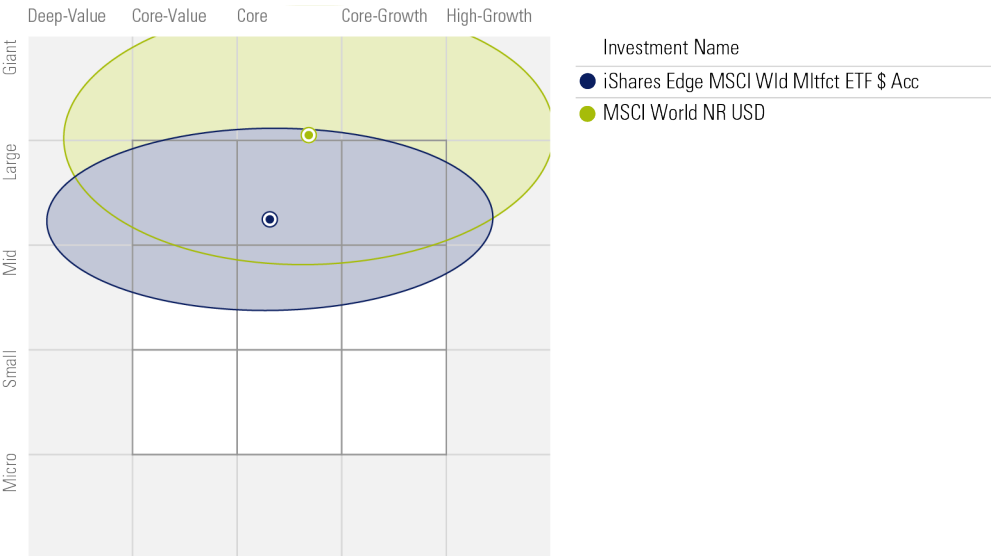
Constraints:

▶ Maximum holding weight restricted to the lower of the security's weight in MSCI World Index +2% or 10 times its weight in MSCI World Index

▶ Minimum holding weight restricted to the higher of the security's weight in MSCI World Index -1% or 0

▶ Country weights with weight over 2.5% in MSCI World are restricted to +/- 5%

▶ Country weights with weight under 2.5% will be capped to 3 times their weight in MSCI World

▶ Exposure to nontargeted factors such as volatility and growth restricted to +/- 0.25 standard deviations relative to the MSCI World Index

▶ Sector weights restricted to +/- 5% from the MSCI World Index sector weights

▶ One-way turnover restricted to a 20% maximum at each semiannual index review

Rebalancing: Index reconstitutes semiannually at the end of May and November
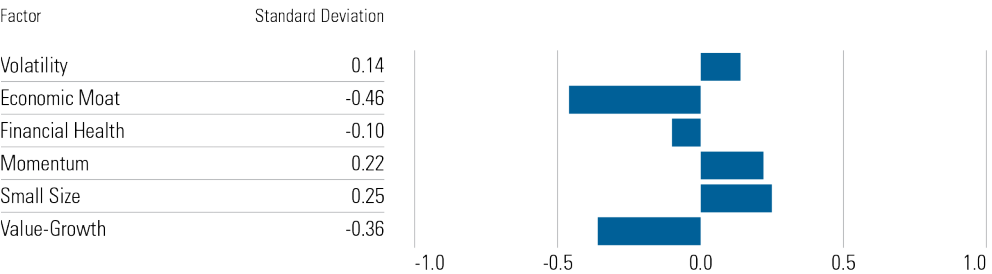
Portfolio Snapshot

Portfolio Characteristics		
	IFSW	MSCI World Index
Value		
Forward P/E	13.2	15.5
P/B	2.0	2.4
Size		
Market Cap ($ Bil)	18.02	60.5
Active Risk		
Tracking Error	4.1%	
Active Share	90.4%	

Morningstar Style Box

Investment Name
- iShares Edge MSCI Wld Mltfct ETF $ Acc
- MSCI World NR USD

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between iShares Edge MSCI World Multifactor and MSCI World

Factor	Standard Deviation
Volatility	0.14
Economic Moat	-0.46
Financial Health	-0.10
Momentum	0.22
Small Size	0.25
Value-Growth	-0.36

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis	
Factor Regression (May 2015 - April 2018)	
Factor	**Coefficient**
Beta	**0.95**
Size	-0.02
Value	-0.11
Momentum	0.05
Profitability	-0.02

Analysis of Fund's Factor Exposures

Overall, the fund has moderate-to-strong exposure to its targeted factors. Our risk model factor analysis suggests that it doesn't have strong exposure to quality, as measured by Morningstar's estimate of its holdings' financial health and economics moats. This is largely due to the fund's value and smaller-cap orientation. The factor regression analysis did not indicate any meaningful exposure.

Footnotes
1) Portfolio holdings data is as of March 2018.
2) Active risk data is calculated against MSCI World Index.
3) Tracking error is calculated from May 2015 through April 2018.
4) The regression analysis is based on the fund's index.
5) Bolded figures in the regression table are significant at the 5% level.
6) The raw data for the factor regression is from the French Data Library.

JPMorgan Diversified Return US Eq ETF

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
JPUS	US Fund Large Blend	0.19%	516	9/29/2015	N/A

Morningstar Take

Although this fund targets stocks with stronger price momentum, lower valuations, and higher profitability, its targeted exposures are overwhelmed by the fund's risk-weighting approach. The fund favors low-risk sectors and assigns sector weightings based on the volatility of each sector's returns. Next, it scores stocks within sectors based on the factors outline but gives higher weightings to stocks that have exhibited lower volatility in the past.

Selection Universe: Russell 1000 Index

Selection Universe Description: The Russell 1000 Index covers about 90% of the U.S. equity market by market capitalization

Number of Stocks in Selection Universe: 1,000

Number of Fund Holdings: 526

Index Name: Russell 1000 Diversified Factor Index

Index Inception Date: July 31, 2015

Index Pre-Inception Performance Start Date: June 30, 1999

Targeted Factors & Factor Measurement

	Momentum	Value	Quality/ Profitability	Low Volatility	Size	Other
Metrics	1-year total return divided by standard deviation of daily returns	Dividend Yield: trailing 12-month dividend divided by market capitalization (50%)	Return on equity: trailing 12-month net income divided by average shareholder equity	N/A	N/A	N/A
		Book to Price: latest book value divided by market capitalization (50%)				
Sector-Relative?	Yes	Yes	Yes			

Weighting Approach: The top 70% of stocks as ranked by their smoothed seven-month simple average aggregate factor score within sector are added to the index and weighted by the inverse of their weekly standard deviation measured over the past year. Sector weights are assigned by the inverse volatility of the sector measured using daily returns during the past year.

Factor Combination: Integrated

Factor Combination Approach: FTSE calculates the composite factor scores as the simple average ranking of each stock within sector.

Constraints:

▶ Maximum stock weighting is the lower of 0.50% or the product of 5 times the average daily trading volume during the past year and 0.25%

▶ Minimum stock weighting is the product of half its target weighting and 1 or 1/(100*(current sector weighting - target sector weighting)^2

▶ Maximum stock weighting increase at rebalance is the lower of 0.25% or the product of 0.25 and the stock's one-year average daily trading volume divided by 0.25%

▶ Maximum stock weighting decrease at rebalance is the lower of 0.25% or the product of 0.75 and the stock's one-year average daily trading volume divided by 0.25%

▶ Current constituents that drop out of the Russell 1000 index can stay in the portfolio if their composite factor score is in the top 80% of their sectors

Rebalancing: Quarterly on the third Friday in March, June, September, and December
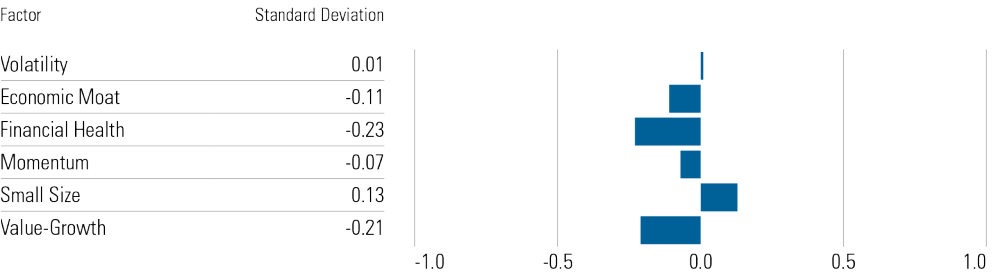
Portfolio Snapshot

Portfolio Characteristics		
	JPUS	Russell 1000 Index
Value		
Forward P/E	16.4	16.9
P/B	2.8	2.8
Size		
Market Cap ($ Bil)	28.4	74.1
Active Risk		
Tracking Error	2.9%	
Active Share	50.5%	

Morningstar Style Box
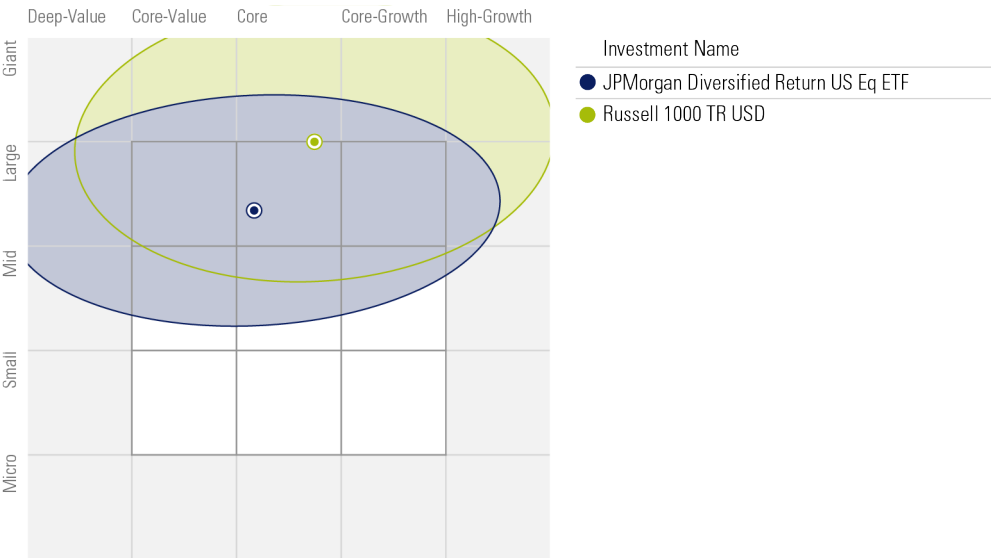
Investment Name
- JPMorgan Diversified Return US Eq ETF
- Russell 1000 TR USD

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between JPUS and Russell 1000 Index

Factor	Standard Deviation
Volatility	0.01
Economic Moat	-0.11
Financial Health	-0.23
Momentum	-0.07
Small Size	0.13
Value-Growth	-0.21

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (April 2013 - March 2018)

Factor	Coefficient
Beta	**0.87**
Size	0.06
Value	-0.08
Momentum	0.05
Profitability	**0.21**

Analysis of Fund's Factor Exposures

The fund's holdings-based and returns-based analyses are inconsistent. The holdings-based analysis suggests it has a value loading, but its quality and momentum loadings are less than those of its parent index. The returns-based analysis indicates that the fund has a statistically significant profitability loading, but its momentum and value exposures are not statistically significant.

Footnotes
1) Portfolio holdings data is as of April 2018.
2) Active risk data is calculated against the Russell 1000 Index.
3) Tracking error is calculated from October 2015 through April 2018.
4) The regression analysis is based on the fund's index.
5) Bolded figures in the regression table are significant at the 5% level.
6) The raw data for the factor regression is from the French Data Library.

UBS ETF MSCI USA Select Factor Mix USD A dis

Ticker	Morningstar Category	Net Expense Ratio	Assets (USD Mil)	Inception Date	Morningstar Analyst Rating
USFMD	EAA Fund US Large-Cap Blend Equity	0.30%	1,051	4/27/2017	🛡 Bronze

Morningstar Take

The fund targets U.S. stocks that have higher-than-average exposure to time-tested factors that have historically been associated with market-topping performance. The fund's low fee should contribute to its edge over the long run, but its short live track record limits its Morningstar Analyst Rating to Bronze.

Selection Universe: MSCI USA Select Factor Mix NR USD

UBS ETF MSCI USA Select Factor Mix USD A dis Selection Universe Description: The MSCI USA Select Factor Mix covers large-, mid-, and small-cap U.S. equities.

Number of Stocks in Selection Universe: 2,207

Number of Fund Holdings: 2,053

Index Name: MSCI USA Select Factor Mix Index

Index Inception Date: Jan. 16, 2017

Index Pre-Inception Performance Start Date: May 31, 1999

Targeted Factors & Factor Measurement

	Momentum	Quality/ Profitability	Value	Low Volatility	Yield	Size
Metrics	12-month risk-adjusted momentum (50%)	Return on Equity (33.3%)	Trailing Price to Earnings (25%)	Cumulative risk of stocks is 50% of the MSCI USA	Total Yield: Dividend Yield + Buyback Yield (50%)	The smallest 1,700 stocks are selected from MSCI's invest-able universe. The index may contain more stocks because of buffering.
	6-month risk-adjusted momentum (50%)	Debt to Equity (33.3%)	Price to Book Value (25%)		Debt Reduction Yield (50%)	
		Earnings Variability (33.3%)	Price to Sales (25%)			
			Price to Cash Earnings (25%)			
Sector-Relative?	No	No	No	No	No	No

Weighting Approach: The MSCI USA Select Factor Mix Index equally MSCI USA Momentum, Prime Value, Quality, Total Shareholder Yield, Dynamic 50% Risk Weighted Factor indexes and Small Cap.

Factor Combination Approach: Isolation. The fund equally weights six single-factor indexes.

Constraints:

▶ No constraints on the MSCI USA Select Factor Mix, only on the six single-factor indexes

Rebalancing: Quarterly on last business day of February, May, August, and November

Portfolio Snapshot

Portfolio Characteristics		
	USFMD	MSCI USA
Value		
Forward P/E	16.4	17.0
P/B	3.1	3.1
Size		
Market Cap ($ Bil)	28.4	74.1
Active Risk		
Tracking Error	4.01	
Active Share	37.9%	

Morningstar Style Box
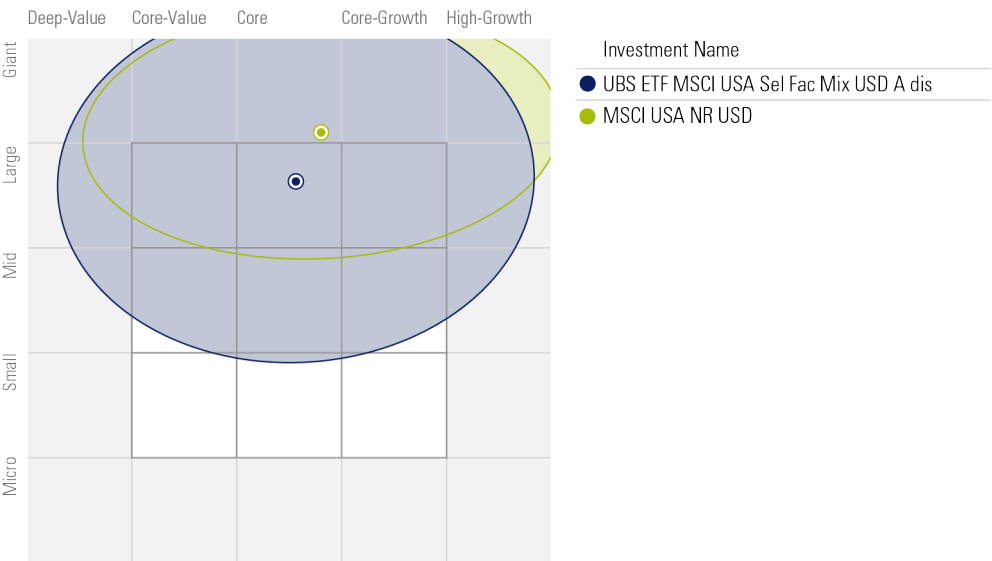
Investment Name
- UBS ETF MSCI USA Sel Fac Mix USD A dis
- MSCI USA NR USD

Source: Morningstar Direct. Data as of March 31, 2018.

Morningstar Risk Model Factor Exposure Differences Between UBS MSCI USA Select Factor Mix and MSCI USA
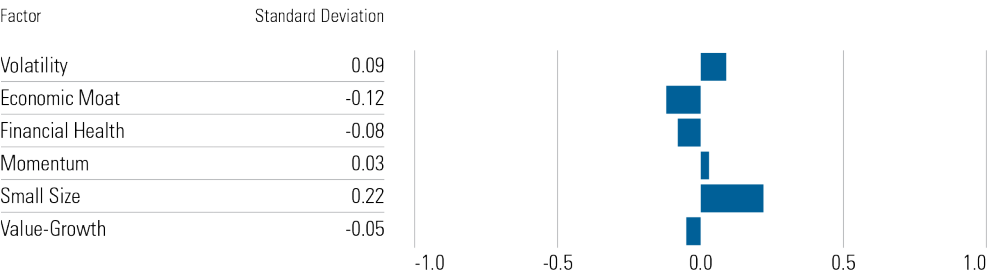
Factor	Standard Deviation	
Volatility	0.09	
Economic Moat	-0.12	
Financial Health	-0.08	
Momentum	0.03	
Small Size	0.22	
Value-Growth	-0.05	

Source: Morningstar Direct. Data as of Jan. 30, 2018.

Returns-Based Analysis

Factor Regression (May 2008 - March 2018)

Factor	Coefficient
Beta	**0.95**
Size	0.04
Value	-0.02
Momentum	**0.06**
Profitability	**0.15**

Analysis of Fund's Factor Exposures

The holdings-based analysis shows that the fund's factor loadings do not deviate from the MSCI USA's by much. The fund offers more exposure toward smaller companies, but its exposure to quality factors is lower relative to the parent index. The returns-based analysis suggests that the fund has statistically significant momentum, profitability, and beta loading. Meanwhile, value and small size are not statistically significant.

Footnotes
1) Portfolio holdings data is as of April 2018.
2) Active risk data is calculated against the MSCI USA.
3) Tracking error based on the fund's index from May 1999 through May 2018.
4) The regression analysis is based on the fund's index.
5) Bolded figures in the regression table are significant at the 5% level.
6) The raw data for the factor regression is from the French Data Library.

Appendix

Instructions for Running a Factor Regression

Directions for Excel

Note: The directions that follow assume the fund return data is denominated in USD (which works for any U.S.-listed fund, including those that invest in foreign stocks). For funds listed outside the United States, it may be necessary to convert the factor-return data into local-currency returns before running the regression.

1. Download the fund's monthly total return data into Excel.
It is best to use at least five years of data. If the fund has not been around that long, try using the return data for the index it tracks.

2. Go to the French Data Library
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

3. If this analysis is for a U.S. equity fund, go to substep a. If this analysis is for a global fund, go to substep b.

a. Click on the first Fama/French 5 Factors (2x3) text link (under U.S. Research Returns Data) and open the file. Next, click on the first Momentum Factor (Mom) text link, and open the file.
      i. The first file includes the following factor data: Mkt-RF (market-risk premium), SMB (small size), HML (value), RMW (profitability, which is a proxy for quality), and CMA (investment). We suggest excluding CMA from the factor regression because it has considerable overlap with HML. The last column includes the risk-free return.
b. If this analysis is for a global fund, click on the Fama/French Global 5 Factors link. Then open the text link next to Global Momentum Factor (Mom).

4. Copy the data from the files into Excel. For each:
      a. Highlight the data, click on the Data tab, and click on Text to Columns
      b. Select the Fixed Width radio button in the dialog window. Click Next. Then click Finish.

5. Delete the extraneous data.

6. Subtract the risk-free returns from the fund's total returns. This accounts for the portion of returns that is compensation for the time value of money.

7. Organize the data so that the explanatory factors are next to each other. In this example, the explanatory variables are in columns B through F.

8. Click on the Data tab in Excel. If Data Analysis appears, proceed to step 9.
a. If Data Analysis is not available, click File, Options, Add-Ins, Analysis ToolPak. Then click Go. Check the box next to Analysis ToolPak in the new window. Click OK.

9. Go to the Data tab and click on Data Analysis. Select Regression from the menu. Click OK.

      a. Select the data from step 6 as the Input Y Range (including the label, which in this case is Fund-RF). This is the dependent variable.

      b. Select the desired factor data for the Input X Range (including the labels). These are the independent variables.

      c. Check the Labels box.

      d. Click OK.

This will generate a table with the regression results. The table below illustrates the results for PowerShares FTSE RAFI US 1000 ETF PRF based on data from April 2008 through March 2018.

Summary Output

Regression Statistics

Multiple R	0.99
R Square	0.98
Adjusted R Square	0.98
Standard Error	0.79
Observations	120.00

ANOVA

	df	SS	MS	F	Significance F
Regression	5.00	2958.85	591.77	943.65	0.00
Residual	114.00	71.49	0.63		
Total	119.00	3030.34			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.05	0.08	0.65	0.52	-0.10	0.20
Mkt-RF	0.99	0.02	50.05	0.00	0.95	1.03
SMB	-0.03	0.03	-1.00	0.32	-0.10	0.03
HML	0.24	0.03	7.83	0.00	0.18	0.30
Mom	-0.14	0.02	-8.21	0.00	-0.17	-0.11
RMW	-0.02	0.05	-0.42	0.68	-0.12	0.08

The adjusted R-squared value indicates the portion of the variance in the fund's returns that the regression explained. An adjusted R-squared of 1.0 indicates that the regression explains 100% of the variance in the fund's returns. In this case, the regression explained 98% of the variance in PRF's returns.

The intercept is the fund's alpha, or excess returns that the model could not explain. Like the other regression coefficients, it is generally not meaningful unless it is statistically significant. Coefficients with a P-value of 0.05 or lower are usually considered to be statistically significant. Therefore, this fund does not have a significant alpha.

The coefficient corresponding to Mkt-RF (market risk premium) is known as the fund's *beta*. A beta of 1.0 means that the fund tends to appreciate 1% for each 1% gain on the market portfolio and lose 1% for each 1% decline in the market, holding all other factors constant. A beta of greater than 1.0 indicates that the fund may be riskier than the market, while portfolios with lower betas tend to be less risky. In this case, the fund's beta of 0.99 indicates that it tends to have a similar level of market risk to the market portfolio.

A fund's exposure to the size (SMB), value (HML), momentum (Mom), and profitability (RMW) factors are indicative of its style orientation. Negative exposure to the size and value factors suggests that a fund exhibits large-cap and growth tilts, respectively. The fund in this example has statistically significant positive exposure to value and negative exposure to momentum. Its exposure to size and profitability are not statistically significant, indicating that there is not strong evidence that the fund has a positive or negative relationship with those variables.

Portfolio Visualizer Directions
Note: This tool is designed for U.S.-listed funds.
1. Go to this link: https://www.portfoliovisualizer.com/
2. Click the Factor Regression link under Factor Analysis.
3. Type in the ticker for the fund of interest. To view more than one fund, insert a comma and space between tickers.
4. Set the date range. If you do not select a date range, it will default to the earliest date available.
5. From the Factor Returns dropdown menu, check the factors you wish to include in the regression.
6. From the Stock Market dropdown menu, select the region that corresponds to the region where the fund invests.
7. Click the Factor Analysis button. The results will be displayed.
8. Click the Rolling Regression tab to view how the fund's factor exposures have changed over time. Ⓜ

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