This is the first in a regular series of publications on factor-based investing, produced by the Optimal team and other contributors.

We aim to develop the art and application of factor allocation to enable advisors and investors to better manage investment portfolios.
The Great Wave off Kanagawa by the Japanese artist Hokusai.
The Great Wave off Kanagawa

The Great Wave off Kanagawa is Hokusai’s most famous work, one of the Thirty Six Views of Mount Fuji. It depicts an enormous wave threatening boats off the coast of the prefecture of Kanagawa. The dramatic visual has, over the past 200 years, found its way onto coffee cups, mousepads and T-shirts as well as on the walls of museums and collectors worldwide. However, I have a personal affection for this image because the details surrounding the masterpiece and its creator so closely reflects our own philosophy at Optimal Asset Management.

Each image in the series features mighty Mount Fuji somewhere in the frame, placing the iconic mountain in a different context. Each new view contains a detail or insight that might be missed or considered unimportant in other views. This strikingly parallels how we analyze and build portfolios, constantly looking at each portfolio over and over, from different points of view, watching for new revelations we might have missed in other views.

The idea of using Hokusai’s Thirty Six Views of Mount Fuji as a visual metaphor for our own work first occurred to me while listening to a lecture by Dr. David Kung, a mathematician (and a musician) and a professor of mathematics at St. Mary’s College of Maryland. He explains it this way:

“Mathematicians love to look at different representations. Mathematicians have things like algebraic representations, graphical, numerical, verbal representations. I like to think of it sort of like Hokusai’s famous woodblock prints Thirty Six Views of Mount Fuji. Hokusai was looking at the same subject, Mount Fuji, in his case, from different perspectives.

Mathematicians do this. They may take something like a parabola ”y equals x-squared” and look at it from an algebraic perspective or graphical...or even a numerical perspective, with a table of numbers. Experts in mathematics effortlessly translate between these two representations, between any one of these, picking the most useful one for their purposes at that particular time.” – DR. DAVID KUNG
Just as Hokusai did, and expert mathematicians do, thoughtful investors also utilize a wide palette of representations, picking the most appropriate ones to reveal different aspects of an investment portfolio before making an investment decision.

We need to constantly remind ourselves to look beyond historical returns and marketing fact sheets; we have several alternative views of a portfolio to examine and choose from, each of which can tell a different story. If we aren’t paying close attention, or if we get fixated on a single view, we risk ignoring the many other views and representations, and it’s even possible we’d end up missing a “Great Wave.”

Hokusai lived a long and amazing life. He is certainly one of the most prolific, influential and successful of the Japanese woodblock masters, creating several thousand artworks, frequently switching artistic genres, styles and techniques.

Though he painted virtually every day, starting from the age of six and all the way to his death in his late eighties, legend has it that his final words were “If only Heaven will give me just another ten years...just another five more years, then I could become a real painter.”

That sort of passion for his chosen line of work and his constant drive to always find ways to do things better makes us love him all the more, and serves as inspiration for own efforts.
The role of asset allocation in determining portfolio performance has long been debated. “With market movements removed, asset allocation and active management are equally important in determining portfolio return differences within a peer group,” according to Ibbotson et al (2010). One of his collaborators, Idzorek (2010), emphasized the point. “For aggregate return levels, asset allocation is king!”

For a typical equity portfolio, a majority of the variation of a fund’s performance is determined by its allocation to some well-known factors like value (or growth), price momentum, riskiness (as measured by volatility) and company quality. This makes an understanding of factor allocation a pretty big deal.

<table>
<thead>
<tr>
<th>TRADITIONAL APPROACH – ‘MODERN’ PORTFOLIO THEORY</th>
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<tbody>
<tr>
<td><strong>Portfolio return =</strong></td>
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<tr>
<td>Market Return Component (βM) +</td>
</tr>
<tr>
<td>Excess return (α)</td>
</tr>
<tr>
<td>• Market return βM is the dominant influencer of returns (which is deemed part of the “Beta Return”)</td>
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<tr>
<td>• In active management, stock selection and market timing are the key variables in generating Alpha, α</td>
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<tr>
<td>• Can exposure to factors like value, momentum, volatility or company quality be controlled?</td>
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<th>‘REALLY MODERN’ APPROACH – FACTOR ALLOCATION</th>
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<tr>
<td><strong>Portfolio return =</strong></td>
</tr>
<tr>
<td>Market Return Component (βM) +</td>
</tr>
<tr>
<td>Other Factor Return Components (βF) +</td>
</tr>
<tr>
<td>Return from manager skill (S)</td>
</tr>
<tr>
<td>• Market return is no longer the sole rewarded risk factor. Other factors are sources of rewarded risk (βF) and are harvested as additional sources of excess return</td>
</tr>
<tr>
<td>• Manager skill S could be positive/negative when factor exposure is excluded</td>
</tr>
<tr>
<td>• Understood in these terms, alpha is the sum of factor allocation and manager skill</td>
</tr>
<tr>
<td>• Factor allocation can be controlled</td>
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Unlike asset allocation, the choice of these factors isn’t always made consciously or explicitly. Portfolios are constructed to meet a range of different objectives; funds are selected on the basis of actual or perceived performance. Whatever approach an investor or advisor chooses the result is the same: *unintended factor bias*. This bias leads to unrecognized exposure to certain factors which to a large extent determine investment performance.

Just as an asset allocation can be constructed to meet an investor’s particular objectives, the selection of factors can be more efficiently determined to meet these same objectives. We call this new technique *factor allocation*, and it’s the new wave in investing.

*Shichiri Beach in Sagami Province* by Hokusai.
FACTOR ALLOCATION IS THE NEW WAVE IN INVESTING

Factor allocation shares a number of features in common with asset allocation—it seeks to explain the selection of investments in terms of a small number of well understood variables with a long-term history of success. Factors are so numerous that Cochrane (2010) referred to the collection as a zoo: adding more factors to the zoo doesn’t help investors and may risk adding more confusion than clarity.

How can investors decide how to use factors in their equity portfolios? The options are endless, given the expansion of smart beta and style-based indices, ETFs and other investment products. We believe one cannot make intelligent choices regarding the investment characteristics of a fund without first understanding its factor exposure.

We identify the factor exposure for any fund or portfolio in terms of four factors:

We believe that these four factors explain the majority of active equity investment returns.
THERE IS MUCH ACADEMIC WORK TO EXPLAIN WHY FACTOR-BASED INVESTING WORKS.

There is much academic work to explain why factor-based investing works, but it’s worth reviewing how we got here. The capital asset pricing model (CAPM) of Treynor (1961), Sharpe (1964), Lintner (1965), and Mossin (1966) argues that investment return is directly related to its sensitivity to market risk – an investment with a high beta, or high exposure to market risk, should earn higher returns over the long-run. However, CAPM is a single-factor model in which an investment’s long-run return is solely determined by its exposure to the market factor.

Expanding the CAPM, Ross (1976) proposed the arbitrage pricing theory (APT), which allows that many systematic risks factors may earn a return premium. While this theory did not specify the risk factors being rewarded, and suggested that they might relate to broader economic factors, it provided a theoretical foundation for factor-based investing. Neither theory completely explained how stock returns relate to their characteristics (or anomalies, as they were then described at the time.)

Source: Vanguard
ACADEMIC EVIDENCE FOR FACTOR-BASED INVESTING

ANOMALIES BECAME FACTORS

One of the first so-called anomalies identified was the size effect. Banz (1981) and follow-on studies such as Keim (1983), suggested that small-cap portfolios experienced higher risk-adjusted returns than portfolios. Research identified other anomalies such as value (portfolios of stocks with low book-to-market-value ratios experienced higher risk-adjusted returns than those with high ratios.)

A substantial body of academic literature subsequently identified the existence of a range of anomalies. Research suggests that factor exposures influence the return of many complex investments, equity and debt. Furthermore, the returns of various indices – not just market cap weighted – can be explained by factor exposures. The return on alternatively weighted indexes can be explained by factor exposures according to Amenc, Goltz, and Le Sourd (2009), Jun and Malkiel (2008), and Philips et al. (2013), although these returns were seen to vary considerably over time.

Another important contribution came with Fama and French (1992, 1993.) Their three-factor model provided evidence that the variability returns within a stock portfolio could be explained by its exposure to the market, size, and value. Carhart added momentum in a four-factor model (1997). Other factors have since been added, such as low volatility and high quality amongst others.
ANOMALIES BECOME NEW PARADIGMS

In the introductory note to “Financial Market Anomalies”, Dr. Donald B. Keim, Director of the Rodney L. White Center for Financial Research at the Wharton School, writes that “the identification of anomalies often presages a transition towards a new paradigm in financial economics.” Keim has long researched the importance of investment factors for most of his academic life, and as an advisor to Dimensional Funds (DFA), he was one of the leading proponents of factor-based investing:

“(We focus) on equity market anomalies including the size effect, value effect, serial correlation in returns and calendar-related patterns in returns related to month of the year and day of the week,” he writes in the article. “Many of these patterns have persisted for decades, suggesting they are not evidence of market inefficiencies.”

—THE NEW PALGRAVE DICTIONARY OF ECONOMICS SECOND EDITION
The diversity of the factor zoo identified by Cochrane (2010) has been further compounded by a wide variety of ways to implement factor-based investment styles. Despite the identification of some important factors there is a continuing debate over the definition of what are compensated and uncompensated factors. While some factors have demonstrated a strong relationship to the volatility of returns, they have not generated excess returns. Other factors have historically produced excess returns, but there is no certainty that these returns will continue into the future.

ACADEMIC THEORIES GIVE LITTLE GUIDANCE ABOUT THE RELATIVE WEIGHTING OF FACTORS, LET ALONE THE TIMING OF THEIR EFFECT.

The decision regarding allocating to factors is as important in factor-based investing as it is in traditional asset allocation. Explaining factor returns remains an elusive goal. While strong economic rationale exists for the excess equity market return premium, measuring it is difficult and implementing any findings is even harder.

The logic and economics of explaining potential factor return premiums is hotly debated. If a behavioral explanation holds for a factor, it can be argued that the return premium may disappear as investors identify and invest in it or recognize their errors and modify their behavior. The analysis of factor exposures now enables investors to move the focus of the allocation decision from asset classes to factor exposures, identifying and compensating them for the factor risks adopted.
## EXPLANATION FOR FACTOR RETURNS

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>RATIONAL ARGUMENT (Premiums are consistent with rational pricing)</th>
<th>BEHAVIORAL EXPLANATION (Premiums are a result of suboptimal investor behavior)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARKET</td>
<td>Economic uncertainty; borrowing constraints; uncertainty about long-run risks.</td>
<td>Loss aversion and concern over short-term volatility of wealth.</td>
</tr>
<tr>
<td>VALUE</td>
<td>Cyclical risk of positive correlation between economic activity and security’s returns.</td>
<td>Recency bias leads to investors shunning distressed firms and overpaying for recent growth.</td>
</tr>
<tr>
<td>SIZE</td>
<td>Cyclical risk of smaller firms being more exposed to changing, negative economic activity and default risk.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>MOMENTUM</td>
<td>Not applicable</td>
<td>Under-reaction to new information being incorporated in asset prices.</td>
</tr>
<tr>
<td>LOW VOLATILITY</td>
<td>Leverage and institutional (benchmarking) constraints.</td>
<td>“Lottery” effects leading to preference for high-volatility stocks with small chance of large payouts.</td>
</tr>
<tr>
<td>TERM</td>
<td>Inflation uncertainty; supply/demand factors.</td>
<td>Loss aversion at longer maturities; role of bonds as a safe-haven asset.</td>
</tr>
<tr>
<td>CREDIT</td>
<td>Default and downgrade risk; positive correlation to economic activity.</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

*Source: Scott N. Pappas, CFA; Joel M. Dickson, Ph.D., Vanguard, “Factor-based investing,” October 26, 2015*
Factor returns can be highly cyclical, and individual factors may under-perform over extended periods. This highlights the need for a disciplined approach when assessing the factor-based investing framework. In our work we stress the analysis of factor performance across different market regimes: bullish or bearish, calm or turbulent, rising or falling interest rates, high or low inflation, and high or low industrial production.

There is no agreement on how to best implement factor-based investments. Factor exposures can be built by creating portfolios of assets around a common characteristic (e.g. stocks with high dividend yields), or multiple characteristics. Many popular approaches use a combination of factors (value and momentum). Weighting schemes vary, with some indices seeking to exploit factor exposure using market cap weights for a selected group of stocks.

Other approaches seek to weight stocks with an eye to the strength of a particular stock’s factor score. More complex factor implementations may also use leverage or short selling. These are all examples of active investing, but all based on the ideas of managing and exploiting factor premia to outperform the market.

Our approach involves customizing the weighting decision to the factor portfolio being considered. For instance, a value portfolio represents a basket of risky stocks, and so we deploy weighting schemes designed to minimize risk. In contrast, the low volatility basket is already relatively a low risk basket by construction. Therefore, our choice of weighting scheme might prioritize fully exploiting any latent correlation potential within the basket, rather than relying on parameter estimates to further reduce risk.
Under Mannen Bridge at Fukagawa by Hokusai.

FOR A DEMONSTRATION OF HOW FACTORALLOCATOR™ OPERATES, PLEASE VISIT WWW.OPTIMALAM.COM
THE THREE C’S OF FACTOR-BASED INVESTING

THERE ARE THREE MAIN BENEFITS TO FACTOR-BASED INVESTING:

- **CLARITY**: Identifying a portfolio’s factor exposures might be the most important consideration of all, as investors may be exposed to a range of factors—either explicitly or implicitly. By focusing on factor exposures as part of the portfolio construction process, investors can gain a better understanding of the drivers of portfolio returns.

- **CONTROL**: Investors wishing to explicitly control their factor exposures might target investments which explicitly track a factor, such as value. Those preferring more long-term exposure, less wedded to a specific factor or factors, might use a portfolio that blends and consistently rebalances to a static mix of long-term risk premia.

- **COST**: By allocating directly to factors, rather than indirectly through another active investment vehicle, investors are likely able to invest much more cost effectively (i.e., a factor-based ETF or SMA.)

Let’s turn to our approach, and our product. FactorAllocator offers investors the means to analyze the factor exposure of any fund or portfolio of stocks. We offer investors the tools to clearly understand their existing factor exposures and the impact they have on investment returns.

In turn, this allows investors to readily control their factor exposures. Factor exposures can be tuned up or down, blended in different combinations, and even replicated in other vehicles (comprising of stocks or ETFs) at lower cost.
Factor Allocator software is based on a set of factor portfolios, or building-blocks developed by Optimal Asset Management, which offer cost-effective exposure to a selection of classic risk factors. These selective portfolios are designed to provide superior risk-adjusted performance relative to typical cap-weight based benchmarks. These are portfolios for which holdings, weights, investment returns, fundamental information and re-balancing impacts have all been assessed. It’s worth understanding how these reference portfolios are constructed.

Optimal Asset Management factor portfolios are designed to deviate from market indices and factor indices with the goal of harvesting excess returns to compensate for the risk of deviating from the index. Our factor portfolios are designed to optimally trade-off representativeness in the pursuit of excess returns. Due to their systematic, efficient, and low-turnover characteristics, they achieve this cost-effectively.

This subtle difference in approach means that our factor portfolios can be used to more efficiently measure or reproduce the factor exposure of any fund or portfolio. They are designed to be stackable, and to perform well in combinations or as components of a blended portfolio.

Constructing Our Factors

Factor portfolios attempt to bridge the gap between cap weighted indices and the traditional “stock picking” of active management. They are “active” relative to market or factor indices. They frequently hold a significantly smaller subset of stocks than a market or factor index. They also make specific choices in many parameters, such as the weighting scheme and rebalancing techniques, the appropriate blends of factors, and the factor sorting criterion.

When constructing factor portfolios, we select stocks from a preferred investment universe and determine which to hold in each of our portfolios. For instance, we construct our Developed World portfolios by considering all stocks classified as Developed World Core (large and mid-cap stocks).
Our factor portfolios typically hold a subset of the stocks of the universe, and are designed to efficiently extract the risk premia available within that universe.

We filter out certain stocks, but not so much that we lose the benefits of diversification in our universe. In fact, we generally are better-diversified due to better weighting techniques than cap-weighting (which tends to lead to highly concentrated mega-cap holdings). We exclude any stock that has not been in the universe under consideration continuously for the prior two years, or for which there is insufficient trading liquidity. The filter applies scoring buffers that act as “soft thresholds” and staggered rebalancings in order to limit unnecessary churn and transaction costs.

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**OUR FACTOR DETAILS**

We chose just four factors because there is a significant amount of evidence in academic literature supporting the idea that these factors offer a long-term risk premium that is likely to persist in the future. These risk premia are cost-effective to harvest at scale through portfolio construction techniques that are well tested, intuitive to understand, and robust. For a more detailed discussion of the construction techniques of our factor portfolio construction see optimalam.com/factor-construction.html

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>TOP PORTFOLIO</th>
<th>BOTTOM PORTFOLIO</th>
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</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>Value</td>
<td>Growth</td>
</tr>
<tr>
<td>MOMENTUM</td>
<td>High Momentum</td>
<td>Low Momentum or Contrarian</td>
</tr>
<tr>
<td>RISK</td>
<td>Stable/Low Vol</td>
<td>Aggressive or Risky/High Vol</td>
</tr>
<tr>
<td>QUALITY</td>
<td>High Quality</td>
<td>Low Quality</td>
</tr>
</tbody>
</table>

*Source: Optimal Asset Management*
**FACTOR CONSTRUCTION**

- **VALUE** – *defined as book to price ratio.*
  We use a constrained flavor of minimum volatility for high value stocks as the higher risk of value stocks makes this an appropriate weighting scheme. Min vol weighting also helps to mitigate risk of the “value trap,” and this leads to better preservation of the value premium. We use maximum decorrelation weighting for low value (growth) stocks.

- **MOMENTUM** – *defined as trailing 12 price change excluding 1 month change, scaled by volatility.*
  To weight stocks, we use a maximum decorrelation for high momentum stocks. The objective is portfolio diversification to avoid security level concentrations. We use constrained variants of minimum volatility for contrarian stocks.

- **VOLATILITY** – *defined as volatility of trailing 2 years of weekly returns excluding the prior months.*
  To weight stocks we use a maximum decorrelation for stable, low risk stocks, and minimum volatility for aggressive, high risk stocks.

- **QUALITY** – *defined as the average of all available z-scores of the following accounting metrics* (applied without broad sector controls): Profitability (cash earnings to book value) and earnings growth (ratio of trend to mean absolute level.)
  To weight high quality stocks we use a maximum decorrelation algorithm. By construction, high quality stocks have more robust fundamentals, so a min vol screen is less material. We use minimum volatility for low quality stocks.

**AVOIDING EXTREME POSITIONS**

Smart beta weighting schemes can assign large weights to companies with small market caps. To avoid this, we ensure that the maximum position that we take in any stock is related to the market cap weight of the stock with relative weight limits. Typically, they have resulted in cumulative adjustments of less than 3% to 5% of the portfolio weights.
Factor portfolios are constructed in pairs of long-only portfolios designed to harvest one “side” of a factor. For instance, we construct both a value and a growth portfolio to provide exposure to the “value factor”. We construct “winner” and “loser” portfolios to provide exposure to the “momentum factor”. We build eight distinct factor portfolios which can be combined in different proportions to form an enormously rich range of blended factor portfolios.

**Harvesting Factor Exposure**

We treat size as a universe choice and not as a risk factor. In contrast, what is typically described in the literature as the “size factor” is implemented in our framework as a universe choice.

**No Size Factor**

We separate our universe into non-overlapping geographical regions (“geo blocks”). The developed world is divided into the US, Canada, Japan, Northern Europe and Continental Europe. All factor portfolios are constructed within each geo block. These blocks are recombined using weights proportional to their float-adjusted market capitalizations. In effect, the weight of each geo block in the portfolio is the same as the weight of that geo block in the cap-weighted portfolio.

**Geographical Neutrality**

We build certain factor portfolios that are controlled for sector effects by classifying all stocks within a geographic region into one of five broad sectors: (technology, healthcare, financial, consumer and industrial.) We build factor portfolios within each broad sector to build “broad sector performance portfolios,” and then recombine the broad sectors into factor portfolios using weights based on the market capitalization of each of the broad sectors. In effect, the weight of each broad sector in the resulting portfolio is the same as the weight of that sector in the cap-weighted portfolio.

**Sector Neutrality**
Fuji from Kanaya on Tokaido, by Hokusai.
CONCLUSION

We believe that FactorAllocator offers investors a revolutionary new way to construct equity portfolios, making some of the key investment drivers apparent and putting them under the investor’s control. Modern technology enables this type of investment management to be simple and easy to use.

This clarity offers the opportunity to make better choices, to reflect current and future investment conditions, and to be much more flexible. The explicit identification of the role of factor exposure allows manager skill, or its absence, to be identified. Careful harvesting of factor premiums can yield enhanced returns that can be more robust and credible than black box or traditional stock pickup approaches. Furthermore, factor exposure can be delivered at much lower cost than active management currently charges.

As with Hokusai’s final picture in his series of views on Mount Fuji, we believe clarity comes only after seeing the picture from many different perspectives.

FOR A DEMONSTRATION OF HOW FACTORALLOCATOR™ OPERATES, PLEASE VISIT WWW.OPTIMALAM.COM
REFERENCES


Bosse, Paul M., Brian R. Wimmer, and Christopher B. Philips, 2013. *Active Bond-Fund Excess Returns: Is It Alpha...or Beta?* Valley Forge, Pa.: The Vanguard Group.


FactorAllocator from Optimal Asset Management is a new online investment tool that helps financial advisors build better portfolios by improving clients’ exposure to key factors that drive performance.

Join a limited group of advisors being offered free access to our interactive factor analyzer, and see how understanding your clients’ factor exposure can enable you to make better investment decisions for them.

CONTACT TEUN LUCAS TO SCHEDULE A FREE TOUR.
TEUN@OPTIMALAM.COM    TEL: 650.472.1187 EXT. 109