Equity factor-based investing: A practitioner's guide

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- This paper builds on the foundation described in *Factor-based investing*.[1] It is a practical guide to the suitability and key portfolio construction considerations relevant for those interested in equity factor-based investments.

- Equity factor-based investing is a form of active management that aims to achieve specific risk or return objectives through systematic, rules-based strategies. It can be used in a number of applications — for example, static tilts, active fund substitution, and portfolio completion. This paper explores these potential portfolio roles using hypothetical case studies.

- Key due-diligence considerations relevant for structuring factor-based investments include factor selection, weighting methods, and all-in costs. Each of these and other portfolio construction and implementation decisions can have a material impact on portfolio outcomes.

Acknowledgments: The authors thank Joel M. Dickson, PhD, of Vanguard's Investment Strategy Group, for his valuable contributions to this paper.

1 Pappas and Dickson (2015).

What's the "right" amount of factor exposure?

The weighting of different factor exposures in a portfolio grows out of an investor's preferences and beliefs about the risk and return characteristics of each factor. In this sense, the factor decision is akin to a security selection decision. Different investors, with different beliefs, will have different exposures to a particular security.

The factor decision shares another important parallel with security selection: It's governed by the zero-sum game. If one investor has a positive exposure to momentum or value, for example, then another must have a negative exposure to those factors in order to add up to the market as a whole (Sharpe, 1991). In aggregate, the overall equity market represents only equity (beta) exposure and, on average, has no momentum, value, quality, or other non-equity-beta factor exposures.

There are various other ways of deconstructing the market into smaller component building blocks, aside from factors. For example, the equity 9-box grid popularised by Morningstar, Inc., dissects the overall market into style and size exposures. These categories are mutually exclusive and exhaustive, and all categories can be combined to "reconstruct" the entire market.

Factor tilts, on the other hand, are not mutually exclusive and exhaustive. A stock may have positive exposures to multiple factors, such as momentum and quality. Other stocks may not be sensitive to any factors. As a result, a simple or identifiable relationship linking percentages of factor exposures and the overall market does not exist.

As an example, consider a hypothetical situation in which unlevered, long-only, value and quality factor portfolios have market betas of 0.90 and 0.95, and momentum and small-cap factor portfolios have market betas of 1.05 and 1.10. A portfolio with a marketlike exposure (i.e. a beta equal to 1) could be easily constructed from any of several combinations of these factor equity portfolios. Each portfolio has the same beta as the overall market with different average factor exposures, and none replicates the market.

In a market with neutral exposure to any one factor, some investors will overweight it and some will underweight it, with the "right" or "neutral" exposure determined by each investor's beliefs and preferences rather than by a factor's average weighting in the market, which is zero.

Notes on risk

All investments are subject to risk, including the possible loss of the money you invest. Past performance is no guarantee of future results. There is no guarantee that any particular asset allocation or mix of funds will meet your investment objectives or provide you with a given level of income.

Contents

Benchmarks represented in this analysis

		Index inception date	Index-live date
Liquidity (lower)	FTSE Developed Illiquidity Factor Index	30 Sep. 2001	11 Aug. 2015
Momentum (higher)	MSCI World Momentum Index	31 May 1973	11 Dec. 2013
Quality (higher)	MSCI World Quality Index	28 Nov. 1975	18 Dec. 2012
Size (lower)	MSCI World Small Cap Index	29 Dec. 2000	1 Jan. 2001
Value (higher)	MSCI World Enhanced Value Index	28 Nov. 1997	11 Aug. 2014
Volatility (lower)	MSCI World Minimum Volatility Index[2]	31 May 1988	14 Apr. 2008

Notes: The index inception date is the date that back-filled performance data are first available for the index. The index-live date is the date that an index is first published to the public and starts calculations using live data.

2 We use a minimum-volatility index to represent the low-volatility factor, but the two approaches differ. A low-volatility vehicle focuses on stocks that have historically exhibited lower absolute volatility than other stocks. In contrast, minimum-volatility vehicles consider stocks with lower volatility and attractive correlation (diversifying) characteristics to create an equity portfolio with lower absolute risk than the broad market.

Factor-based investing is not new — investors have looked beyond asset-class categorisations for many years. It is simply a different perspective for viewing a range of investment strategies that, in many cases, have been well-known for decades. For example, value investing was advocated by Graham and Dodd (1934). But some vehicles available to tilt portfolios to specific factors are new. And in an era when products tend to proliferate at a rapid pace, it can be difficult to keep up with the range of strategies available to those interested in factor-based investing. Sifting through the noise to determine what, if anything, to do with these types of products and how to select the right one can be challenging.

A range of different ways exists to take active risk in the equity market — factor-based investing is just one way of doing so. It often employs a consistent, systematic, rules-based process that targets a subset of stocks with certain desired characteristics.[3] These stocks are selected to achieve a specific investment objective, such as lower portfolio volatility or higher returns. The purpose of this paper is to provide a framework for determining whether and how to include equity factor-based investments in a portfolio.

The first section explores the historical performance of a few commonly discussed long-only, factor-based equity investment strategies (hereafter, equity factor tilts). It assesses how consistent their relative returns have been and how they have performed under different economic, market, and monetary policy conditions. It demonstrates that the performance of factor-based investments is cyclical and that their relative short- and long-term results are anything but certain or guaranteed.

The next section discusses key considerations relevant to choosing equity factor tilts. All equity investments have factor exposures that help influence and explain their performance. Increasingly, though, active and indexed investment vehicles are being designed specifically to target particular factor exposures — akin to genetically modifying a crop to enhance a particular characteristic such as insect resistance. This section explores portfolio construction and due diligence, describes the different decisions that can materially affect investment results, and highlights why a rigorous portfolio construction and due-diligence process is necessary.

The final section details four case studies that explore how equity factor tilts can be used in a portfolio. The list is by no means exhaustive, but it highlights the primary ways investors may choose these investments to potentially achieve certain objectives.

3 Although similar in many ways, factor-based investing differs from quantitative active management. As outlined in Pappas and Dickson (2015), equity factor-based investing explicitly creates specific factor exposures within a portfolio. In contrast, quantitative active investing aims to generate excess returns through combinations of academic and proprietary signals that may also implicitly or explicitly consider factor exposures.

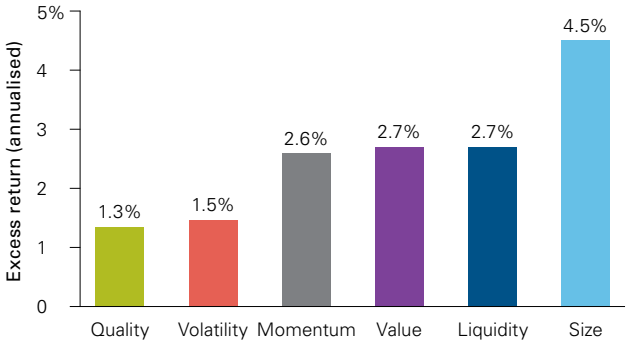
I. Performance

Why the interest in factors? Although stocks can be sorted in many different ways, attention is typically paid to those factors with an extensive academic literature and empirical evidence of historical positive risk-adjusted excess returns — in other words, certain factors that have "worked" in the past. In this paper, we focus on those most frequently addressed in the literature: value, momentum, quality, size, volatility, and liquidity. We use global, long-only equity index data to represent the performance of these factors (see the table on page 3). The analysis that follows offers insights into the historical performance of these equity factor tilts. **Figure 1** displays the annualised excess return, relative to the broad global equity market, that each such tilt has generated (before costs) since the inception of each factor index.

Factor performance varies considerably over time

Like other forms of active management, the performance of equity factor tilts relative to the broad market is difficult to predict. Regardless of the type of active management employed, long-term success demands strong patience to endure the inevitable periods of underperformance.[4] **Figure 2** showcases the year-to-year relative performance of each equity factor tilt.

Figure 1. Different equity factor tilts have outperformed historically

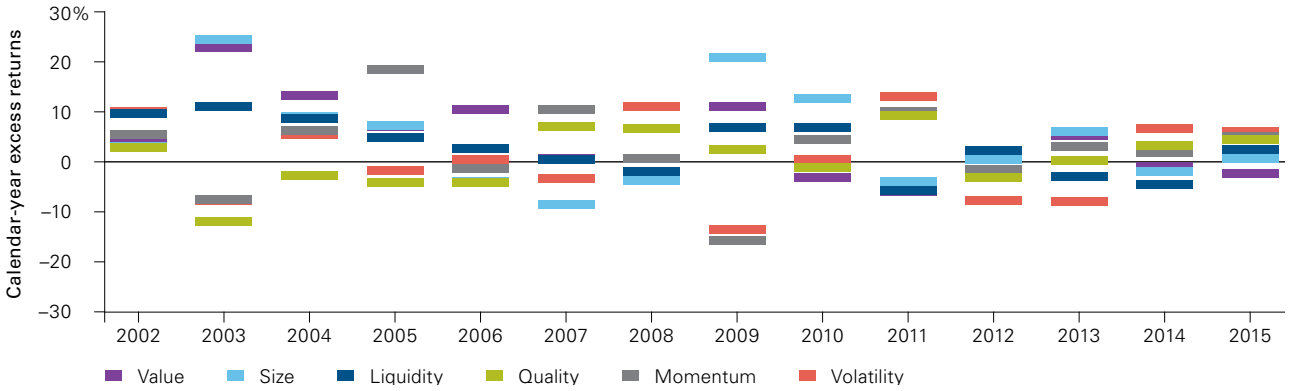


Past performance is not a reliable indicator of future results.

Notes: Excess returns are calculated relative to the MSCI World Total Return Index (USD). All results are as at 30 September 2016. MSCI World Momentum Index (USD) history begins 31 May 1973; MSCI World Value Index (USD) is from 31 December 1974 to 30 November 1997 and MSCI World Enhanced Value Index thereafter; MSCI World Quality Index (USD) begins 30 November 1975; MSCI World Minimum Volatility Index (USD) begins 31 May 1988; MSCI World Small Cap Index (USD) begins 31 December 2000; and FTSE Developed Illiquidity Factor Index (USD) begins 30 September 2001.

Sources: Vanguard calculations, using data from Thomson Reuters Datastream, MSCI, Bloomberg, and FTSE.

Figure 2. Equity factor tilt relative performance has been inconsistent



Past performance is not a reliable indicator of future results.

Notes: Data cover 1 January 2002 through 31 December 2015. Excess returns are calculated relative to the MSCI World Total Return Index (USD).

Sources: Vanguard calculations, using data from Thomson Reuters Datastream, MSCI, Bloomberg, and FTSE.

4 For more on patience with active management, see Wallick, Wimmer, and Balsamo (2015); Goyal, Ilmanen, and Kabiller (2015); and Hsu, Myers, and Whitby (2016).

Although the relative performance of equity factor tilts varies over time, it is difficult to profit from these swings through market timing. Using the available history for each equity factor tilt, **Figure 3** on the facing page illustrates how they performed versus a broad equity market index under different market, economic, and monetary policy conditions.[5]

As the wide dispersion of the results indicates, a high degree of uncertainty is associated with the relative performance of equity factor tilts in different environments. The challenge of forecasting what the environments will be and when they will occur, and how factors will act as a result, is notoriously difficult. Investors should tread carefully if considering tactically timing using different equity factor tilts.[6]

Challenges in considering future equity factor performance with real-world portfolios

A debate persists whether equity factors will earn excess returns in the future, particularly after there is broad awareness of their potential effectiveness (McLean and Pontiff, 2016; Asness, 2015). In addition, data mining and other statistical biases may affect the validity of conclusions drawn from the analysis of historical data.[7] An in-depth analysis of these important and complex issues is beyond the scope of this paper, but investors should consider whether there is a sound, rational risk and/or behavioural reason(s) supporting particular factors — and, critically, whether the potential benefits can be captured after all applicable costs are considered.[8]

Many academic and practitioner papers (including this one) that explore the characteristics of equity factor-based investing do not incorporate various implementation costs into their results; these costs can materially affect performance in real-world portfolios. When evaluating the appropriateness of an equity factor-based investment vehicle, it is important to take these potential performance drags into account. Four key implementation challenges can affect potential returns relative to what is typically reported in academic journal articles and factor index returns:

Short-selling constraints: Academic studies are often conducted by analysing long-short, single equity factor portfolios. Such portfolios often require significant short selling, which can be expensive and may not be achievable in practice.

Management and oversight expenses: The cost of both paying for day-to-day management and conducting ongoing oversight of these vehicles is rarely taken into consideration by academic and practitioner research and, in some cases, can be a significant portion of the theoretical factor returns.

Transaction costs: Equity factor tilts require varying degrees of turnover to maintain the desired exposure. This can generate costs because of bid-ask spreads, commissions, and market impact.[9]

Taxes: Taxes can reduce the potential returns of equity factor tilts.[10] The size of the impact will depend on the tax jurisdiction, the type of account, and the investor's tax status, as well as the investment strategy chosen.

The actual significance of these various effects will be influenced by numerous issues, such as the specific factor, how securities are weighted, the size of the potential investment, the investment vehicle's rebalancing policy, and the investor circumstances under consideration. The impact of these costs will also depend on the initial basis of the analysis; for example, the publication effect and short-selling constraints will generally have a greater impact on long-short academic results than on reported long-only factor index returns. Investors considering equity factor-based investment strategies should assess the relevant implementation costs.

5 We use US economic and monetary conditions as a proxy for global conditions, given the leading role of the US economy and stock market in global finance and the broad use of the US dollar as a reserve currency. It is important to note that the time periods studied for each factor index vary based on the data availability. Because this analysis requires that certain conditions exist, the number of occurrences (and hence sample size) of each is low, which limits the robustness of the results.

6 Arnott et al. (2016) argue that relative valuations may be a way to successfully time equity factor tilts; however, Blitz (2015) and Asness (2016) warn that timing factors is very difficult.

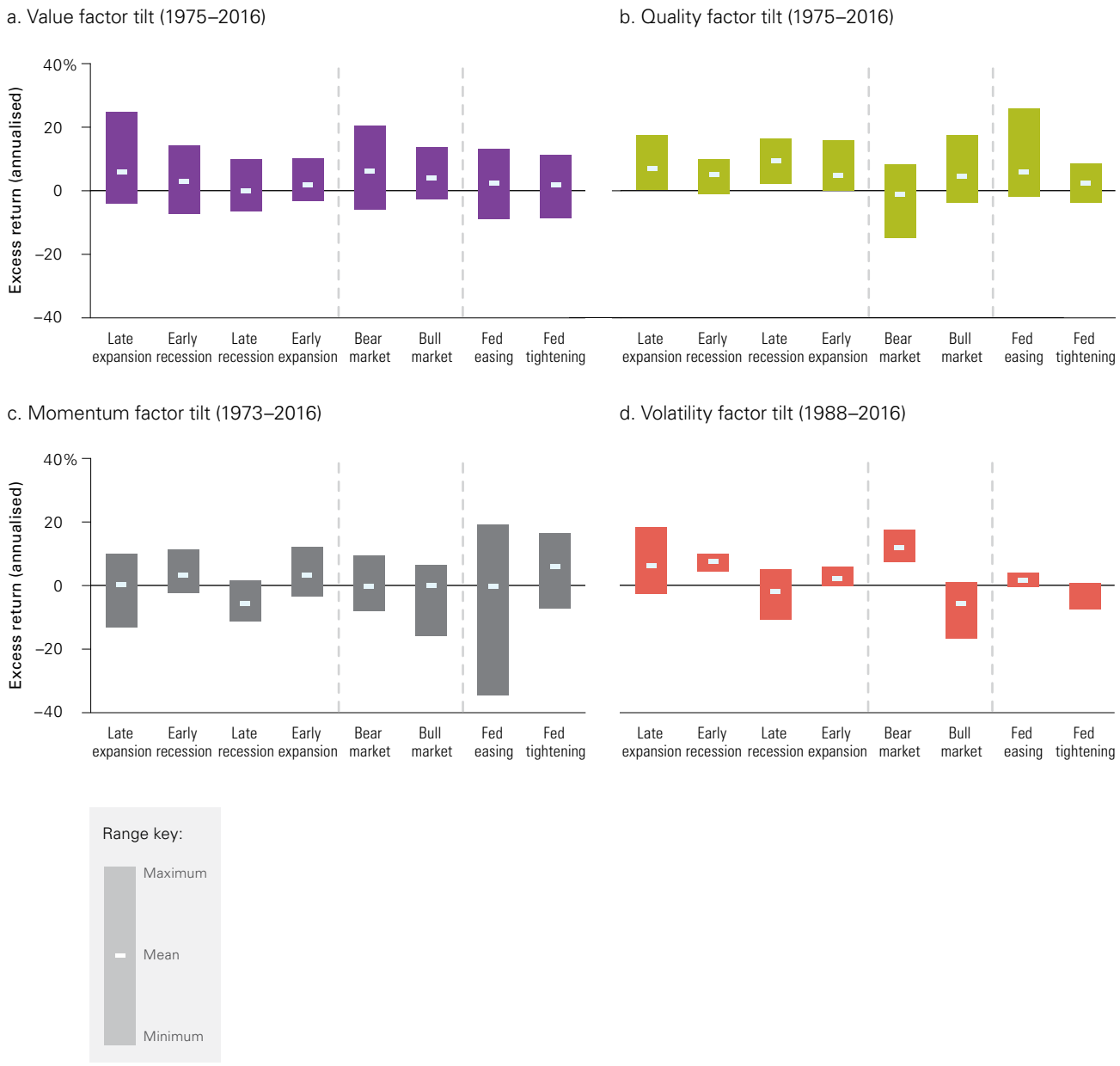
7 Literature on this topic is expanding. For instance, see Novy-Marx (2016) and the citations within it.

8 Asness et al. (2015) survey a sample of the various risk and behavioural explanations proposed in the academic literature. Ang (2014), Amenc et al. (2014), and Harvey, Liu, and Zhu (2016) suggest different frameworks for determining whether a factor's performance may persist in the future.

9 For more on this topic, see Novy-Marx and Velikov (2016) and the citations within it.

10 For more on this topic, see Santodomingo, Nemtchinov, and Li (2016) and the citations within it.

Figure 3. Performance in different environments has been unpredictable



Past performance is not a reliable indicator of future results.

Notes: Excess returns are annualised and are calculated relative to the MSCI World Total Return Index (USD). All results are as at 30 September 2016. MSCI World Momentum Index (USD) history begins 31 May 1973; MSCI World Value Index (USD) is from 31 December 1974 to 30 November 1997 and MSCI World Enhanced Value Index thereafter; MSCI World Quality Index (USD) begins 30 November 1975; and MSCI World Minimum Volatility Index (USD) begins 31 May 1988. Because of the limited history, the liquidity and size factors were not included in the analysis. To define early and late recession, we divided each historical recession in half. The 12-month period before a recession was defined as late expansion, and the 12-month period after a recession was defined as early expansion. We used the dating for US recessions from the National Bureau of Economic Research. Bull markets were defined as continuous periods without a broad equity market decline of more than 20%. Bear markets were defined as periods when the market fell at least 20%. Fed easing was defined as periods that included three consecutive reductions in the US federal funds target rate. Fed tightening was defined as periods with three consecutive increases in the target rate.

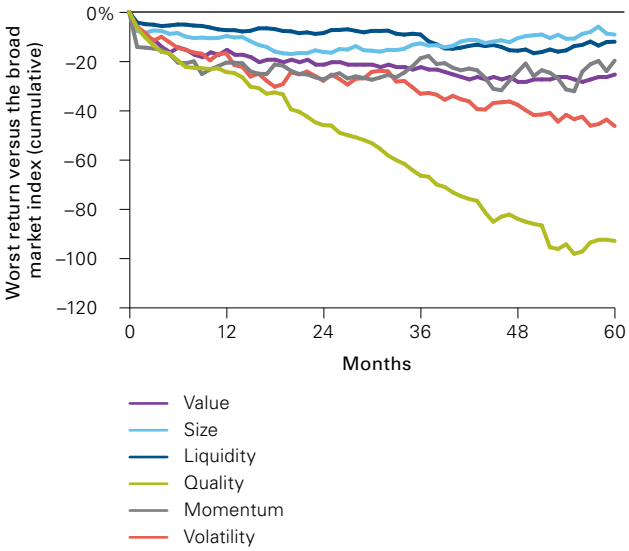
Sources: Vanguard calculations, using data from Thomson Reuters Datastream, MSCI, and Bloomberg.

Periodic underperformance can be severe and lengthy

Equity factor tilts have experienced extended stretches of both relatively strong and relatively weak performance compared with the broad equity market. **Figure 4** charts the worst periods of underperformance that each equity factor tilt has had during different periods. All have experienced periods of 60-plus months of such underperformance, potentially challenging the conviction of even the most patient investors to stay the course. The magnitude of underperformance has also been significant: Each factor tilt has underperformed the broad market index by at least 7 percentage points over a 12-month period.

Individual and institutional investors have tended to sell active investments when those are underperforming over shorter periods (Kinniry et al., 2016; and Goyal, Ilmanen, and Kabiller, 2015). Therefore, it is critical for investors, and other stakeholders, to determine in advance whether they have the willingness, ability, and time horizon necessary to handle periods of poor relative performance.

Figure 4. Investors must be able to withstand difficult stretches of underperformance



Past performance is not a reliable indicator of future results.

Notes: Excess returns are calculated relative to the MSCI World Total Return Index (USD). All results are as at 30 September 2016. MSCI World Momentum Index (USD) history begins 31 May 1973; MSCI World Value Index (USD) from 31 December 1974 to 30 November 1997 and MSCI World Enhanced Value Index thereafter; MSCI World Quality Index (USD) begins 30 November 1975; MSCI World Minimum Volatility Index (USD) begins 31 May 1988; MSCI World Small Cap Index (USD) begins 31 December 2000; and FTSE Developed Illiquidity Factor Index (USD) begins 30 September 2001.

Sources: Vanguard calculations, using data from Thomson Reuters Datastream, MSCI, Bloomberg, and FTSE.

II. Portfolio construction and due diligence

We consider any equity factor tilt, other than the market itself, to be an active strategy, because its intent is to achieve performance that differs from a broad market-cap-weighted index. So it is critical for investors to employ thorough due diligence when assessing these investment vehicles regardless of whether they are packaged in an active or index product.[11]

To conduct robust due diligence, investors need strong quantitative aptitude and access to risk factor analytics software.[12] In this section, we discuss the key decisions that can materially affect performance. Importantly, there is no "one size fits all" for those interested in equity factor-based investing. In many cases, the relative attractiveness of a particular approach will depend on the investor's unique objectives, constraints, due-diligence capabilities, and belief set.

The security weighting decision can meaningfully affect results

No widely accepted method exists for weighting securities in an equity factor tilt strategy. The numerous approaches used in the industry can be broadly classified into three main types: market capitalisation, alternatively weighted, and long-short. **Figure 5** highlights some of their key differences.

The alternatively weighted category is a catchall for any long-only techniques that are not market-capitalisation-weighted. Although many different methodologies are in the marketplace, alternatively weighted vehicles generally set stock weightings based on a stock's sensitivity to the desired factor or factors.[13] In some cases, these weightings are constrained by the active manager or index provider to meet certain liquidity and diversification guidelines.[14]

Figure 5. The security-level weighting choice has numerous implications

Key differentiating characteristics	Market-cap weighted	Alternatively weighted	Long-short
Factor sensitivity	Lower	Medium	Higher
Turnover/transaction costs	Lower	Medium	Higher
Expenses	Lower	Medium	Higher
Correlation with broad equity market	Higher	Higher	Lower

Higher Medium Lower

Note: Points of differentiation in this table are considered relative to one another.
Source: Vanguard.

11 For instance, not all factors are defined the same way. Users need to understand the differences. With long-only, equity factor-tilted index products, the active decisions are made during the index methodology creation process (Berger and McCarthy, 2016). During the design stage, the index provider makes choices about the selection universe, weighting method, stock characteristics to target, rebalancing policy, turnover rules, liquidity guidelines, etc. For more details on some of these active choices, see Bender and Wang (2015b).

12 Investors often conduct this type of quantitative assessment using risk analytics software tools from vendors such as Axioma, Barra, or Style Research.

13 Alternatively weighted equity index vehicles are commonly referred to as smart beta or strategic beta, which include factor-based approaches. However, certain alternatively weighted indices are not designed to intentionally target consistent exposure to a specific factor or set of factors (e.g. the FTSE RAFI Index Series and the Standard & Poor's 500 Equal Weight Index). Although factor exposure may explain the performance of these indices, their ad hoc weighting methodologies can lead to unstable exposure (style drift) to different factors (Amenc et al., 2015, and Philips et al., 2015). Given the roles that equity factor tilts tend to play in portfolios (as described in the Application Case Studies section on page 15), using alternatively weighted indexed investments with exposures that are time-varying may not be preferable for those trying to deliberately seek stable factor tilts.

14 Concentration levels can vary significantly from product to product. If the vehicle's holdings are too concentrated, it can add material idiosyncratic and other unrewarded risks (Amenc et al., 2016).

A long-short weighting method fundamentally differs from a long-only approach. Long-only techniques, whether capitalisation or alternatively weighted, provide exposure to a combination of the chosen factor plus the equity market factor (equity risk premium). In contrast, the long-short approach provides exposure to the selected factor. These portfolios are often designed to have a market beta close to zero and therefore should not be expected to earn the equity risk premium over the long term. This has significant implications for the decision about which part(s) of the portfolio should be used to fund this type of strategy from and how to properly evaluate performance.[15]

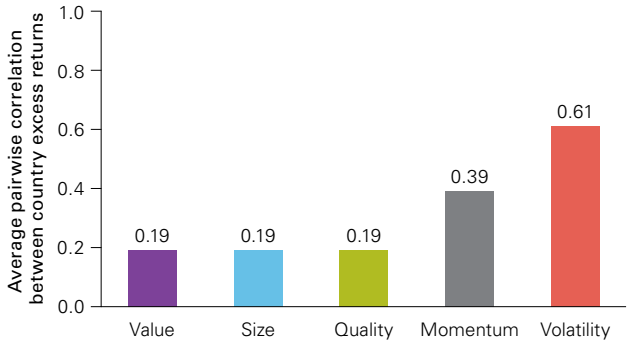
The long-short weighting technique introduces additional complexities into the portfolio management process that can influence its effectiveness, along with the willingness, ability, and time horizon of certain investors to pursue this type of approach. For example, capacity — the to short certain stocks and the cost to do so — can reduce the level of interest in this approach. There may also be liquidity, leverage, or derivatives considerations that the investor must evaluate before making a decision.[16] Although this technique offers the highest degree of factor sensitivity and is the purest form of obtaining factor exposure, investors need to consider the unique practical implications and risks inherent in using it.[17]

Global or local?

Single-country and global equity factor tilt products are available to investors. The decision of which to use is typically based on the investor's preferences. By choosing to harvest a factor tilt through a global mandate, investors benefit from increased market and currency diversification, which potentially lowers volatility.[18]

An investor may also obtain factor diversification when investing in an equity factor tilt in different countries. **Figure 6** measures the average pairwise correlation of the excess returns of the United States, Japan, and United Kingdom equity factor tilts versus their local broad equity market indices in US dollars.

Figure 6. Expanding factor exposure globally has produced diversification benefits



Notes: Calculations use monthly excess returns from 31 December 2000 to 30 September 2016, except for the volatility factor, which covers 30 November 2001 to 30 September 2016. Single-country factor indices used (all based in USD) were the MSCI USA Value Index, MSCI USA Small Cap Index, MSCI USA Quality Index, MSCI USA Minimum Volatility Index, MSCI USA Momentum Index, MSCI Japan Value Index, MSCI Japan Small Cap Index, MSCI Japan Quality Index, MSCI Japan Minimum Volatility Index, MSCI Japan Momentum Index, MSCI United Kingdom Value Index, MSCI United Kingdom Small Cap Index, MSCI United Kingdom Quality Index, MSCI United Kingdom Minimum Volatility Index, and MSCI United Kingdom Momentum Index. The excess returns for the US factor indices were calculated versus the MSCI USA Index (USD). The excess returns for the Japan factor indices were calculated versus the MSCI Japan Index (USD). The excess returns for the UK factor indices were calculated versus the MSCI United Kingdom Index (USD). The liquidity factor was not included because of data limitations.

Sources: Vanguard calculations, based on data from Thomson Reuters Datastream and MSCI.

For example, the average correlation of excess return of the momentum factor across these three countries, after controlling for currency and local market returns, is 0.39.

All else being equal, single-country factor tilts are not as diversified as global factor tilts. However, when building a globally diversified equity portfolio, some investors may prefer combining single-country factor tilts, which provide the flexibility to customise the country and currency allocation to suit their preferences or constraints.

15 Long-short equity factor strategies are sometimes used by hedge funds and liquid absolute-return-type vehicles. For more on how this affects suitability and the role in portfolios, see Wallick et al. (2015) and Wallick et al. (2016).

16 For more on the risks of shorting in order to obtain larger factor exposure, see, for instance, Bender and Wang (2015a).

17 For a more in-depth comparison between long-only and long-short implementation, see, for instance, Blitz et al. (2014).

18 For more on the general benefits of global equity diversification, see Philips (2014) and Asness, Israelov, and Liew (2011).

Index or actively managed?

Equity factor tilts can be implemented using index or active vehicles. Index versions offer high transparency, typically have lower costs, and are mechanical in nature — investment decisions are driven by the underlying methodology documented by the index provider.[19] The rebalancing process is often rigid, particularly if the manager aims to minimise tracking error relative to a factor-weighted benchmark. In addition, a primary objective of index construction is often high capacity and investability. In some cases, these objectives may take precedence over certain performance characteristics and factor sensitivity.

There are two main types of active approaches. *Active selection* seeks to add value over and above the exposure to the equity factor (e.g. security selection). *Active implementation* tries to maintain consistent factor exposure, accounting for such trade-offs as substantially similar securities, overall portfolio risk exposure, and transaction costs. Active methods can be particularly beneficial for equity factor tilts that require higher turnover to maintain or that involve stocks with higher trading costs. Also, given that the vehicles may not be tied to a factor-weighted benchmark index, they can further enhance the way they harvest the targeted factor(s) over time. This option may or may not be attractive to certain investors, as some prefer that the manager preserves the same methodology through time.

If either an index or active approach is considered, potential investors must weigh their preferences for portfolio construction, manager flexibility, transparency, and cost. Part of the investor's due diligence must include a risk assessment of each equity factor tilt versus the broad market index, not necessarily the vehicle's publicly reported benchmark. This ensures that all the comparisons are apples-to-apples, as designated benchmarks can vary widely. For example, an equity factor tilt index product is likely to have low tracking error relative to its factor-tilted benchmark but have material tracking error versus the broad market index.

Multifactor

Does combining factors improve diversification?

The significant active performance cyclicality of single equity factor tilts (described in the Performance section) has led some investors to consider combining them to achieve certain objectives. A prime motivation is the potential diversification benefits that can be garnered by merging equity factor tilts. This benefit can be evaluated in two primary ways: diversification of relative (active) risk or absolute risk. From the perspective of active risk, the diversification benefits associated with multiple factor tilts has historically been reasonably strong. That is, the active risk that accompanies equity factor tilts can potentially be reduced by holding a combination of factor tilts.

19 In some cases, actively managed equity factor tilt vehicles have lower costs than certain equity factor tilt index products.

Figure 7 shows the historical correlation of the *excess* returns of different equity factor tilts versus the broad market index. On balance, their correlation has been low, with an average pairwise correlation of 0.06. This low correlation indicates the potential diversification benefits of combining multiple factor tilts.

When analysed from the perspective of absolute risk, however, the diversification potential is not as apparent. **Figure 8** shows the correlation of *total* returns. Although long-only, equity factor-based investments deliberately tilt toward specific factors, their overall returns are still mainly driven by the market factor, since they are all fully invested in stocks by design. Because of this common market exposure, many tilts exhibit high correlation with the broad equity market. Therefore, from the perspective of total returns, the diversification benefits of multiple factor tilts are more limited.

Figure 7. Low correlation of excess returns can diversify active risk

Correlation of monthly excess returns: 2002–2016

	Value	Quality	Volatility	Momentum	Size	Liquidity
Value						
Quality	–0.59					
Volatility	–0.38	0.49				
Momentum	–0.11	0.37	0.37			
Size	0.43	–0.30	–0.15	0.10		
Liquidity	0.57	–0.44	–0.13	0.08	0.63	

High: > 0.7 Medium: 0.3–0.7 Low: < 0.3

Notes: Data cover 31 December 2001 through 30 September 2016. Excess returns are calculated relative to the MSCI World Total Return Index (USD).
Sources: Vanguard calculations, using data from Thomson Reuters Datastream, MSCI, Bloomberg, and FTSE.

Figure 8. High correlation of total returns means limited diversification of absolute risk

Correlation of monthly total returns: 2002–2016

	Market	Value	Quality	Volatility	Momentum	Size	Liquidity
Market							
Value	0.96						
Quality	0.97	0.90					
Volatility	0.90	0.85	0.88				
Momentum	0.88	0.85	0.88	0.83			
Size	0.92	0.93	0.86	0.82	0.84		
Liquidity	0.97	0.97	0.92	0.88	0.88	0.95	

High: > 0.7 Medium: 0.3–0.7 Low: < 0.3

Notes: Data cover 31 December 2001 through 30 September 2016. The broad equity market is represented by the MSCI World Total Return Index (USD).
Sources: Vanguard calculations, using data from Thomson Reuters Datastream, MSCI, Bloomberg, and FTSE.

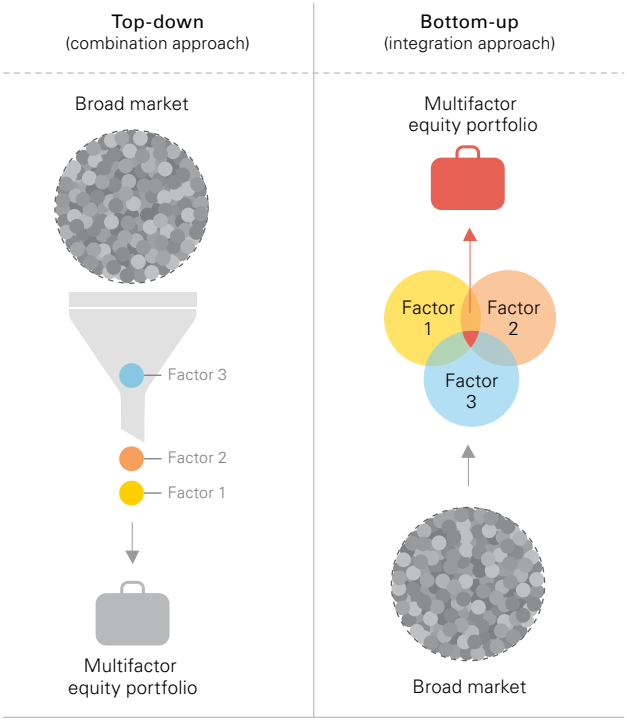
Comparing multifactor weighting approaches

Two primary methods exist for obtaining exposure to multiple equity factor tilts in a portfolio: top-down and bottom-up (see **Figure 9**). The most suitable approach will vary depending on one's investment objectives, constraints, preferences, due-diligence capabilities, and belief set. Below is a brief overview of the competing approaches.

Top-down:[20] This approach determines factor exposures through vehicle selection. Investments are made in separate vehicles that each target a single specific factor. This method gives the end investor the flexibility to control *which* factors to include, *what* weighting schemes to use for the specific factors, *who* the asset manager is for each, and *how* much to allocate to each single-factor vehicle.

Bottom-up:[21] This approach determines factor exposures through security selection. Stock portfolios are formed based on the factor sensitivity of individual stocks to *all* the desired factors. That is, a stock with a moderate sensitivity to several of the preferred factors is more likely to be selected in the bottom-up portfolio than a stock with a high sensitivity to just one factor and poor sensitivity to the other(s). Given that the stock portfolio is built from the security level bottom-up, in most cases the end investor must find an investment vehicle with the preferred factors and weighting technique. This method may also reduce turnover versus a top-down approach, because stocks that no longer exhibit very strong sensitivity to one factor do not necessarily have to be sold if they still rank favourably with the other factor(s). Lastly, this process ensures that the chosen stocks are not inadvertently tilted against any of the targeted factors.[22]

Figure 9. A bottom-up, multifactor approach targets stocks that have multiple desired characteristics



Source: Vanguard.

By assessing stocks across multiple factors before including them in an equity portfolio, the bottom-up approach may lead to better long-term results for investors who plan to maintain their factor exposure weightings over the long term. Bender and Wang (2016) compare the gross historical performance of a bottom-up and a top-down factor portfolio comprising four global equity factor tilts: value, volatility, momentum, and quality. **Figure 10** summarises their results and shows that both multifactor approaches

20 Also referred to as a "combination", "building blocks", or "a la carte" approach.

21 Also referred to as an "integrated" or "composite" approach.

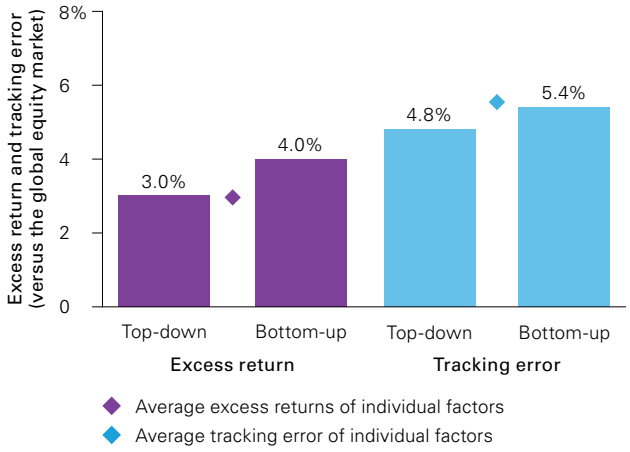
22 As an example of this interaction effect with a bottom-up approach, a stock might look attractive in a value factor screen because its valuation has become very low as a result of a significant price drop in the recent past. However, because it has performed poorly relative to other stocks, it would not pass a momentum factor screen. By considering possible unfavourable information on both characteristics by avoiding low-valuation stocks that have poor relative momentum and high-momentum stocks that have lofty relative valuations, the end investor may be able to improve the risk–return trade-off while reducing unnecessary trading and taxes, since the multidimensional ranking occurs at the stock level first. For more on the differences between top-down and bottom-up approaches, see Bender and Wang (2016) and Fitzgibbons et al. (2016).

exhibit less tracking error than the average of the four individual factors (blue diamond). The excess return of the top-down multifactor approach roughly matches the average excess return of the individual equity factor tilts during the period (purple diamond). However, the bottom-up approach earned an additional 1 percentage point per year (purple bars), while increasing tracking error only by about half a percentage point relative to the top-down approach (blue bars).[23]

There is no optimal or "all-weather" multifactor combination for all investors

Investors' objectives and constraints may affect their choice of factors and desired weightings. For example, is the investor trying to maximise excess return regardless of tracking error? Maximise the Sharpe ratio? Maximise the information ratio?[24] When considering factor weights, it is important to understand that future outcomes with equity factor tilts may differ in both risk and return from what was observed during a sample period. As a result, investors should be careful not to try to "optimise" weights based on a certain period of historical performance.[25] Regardless of the decision, investors must realise there is no "all-weather" multifactor approach that guarantees success over either short or long periods. They should be prepared for a bumpy performance road and the possibility that equity factor tilts may not add value in the future.

Figure 10. Bottom-up construction has tended to produce superior long-term results



Past performance is not a reliable indicator of future results.

Notes: Data cover 31 December 1992 to 31 March 2015. Results are based on a historical simulation conducted by Bender and Wang (2016), who tested the results of an equally weighted combination of value, volatility, quality, and momentum factor tilts versus an equity portfolio constructed bottom-up with an equal weighting to the same factors.

Sources: Vanguard calculations, based on data from Bender and Wang (2016).

23 This does not imply that a bottom-up approach will always outperform the top-down method. In particular, during periods in which the targeted factors are not doing well, the top-down approach is likely to do better.

24 For more details on how objectives affect factor weights, see Blitz (2015) and Amenc et al. (2014).

25 See, for instance, Novy-Marx (2016). In some cases, end investors may not be able to find their preferred group of factors or weighting method, or both, in available investment offerings in the marketplace. Therefore, they may have to weigh the trade-offs of different "off-the-shelf" multifactor investment vehicles, designed using a bottom-up approach, with single equity factor-tilted vehicles that could be combined using the desired mix in a top-down approach. Also, investors should not combine equity factor tilts simply because they want to diversify active risk exposure or because they back-test well together (Novy-Marx, 2016). Investors must first believe that each factor they choose to include in the equity portfolio will help achieve their objective.

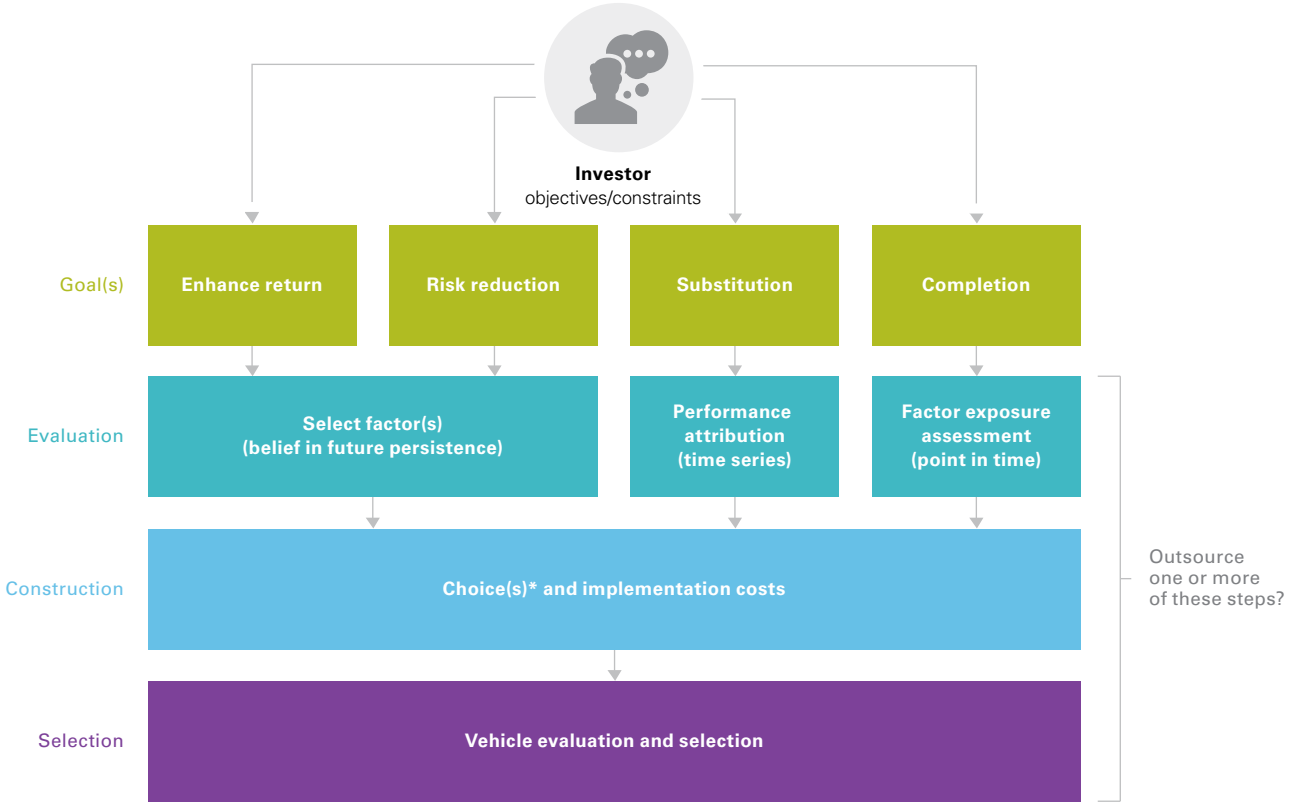
III. Application case studies

Equity factor-based investing can be used in a range of different applications by investors. Because each investor has a unique combination of objectives, constraints, due-diligence capabilities, and belief sets and can use equity factor tilts in multiple ways, it is inadvisable to suggest a universal equity factor tilt approach.

Figure 11 provides a decision tree to help investors determine the most appropriate choice based on the important considerations discussed throughout this paper. Investors have the option — during the evaluation, construction, and/or selection stage — to retain control over some or all of the decisions or to outsource them to a third party to help determine and implement the most appropriate strategy for their specific situation.

On pages 16–20 are four case studies that showcase how equity factor tilts can be used to create intentional static tilts, substitute for certain active manager performance, and mitigate unintended risk exposures.

Figure 11. A decision-making framework for equity factor tilts



* Decisions include single factor versus multiple factors, active versus index, global versus local, weightings across and within factors and regions, top-down versus bottom-up (if multifactor), and impact on a portfolio.

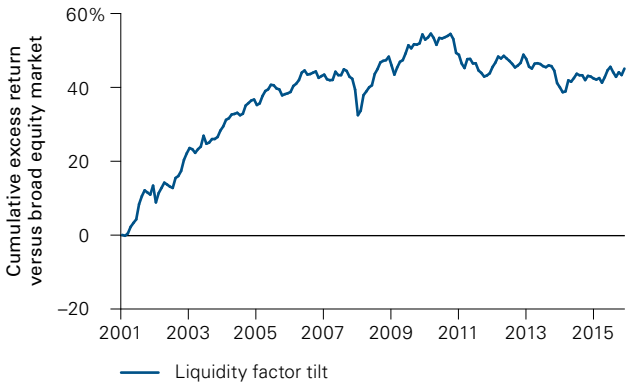
Source: Vanguard.

Static tilt: Outperformance

A Canadian wealth management firm is comfortable taking active risk for its more aggressive and patient clients. Historically, the firm has used traditional active managers to try to outperform the equity market; however, it has been disappointed in its ability to select high-quality managers. Clients are starting to ask why they are paying high active manager fees for poor results. Accordingly, the firm is interested in possibly using an equity factor tilt to help achieve the outperformance goal and reduce costs to decrease the risk of losing clients.

After significant research and deliberation, the firm decides to add a static, liquidity equity factor tilt to its aggressive client portfolios as a systematic approach to potentially generate outperformance. **Figure 12** shows how the equity factor tilt has performed historically. The tilt is funded by redeeming a portion of the assets held by its traditional active managers while making sure that the new mix has no unintended factor exposures.[26]

Figure 12. Liquidity equity factor tilt has outperformed historically



Past performance is not a reliable indicator of future results.

Note: All calculations are relative to the MSCI World Total Return Index (USD) and cover 30 September 2001 through 30 September 2016.

Sources: Vanguard calculations, using data from Thomson Reuters Datastream and FTSE.

The firm strongly believes that over the long term, this tilt will generate excess returns net of all implementation costs. It also understands there will be sizeable active performance cyclicality in the short and intermediate term. This cyclicality will require behavioural coaching of clients, particularly since the firm has not used an equity factor tilt for them in the past.[27] Because these clients have previously demonstrated an aggressive tolerance for active risk, the firm feels confident that they will be able to handle prolonged future periods of underperformance against the broad equity market.

Static tilt: Lower volatility

An Australian superannuation fund has a range of investment options available to its members. The fund is interested in lessening the total volatility of one of its conservative fund-of-fund options with a minimal reduction in return. Participants typically use this offering in their decumulation stage. After conducting thorough due diligence, the fund believes that shifting some of its global equity exposure in the conservative option to a low-volatility-tilted vehicle will help achieve this objective.

Figure 13 shows that the standard deviation of the volatility factor tilt was lower than the broad market over the period 1988–2016. On average, the reduction in volatility was 24%. An important part of the change for the superannuation fund will be educating its stakeholders and members about reasonable expectations for performance.[28] Although the vehicle may help reduce absolute risk in the portfolio over the long term, it will produce high tracking error versus the broad equity market, which will require a strong tolerance for this type of risk.[29]

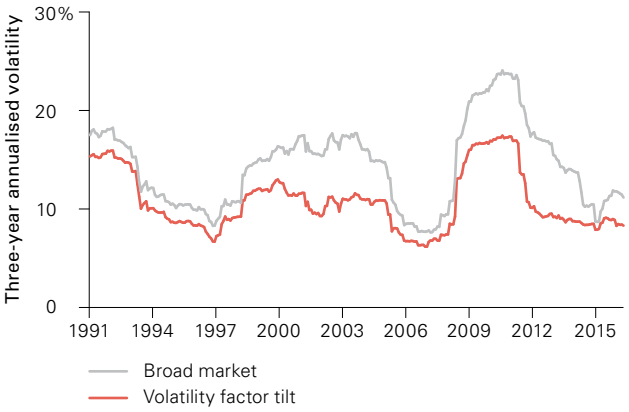
26 Unintended factor exposures are discussed in more detail in the Completion case study on page 20.

27 For more on the importance of behavioural coaching, see Bennyhoff and Kinniry (2016).

28 If the volatility factor tilt produced lower volatility than the broad market, conventional wisdom would suggest that the return was probably lower as well. However, over this particular period, the factor tilt actually outperformed the broad market by an annualised 1.5 percentage points. This may not be the case in the future.

29 Over the period from 31 May 1988 to 30 September 2016 the tracking error versus the broad market index was 6.7%.

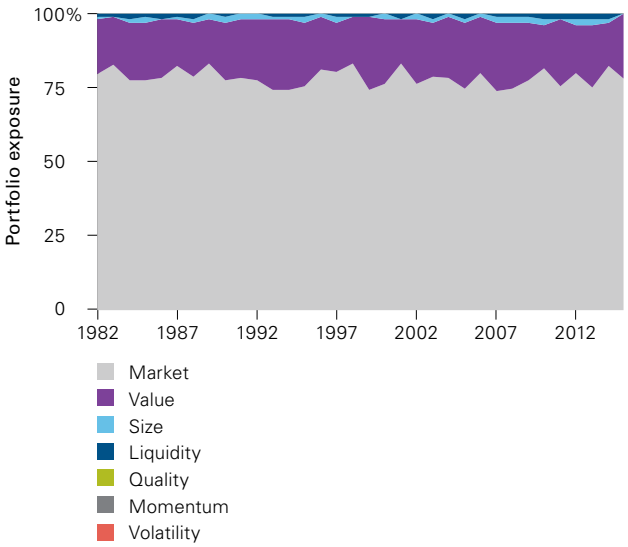
Figure 13. Volatility equity factor tilt has exhibited consistently lower absolute volatility



Notes: Calculations are based on the three-year annualised standard deviation of returns and cover 31 May 1988 through 30 September 2016. The broad market is represented by the MSCI World Total Return Index (USD).

Sources: Vanguard calculations, using data from Thomson Reuters Datastream, MSCI, and Bloomberg.

Figure 14. Hypothetical returns-based style analysis shows a consistent value factor tilt for a certain traditional active manager



Note: This example is hypothetical and does not represent the exposures for a specific traditional active manager. The figure shows that the manager did not showcase any quality, momentum, or volatility exposure over the period, and the exposure to size and liquidity was de minimis.

Source: Vanguard.

Active manager substitution

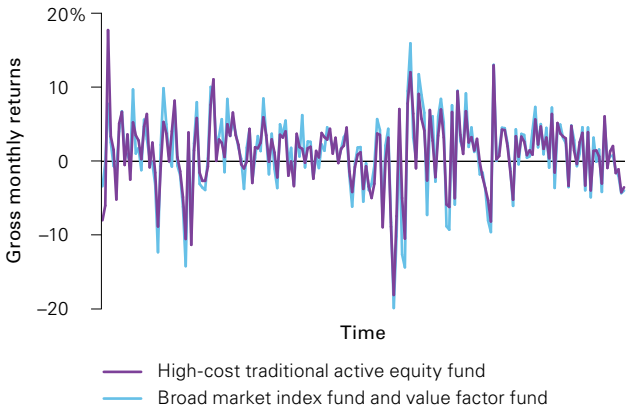
A Scandinavian pension fund invests in very low-cost market-capitalisation-weighted index vehicles as well as in assets held by a number of traditional and quantitative active managers. Its in-house investment staff decides to comprehensively analyse the performance drivers for each active manager.

During this assessment, it finds that a particular manager's returns are largely explained by common factor exposures. This manager, which is benchmarked against the broad equity market index, has maintained a relatively consistent factor tilt to value over time, as shown in the returns-based style analysis in **Figure 14**.

After adjusting for this fairly steady value factor tilt, the staff observes that the manager has not produced any additional return through either security selection or market timing. As a result, the staff tests whether it could represent the manager's returns with a broad market index vehicle paired with a low-cost, value-factor-tilted equity product. **Figure 15** shows a very consistent co-movement between the active manager and the substitution (sometimes referred to as factor mimicking) approach.

Finally, undertaking a cost analysis, the staff finds that switching to the substitution approach would lead to significant savings for the pension fund over time. Given the high management costs, the relatively predictable and consistent factor exposures, the lack of style-adjusted alpha, and the strong connection between the manager's returns and the substitution strategy, the pension investment committee decides to replace the high-cost manager with the more transparent, lower-cost combination of a value equity factor-tilted product and a broad market index vehicle.[30]

Figure 15. Returns of a substitution approach appear quite like those of a high-cost, traditional active manager



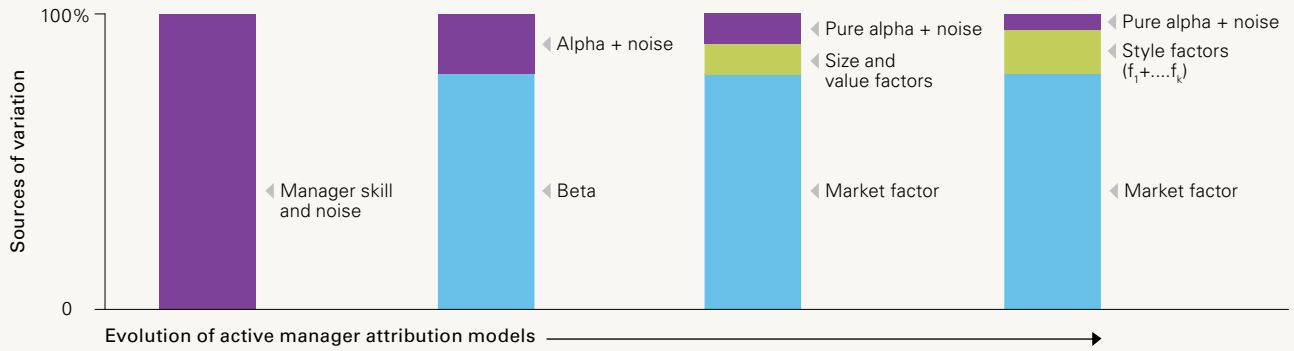
Note: This example is hypothetical, representing a period of several decades, and does not represent the exposures for a specific traditional active manager.
Source: Vanguard.

30 Any of the equity factor tilts covered in this paper could be considered for this role. Also, if this returns-based style analysis graph had shown a lot of variation in value factor exposure through time, it would be more challenging to represent in the future, which would alter the cost-benefit analysis on making the switch.

A higher bar for active management

The ability to cheaply replicate systematic factor returns has raised the performance hurdle for both traditional and quantitative active equity managers. **Figure 16** displays the evolution of active manager performance attribution over time. To justify charging higher fees, traditional active managers must be capable of generating returns in excess of broad market indices and low-cost factor-tilted vehicles.[31] Ultimately, this evolution provides a better understanding of the true source(s) of active manager returns and risk and, as a result, helps investors consider the appropriate fee level for different sources of return.

Figure 16. Equity attribution models have evolved to distinguish factor exposure contribution from true alpha contribution



Notes: This is a hypothetical scenario for illustrative purposes only. It does not represent any particular equity investment. "Noise" refers to the fact that through any period, some degree of randomness always affects results versus the broad equity market. The degree of influence varies and can be difficult to statistically distinguish from alpha without extensive data.

Source: Vanguard.

31 The primary goal must be focused on generating pure alpha through unique insight. Bender, Hammond, and Mok (2014) found that up to 80% of the excess return generated by active managers can be explained by systematic factor exposures. Even without any additional factors considered beyond the Fama-French Three-Factor Model, historically it has been challenging for active equity managers to outperform the market (Harbron, Roberts, and Rowley, 2016, and Fama and French, 2010).

Completion

A US college endowment has a public equity line-up that includes broad market-cap-weighted index vehicles and three traditional active equity managers. The managers have been selected through extensive research, but during a recent risk budget assessment, the endowment realised that its aggregate public equity portfolio has negative exposure to the momentum factor. The current active factor exposures are displayed in **Figure 17a**.

Although the endowment investment committee understands that its traditional active managers must accept active risks in order to potentially generate excess returns, the degree of the unintentional aggregate negative momentum factor exposure is outside its documented tolerance range. The committee decides to address this by selling a certain portion of the assets allotted to each traditional active manager and putting the proceeds in a momentum-tilted factor fund.

Figure 17b demonstrates the resulting factor exposures in the proposed portfolio. By adding the factor fund, the inadvertent momentum underweight has been reduced to fit within the endowment's active-risk budget. This showcases how single-factor equity vehicles can potentially help investors control for unwanted risk exposures that may occur as a byproduct of other active decisions made in the equity portion of the portfolio.[32]

Figure 17. Equity factor tilts can help investors calibrate risk exposures

a. Current equity portfolio significantly underweights the momentum factor

b. Proposed equity portfolio would have no factor exposures that violate risk budget thresholds

Note: The portfolios shown are hypothetical and are used for purposes of illustration only.

Source: Vanguard.

32 It is important to point out that even single factor-tilted equity vehicles have some unintended positive and negative exposures to other factors. Every stock is influenced by numerous forces. This makes it challenging to design a single-factor product that can completely neutralise sensitivity to other factors. As a result, the equity factor tilt used in this case study changed some of the other factor exposures in the equity portfolio, albeit in a minor way.

IV. Conclusion

Equity factor-based investing is a form of active management. It offers the potential to achieve different risk and return objectives by explicitly tilting equity portfolios toward specific exposures using rules-based strategies. The mechanics of this approach are not new; the concepts that guide factor-based investing have been recognised and used by numerous academics and practitioners for decades. Specific equity factor tilts and portfolio construction techniques have unique characteristics, and no one particular combination and/or method conforms to all investor objectives, constraints, and belief sets.

Factor-based investment performance is highly cyclical and typically inconsistent across different economic and market conditions. To increase the odds of success, investors must be willing and able to endure numerous and potentially extended periods of underperformance relative to the broad market index.

Successful equity factor-based investing requires a thorough approach to due diligence and portfolio construction. Three potential applications of equity factor-based investing are static tilts, active fund substitution, and completion procedures. Investors should determine which factors, if any, they believe will help them meet their goal(s); what portfolio configuration best suits their objectives, philosophy, and investment process; and how implementation costs may affect performance.

References

Amenc, Noël, Felix Goltz, Ashish Lodh, and Lionel Martellini, 2014. Towards Smart Equity Factor Indices: Harvesting Risk Premia Without Taking Unrewarded Risks. *The Journal of Portfolio Management* 40(4): 106–122.

Amenc, Noël, Felix Goltz, Sivagaminathan Sivasubramanian, and Ashish Lodh, 2015. Robustness of Smart Beta Strategies. *The Journal of Index Investing* 6(1): 17–38.

Amenc, Noël, Frederic Ducoulombier, Felix Goltz, Ashish Lodh, and Sivagaminathan Sivasubramanian, 2016. Diversified or Concentrated Factor Tilts? *The Journal of Portfolio Management* 42(2): 64–76.

Ang, Andrew, 2014. *Asset Management: A Systematic Approach to Factor Investing*. Oxford: Oxford University Press.

Arnott, Robert, Noah Beck, Vitali Kalesnik, and John West, 2016. *How Can 'Smart Beta' Go Horribly Wrong?* Research Affiliates; available at www.researchaffiliates.com/en_us/publications/articles/442_how_can_smart_beta_go_horribly_wrong.html?

Asness, Clifford S., 2016. The Siren Song of Factor Timing aka "Smart Beta Timing" aka "Style Timing." *The Journal of Portfolio Management* 42(5): 1–6.

Asness, Clifford S., 2015. *How Can a Strategy Still Work If Everyone Knows About It?* 31 August; available at www.aqr.com/cliffs-perspective/how-can-a-strategy-still-work-if-everyone-knows-about-it.

Asness, Clifford S., Antti Ilmanen, Ronen Israel, and Tobias J. Moskowitz, 2015. Investing with Style. *The Journal of Investment Management* 13(1): 27–63.

Asness, Clifford S., Roni Israelov, and John M. Liew, 2011. International Diversification Works (Eventually). *Financial Analysts Journal* 67(3): 24–38.

Bender, Jennifer and Taie Wang, 2015a. Extending Rules-Based Factor Portfolios to a Long-Short Framework. *Alternative Investment Analyst Review* 4(3): 12–21.

Bender, Jennifer and Taie Wang, 2015b. Tilted and Anti-Tilted Portfolios: A Coherent Framework for Advanced Beta Portfolio Construction. *The Journal of Index Investing* 6(1): 51–64.

Bender, Jennifer and Taie Wang, 2016. Can the Whole Be More Than the Sum of the Parts? Bottom-Up Versus Top-Down Multifactor Portfolio Construction. *The Journal of Portfolio Management* 42(5): 39–50.

Bender, Jennifer, P. Brett Hammond, and William Mok, 2014. Can Alpha Be Captured by Risk Premia? *The Journal of Portfolio Management* 40(2): 18–29.

Bennyhoff, Donald G., and Francis M. Kinniry Jr., 2016. *Vanguard Advisor's Alpha*. Valley Forge, Pa.: The Vanguard Group.

Berger, Adam, and Conor McCarthy, 2016. The Last Smart Beta Paper You'll Ever (Have to) Read: Nuggets of Hope Beneath the Hype. *The Journal of Index Investing* 7(1): 116–123.

Blitz, David, 2015. Factor Investing Revisited. *The Journal of Index Investing* 6(2): 7–17.

Blitz, David, Joop Huij, Simon Lansdorp, and Pim van Vliet, 2014. Factor Investing: Long-Only Versus Long-Short. 28 March; available at papers.ssrn.com/sol3/papers.cfm?abstract_id=2417221.

Fama, Eugene F., and Kenneth R. French, 2010. Luck Versus Skill in the Cross-Section of Mutual Fund Returns. *The Journal of Finance* 65(5): 1915–1947.

Fitzgibbons, Shaun, Jacques Friedman, Lukasz Pomorski, and Laura Serban, 2016. Long-Only Style Investing: Don't Just Mix, Integrate. 30 June; available at www.aqr.com/~/media/files/papers/aqr-longonly-style-investing.pdf.

Goyal, Amit, Antti Ilmanen, and David Kabiller, 2015. Bad Habits and Good Practices. *The Journal of Portfolio Management* 41(4): 97–107.

Graham, Benjamin, and David L. Dodd, 1934. *Security Analysis*. First Edition. New York: McGraw-Hill.

Harbron, Garrett L., Daren R. Roberts, and James J. Rowley, Jr., 2016. *The Case for Low-Cost Index-Fund Investing*. Valley Forge, Pa.: The Vanguard Group.

Harvey, Campbell R., Yan Liu, and Heqing Zhu, 2016. … and the Cross-Section of Expected Returns. *Review of Financial Studies* 29(1): 5–68.

Hsu, Jason, Brett W. Myers, and Ryan Whitby, 2016. Timing Poorly: A Guide to Generating Poor Returns While Investing in Successful Strategies. *The Journal of Portfolio Management* 42(2): 90–98.

Kinniry, Francis M., Jr., Colleen M. Jaconetti, Michael A. DiJoseph, Yan Zilbering, and Donald G. Bennyhoff, 2016. *Putting a Value on Your Value: Quantifying Vanguard Advisor's Alpha*. Valley Forge, Pa.: The Vanguard Group.

McLean, R. David, and Jeffrey Pontiff, 2016. Does Academic Research Destroy Stock Return Predictability? *The Journal of Finance* 71(1): 5–32.

Novy-Marx, Robert, 2016. *Testing Strategies Based on Multiple Signals*. Simon Graduate School of Business, University of Rochester; available at rnm.simon.rochester.edu/research/MSES.pdf.

Novy-Marx, Robert, and Mihail Velikov, 2016. A Taxonomy of Anomalies and Their Trading Costs. *Review of Financial Studies* 29(1): 104–147.

Pappas, Scott N., and Joel M. Dickson, 2015. *Factor-Based Investing*. Valley Forge, Pa.: The Vanguard Group.

Philips, Christopher B., 2014. *Global Equities: Balancing Home Bias and Diversification*. Valley Forge, Pa.: The Vanguard Group.

Philips, Christopher B., Donald G. Bennyhoff, Francis M. Kinniry, Jr., Todd Schlanger, and Paul Chin, 2015. *An Evaluation of Smart Beta and Other Rules-Based Active Strategies*. Valley Forge, Pa.: The Vanguard Group.

Santodomingo, Rey, Vassilii Nemtchinov, and Tianchuan Li, 2016. Tax Management of Factor-Based Portfolios. *The Journal of Index Investing* 7(2): 78–86.

Sharpe, William F., 1991. The Arithmetic of Active Management. *Financial Analysts Journal* 47(1): 7–9.

Wallick, Daniel W., Brian R. Wimmer, and James Balsamo, 2015. *Keys to Improving the Odds of Active Management Success*. Valley Forge, Pa.: The Vanguard Group.

Wallick, Daniel W., Douglas M. Grim, Christos Tasopoulos, and James Balsamo, 2015. *The Allure of the Outlier: A Framework for Considering Alternative Investments*. Valley Forge, Pa.: The Vanguard Group.

Wallick, Daniel W., Douglas M. Grim, Nathan Zahm, and Kevin DiCiurcio, 2016. *A Framework for Institutional Portfolio Construction*. Valley Forge, Pa.: The Vanguard Group.

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