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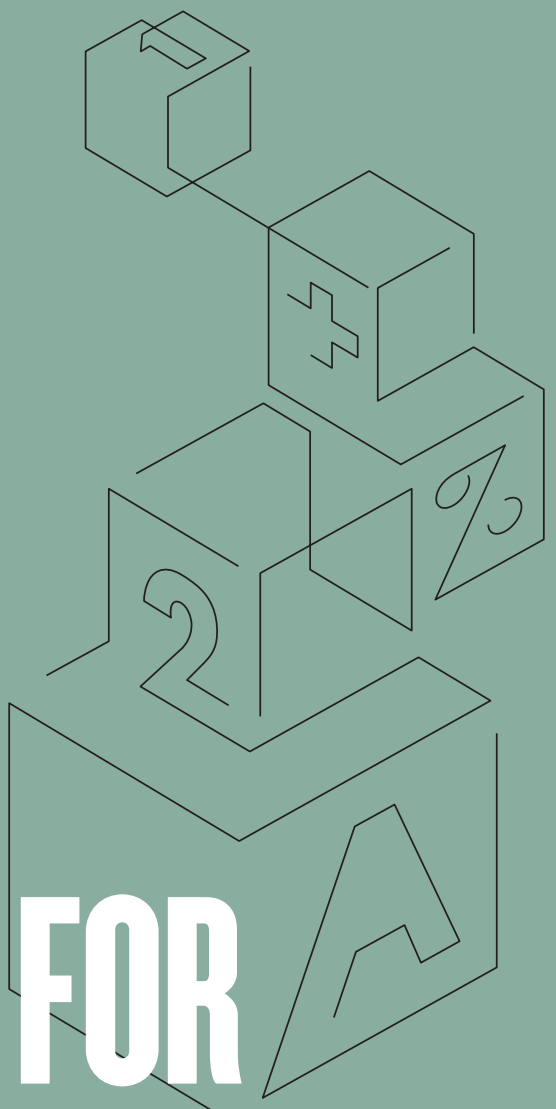

PRACTICAL APPLICATIONS FOR FACTOR BASED ASSET ALLOCATION

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STATE STREET GLOBAL ADVISORS®

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15 Summary

Investors today are pressed with many challenges associated with traditional asset allocation. These challenges include how to diversify risk in the face of highly correlated asset classes, and how to enhance return above traditional cap-weighted indexes. Against this background, the financial community has engaged in a meaningful debate around the merits of factor based asset allocation. This is a large topic with many subsets, invariably leading to conversations regarding various investment strategies such as risk parity, smart beta, and hedge fund replication, all topics which we address in this paper.

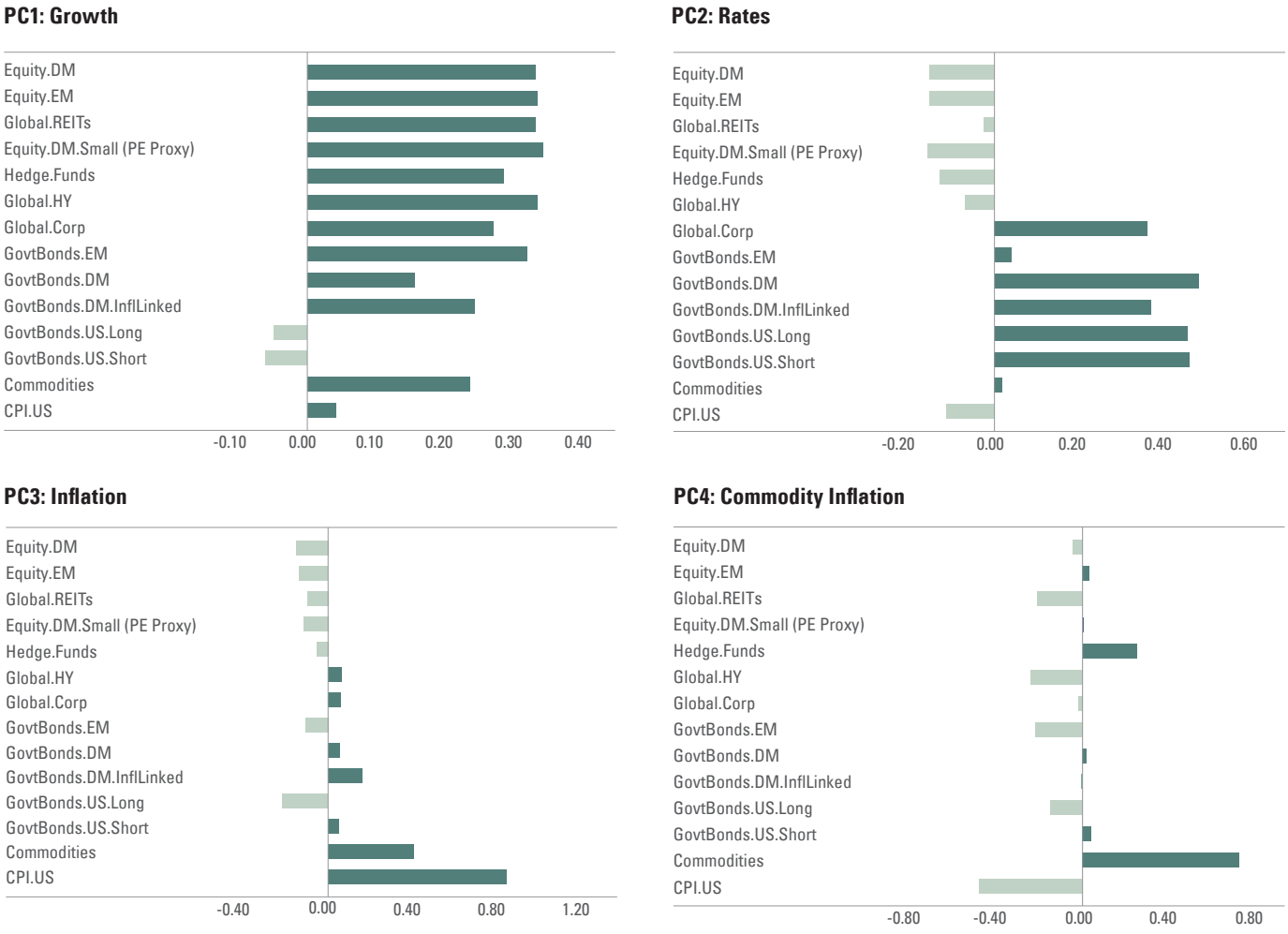
Investing is primarily concerned with risk and return. Improved methodologies to manage risk and potentially enhance return are of primary importance and factor based investing is often put forth as a framework to improve both. In this paper we analyze various factor approaches from both a risk and return perspective, demonstrating a number of practical and useful applications. While we are generally supportive of a factor approach to investing, our intent is to highlight both the potential benefits and pitfalls for investors who are considering moving in this direction.

Asset Classes versus Factors: What is the Difference?

Andrew Ang (2010) provided a useful description of factor based asset allocation by comparing asset classes to food and factors to nutrients. We eat food in order to get nutrients, not the other way around. Likewise, as investors, we will always buy asset classes, not factors, regardless if we are adopting a factor approach. However, whether we are conscious of it or not, these asset classes expose the investment plan to various risk factors. Paying attention to (yes, quantifying) the volume and nature of these factors makes for a healthier investment diet.

So, what are the main factors that drive asset class returns? To answer this question, we run a principal component analysis (PCA) on the main asset classes of interest to institutional

Figure 1: Principal Factor Portfolios, 1998–2013



Source: State Street.

The use of the term portfolio is not meant to indicate an investable portfolio but rather is meant to express a collection of asset classes that in aggregate capture the main factors that explain the variation in asset returns.

investors. PCA is a technique that is used to simplify and reduce the dimensions of a problem. With regards to asset classes, it looks for correlations and groups asset classes together in order to identify the key factors that drive returns.

PCA produces a number of principal factor portfolios. Importantly, each factor is orthogonal (independent) to the other factors. Hence each factor brings a new set of information and this independence allows for a clean interpretation of the results.

Figure 1 shows four principal component (PC) factors and the relative exposures to each factor from different asset classes or return series.

This PCA spans the years 1998–2013. The factors are not defined, in advance, but are merely a product of the data. As a result, the output needs interpretation.

The first factor contains positive loadings, or weights, from most asset classes. These weights decline as we go from equity based assets to lower risk fixed income asset classes. We label this factor "Growth." The interpretation is simply that the returns from higher-beta risk-seeking assets are the most important factors explaining major asset class returns.

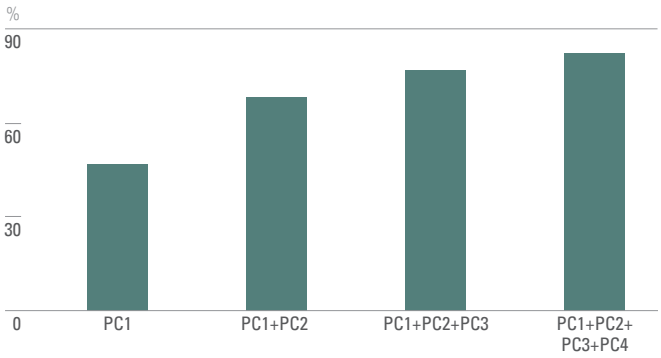
The next two factors also have fairly intuitive interpretations. The second principal factor is heavily influenced by interest rates, since it shows positive weights on fixed income asset classes. We label the third factor "Inflation," since both commodities and the Consumer Price Index ("CPI") demonstrate high loadings. The fourth factor appears to capture the spread between commodity price inflation and consumer price inflation.

The interpretations become fuzzier after the first three factors. Additional factors add very little to our ability to explain the variation in asset class returns.

Figure 2 shows the cumulative percentage of return variation explained by adding in additional factors. Each factor, or eigenvector, comes with an associated eigenvalue. The eigenvalue is simply a number that shows how much of the correlation matrix is explained by its associated eigenvector, or factor.

Since PCA is used to reduce the dimension of a problem, we only want to keep the most important factors for interpretation and further analysis. The first three factors are intuitive, and their combination explains nearly 80% of the total asset class correlation matrix. Therefore, we will keep these three factors for further analysis. In other words, we have now simplified our problem by converting a set of 14 asset classes into 3 intuitive factors (Growth, Rates, and Inflation).

Figure 2: Cumulative Percentage of Variation Explained by Additional Factors, 1998–2013



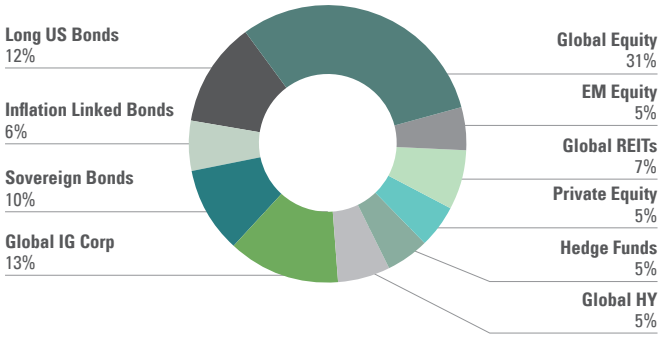
Source: State Street

For illustrative purposes only.

Next, we examine a representative pension fund to understand how much exposure the fund has to each factor. Gaining an understanding of factor exposure can help highlight key factor risks and help us understand if the fund is properly diversified.

We used the average asset allocation from the Mercer Survey of European Pension Funds,[2] 2013, to build our representative fund. We acknowledge that plans throughout Europe have a fair degree of variation regarding asset allocation, due to different liability hedging needs and regional preferences for certain asset classes. We use an average as a representation of the general risks faced broadly by European pensions.

Figure 3: Representative Pension Fund Asset Allocation



Source: State Street, Mercer 2013.

Mercer Asset Allocation Survey, European Institutional Marketplace Overview, 2013. Survey data collected in January, 2013. The information contained above is for illustrative purposes only.

At first blush, the Mercer survey suggests that European pensions are fairly well diversified across a host of asset classes. The exposure to equities is modest, at 36%, while the fixed income allocation is nearly 50%. There are also moderate exposures to alternative asset classes, such as hedge funds, and private equity. So, it appears that there is healthy asset class diversification.

But is there healthy factor diversification? To understand the exposure to the three main factors, we first create a historical monthly return series for 2013 using the fixed weights from Figure 3. Similarly, we create a historical return series for each of the three principal factor portfolios defined earlier. Then we regress the pension fund returns on the three principal portfolio returns.

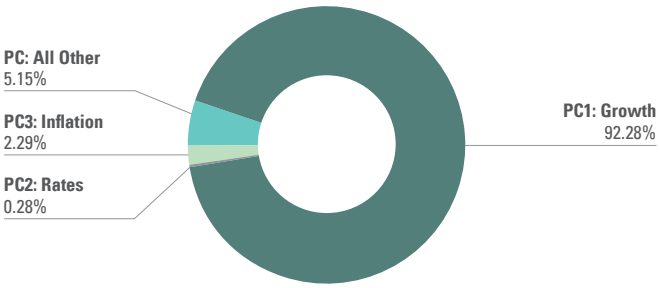
$$R_{pt} = \alpha + \beta_1(R_{f1t}) + \beta_2(R_{f2t}) + \beta_3(R_{f3t}) + \varepsilon_t$$

Recall that each principal portfolio is orthogonal, or independent, of the other portfolios. This allows for us to estimate the variance without any cross products and allows for a clean estimate of the variation coming from each factor.

$$\text{Estimated risk allocation to factor x} = \hat{\sigma}_x^2 * \beta_x^2 / \hat{\sigma}_p^2$$

Figure 4 shows that despite the somewhat limited allocation to equities, the overall pension fund has a huge exposure to Growth (92%). Also, of interest, the correlation to Rates is almost non-existent, despite containing a 30% allocation to fixed income.

Figure 4: Representative Pension Fund Risk Factor Exposures, 2013



Source: State Street, Mercer 2013.

Mercer Asset Allocation Survey, European Institutional Marketplace Overview, 2013. Survey data collected in January, 2013. The information contained above is for illustrative purposes only.

A practical interpretation is that the pension fund needs the equity market to do well in order to generate positive returns. The fixed income allocation is merely serving to tone down the equity risk, but any change in rates or the slope of the yield curve will have little bearing on the variation of the pension fund returns. The fixed income allocation is simply subsumed by the equity allocation.

A heavy exposure to Growth for many pension funds hardly comes as a surprise. Over long periods of time, the global economy generally grows, historically allowing publicly traded companies to generate profits and return value to shareholders. A positive exposure to Growth is a reasonable profile for most investment plans.

Nonetheless, the lack of balance between the major risk factors may not always be desirable. A fully funded corporate defined benefit plan might prefer less growth risk and more interest rate risk, so that the variation in their assets better matches the variation in their liabilities. This could be especially true for public defined benefit plans, which could ultimately be forced to value liabilities at market based discount rates (see, for example, Wilson, David R. "Is it Time for Public Funds to Embrace an LDI Approach?", 2014).

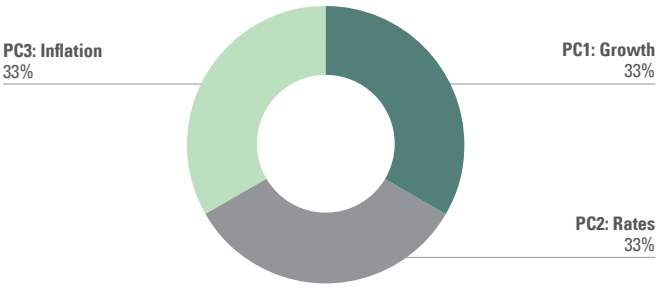
The Rise of Risk Parity

One factor based concept that has gathered interest is "risk parity," popularized by Bridgewater's "All Weather" approach.[3] The idea is to balance the risks between the three or more factors, so that no matter what factor is in favor, the portfolio is hedged and can potentially benefit from that factor's performance.

Risk parity carries several distinguishing characteristics. First the asset class weights generally sum to more than 100%, hence there is implicit leverage at the portfolio level. The leverage is necessary in order to scale up the interest rate risk to the same degree as the equity risk. In addition, since the risks are equalized, but the volatility of each factor is different, the capital allocations will not be the same.

In theory, the volatility of risk parity should sit in between a minimum variance approach and an equal weighted approach. In effect, it is the bridge that links these two alternative portfolio construction methods. Minimum variance is, by definition, the least volatile portfolio. Since risk parity equalizes risk, not capital, it will overweight the least volatile factors and asset classes, and it should carry less volatility than an equal capital weighted approach.

Figure 5: Risk Parity Theoretical Risk Exposure



Source: State Street.

For illustrative purposes only.

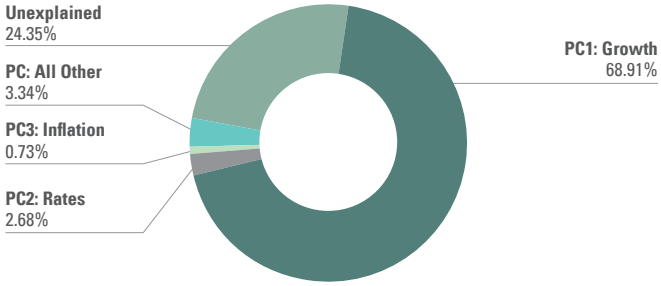
How have risk parity managers faired, in practice, in balancing these factor risks? The next set of charts estimates the exposures to our principal factor portfolios from the actual returns of four self-identified risk parity strategies. The returns were extracted from the eVestment Alliance database, and consist of four managers with track records extending back to 2006.[4] If risk parity is truly balancing the risks, we should see a result that looks like Figure 5. Unfortunately, the reality is a bit different as we still see risks that are heavily weighted toward Growth. Nonetheless, in terms of balancing the risks of an investment plan, the risk parity method appears more balanced than the positioning of the average pension fund.

There are likely several reasons that risk parity funds are still skewed toward Growth. Recall that our principal portfolios have negative loadings, or weights, on some of the factors. It is likely that risk parity portfolios are generally long-only on the major asset classes. In addition, there are likely other exposures in risk parity funds not accounted for here, including trading strategies such as currency carry and CDX arbitrage. It may be the case that these strategies and asset exposures are positively correlated to the equity market, but the exposure finds its way into the fixed income (Term Structure) bucket, and skews the actual risks more towards growth risk.

Risk Parity Fixed Income

Factor analysis and factor based allocations can be a useful framework within an asset class, not just across asset classes. For example, the Barclays Aggregate Fixed Income Index serves as a common option in many defined contribution plans. Typically Investors nearing retirement, who desire yield and have a high degree of risk aversion are often attracted to strategies managed against this index.

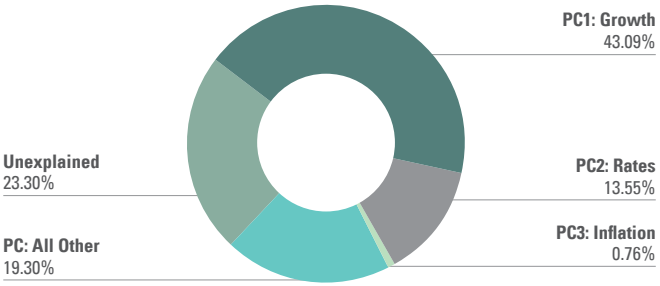
Figure 6: Risk Parity Manager A, Factor Exposures, 2006–2013



Source: State Street, eVestment Alliance.

The information contained above is for illustrative purposes only.

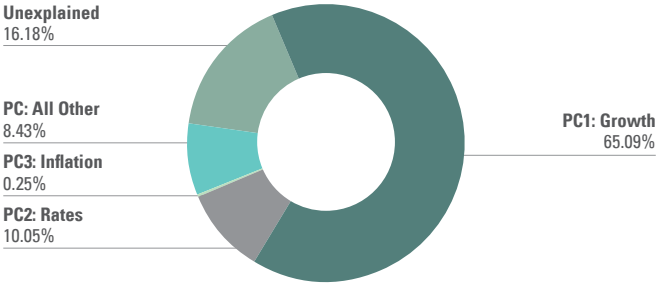
Figure 7: Risk Parity Manager B, Factor Exposures, 2006–2013



Source: State Street, eVestment Alliance.

The information contained above is for illustrative purposes only.

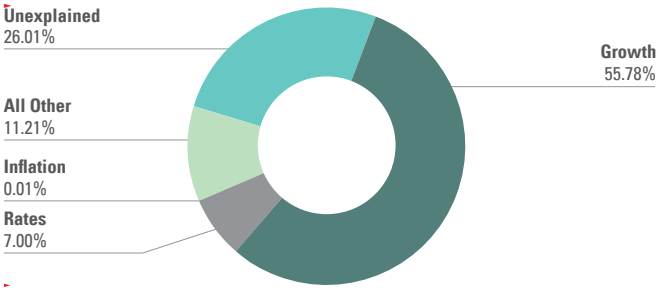
Figure 8: Risk Parity Manager C, Factor Exposures, 2006–2013



Source: State Street, eVestment Alliance.

The information contained above is for illustrative purposes only.

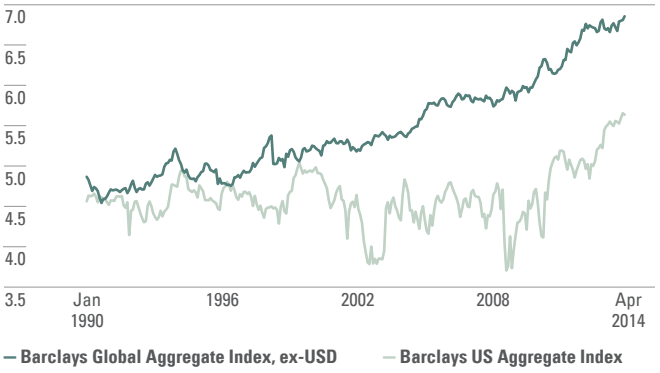
Figure 9: Risk Parity Manager D, Factor Exposures, 2006–2013



Source: State Street, eVestment Alliance.

The information contained above is for illustrative purposes only.

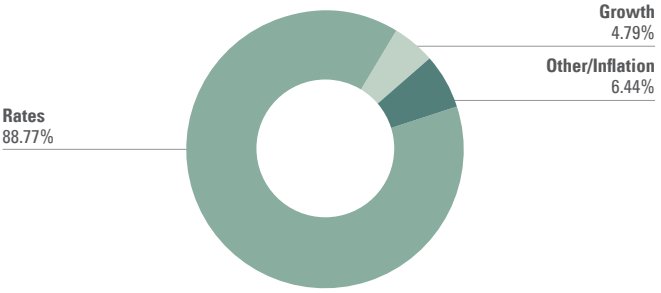
Figure 10: Modified Adjusted Duration, Jan. 1990–Apr. 2014



Source: Barclays and State Street Global Advisors.

The information contained above is for illustrative purposes only.

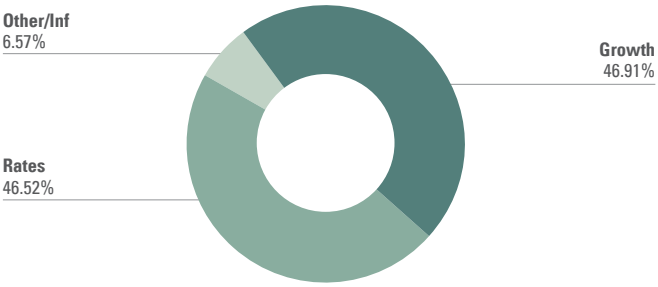
Figure 11: Factor Exposures for the Barclays US Aggregate Index



Source: State Street, Barclays as of March 31, 2014.

The information contained above is for illustrative purposes only.

Figure 12: Factor Exposures for 72% Barclays US Aggregate Index and 28% Speculative Grade Credit



Source: State Street, Barclays as of March 31, 2014.

The information contained above is for illustrative purposes only.

But the characteristics of global fixed income markets have changed noticeably over the past ten years, making the index less attractive to many investors. Figure 10 shows that the duration of major fixed income indexes has extended an additional year since 2003. In addition, heavy Treasury issuance has boosted the Treasury weight, at the expense of a slightly lower corporate bond weight. So, just when rates have hit a secular low, interest rate risk has hit a secular high. We believe this is an example of return-free risk.

A factor analysis of the index shows that interest rate risk is the dominant risk factor, with growth a secondary exposure. Investors concerned with rising rates and dissatisfied with the low level of yields might prefer a more balanced risk profile of this index.

We next introduce other Growth based fixed-income asset classes in order to raise the Growth exposure to the level of Rates exposure. Figure 12 shows that adding 28% in a diversified set of credit strategies — including convertibles, local EM bonds, bank loans, short duration high yield, and crossovers — can balance the risk exposures. This is a factor based approach, giving us a risk parity profile, without leverage. Of interest, this approach may help mitigate the damage from the Rates factor in a rising rate environment. A secondary benefit is that the addition of this set of out-of-index asset classes potentially helps boost the yield profile of the strategy. This exercise is an illustration of how factor based tools can help re-weight asset classes and improve a strategic asset allocation to better align the actual risks with the desired risks.

We were able to analyze the return pattern of this strategic redesign of fixed income and found promising results. We created a fixed-weighted allocation through time, with monthly rebalancing, consisting of the weights shown in Figure 12: 28%

to the referenced credit strategies in equal weighted proportions and 72% to the Barclays US Aggregate Index. Despite the inclusion of 28% in largely speculative grade credit, this portfolio exhibited lower long-run absolute risk than the Barclays US Aggregate Index from January 1994 to March 2014 (3.44% vs. 3.68%), A period that includes one of the worst credit crises in global financial history. This is certainly a testament to the potential diversification benefits of combined Growth and Rates exposure. It also outperformed over this period (6.49% vs. 5.79%)[5] in the face of a secular decline in interest rates that should have, all else constant, benefited the portfolio with the highest term-structure exposure.[6]

Factors and Risk Concentration

In our discussion thus far, we have focused on the explanatory power of factors; that is, how factor analysis can help investors identify the underlying drivers of their returns. But PCA can also help investors measure the degree to which risk is concentrated across a few factors or spread out across many. Kritzman et al (2011) introduced a measure called the Absorption Ratio, which is equal to the proportion of variation across a set of investments that can be described by a small, fixed set of principal components.

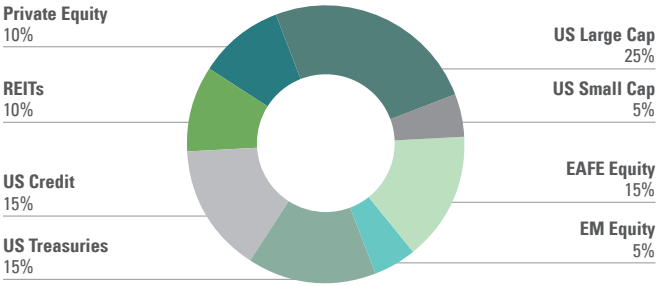
Furthermore, the authors found that changes in the Absorption Ratio can be informative. When the Absorption Ratio rose rapidly, as measured by a rolling z-score greater than 1.0, they found subsequent equity drawdowns were more frequent and equity returns were lower on average. When the Absorption Ratio fell rapidly, when the z-score was less than -1.0, they found that subsequent equity drawdowns were less frequent and equity returns were higher on average. These results are consistent with the intuition that markets where risk is highly concentrated are more fragile than markets where risks are more spread out. If returns are being driven by a small set of macro risk factors, it is more likely that a shock will spread quickly and precipitate drawdowns. If returns are being driven by a large, diverse set of factors, shocks may be isolated to a particular security or industry. In this sense, the Absorption Ratio is a measure of systemic risk. Indeed, Kinlaw et al (2012) show how a decomposition of the Absorption Ratio can be used to identify systemically important financial institutions.

A simple story should help clarify the meaning and the importance of the Absorption Ratio. There are two popular restaurants in town. One night, you interview people coming out of these two restaurants (or read the restaurants' Yelp reviews) and ask diners what they like most about their experience. The responses for Restaurant 1 have a similar pattern. People repeatedly say, "It's the chef we like," "We come for the chef," or "The chef is phenomenal." So, the chef is the main attraction for this establishment. If this chef quits, the restaurant is in trouble and may go out of business. For this restaurant, a single factor explains its success, and there is a great deal of systemic risk associated with that factor.

The responses for Restaurant 2 are varied: Some people like the chef, some like the ambiance, and some people mention the live music. Others mention the desserts, the location, or the attention to detail. So, there are many factors in this case explaining the success/popularity of this restaurant. In this case, if the chef quits, the restaurant will likely suffer, but not go out of business.

Systemic risk for the first restaurant is high (for financial markets: when the fraction of the total variance of a set of assets explained or "absorbed" by a finite number of eigenvectors is high, then the Absorption Ratio is high, and this implies that the markets are more compact, tightly coupled, fragile and susceptible to shocks), and it is low for the second restaurant.

Figure 13: Sample Portfolio Allocation



Source: State Street.

The information contained above is for illustrative purposes only.

Benchmark Information:

US Large Cap: S&P 500 Index

US Small Cap: Russell 2000 Index

EAFE Equity: MSCI EAFE Index

EM Equity: MSCI EM Index

US Treasuries: Barclays US Treasuries Index

US Credit: Barclays US Credit Index

REITs: FTSE EPRA/NAREIT U.S. Index

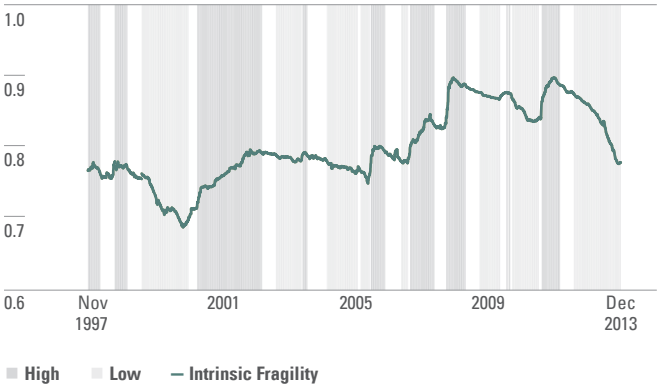
Private Equity: LPX 50 Index

There are a number of useful ways that an investor could employ the Absorption Ratio. In this section, we show two examples. The first is for dynamic asset allocation and the second is for tail risk protection using put options. For both examples, we use the following portfolio allocation which is representative of the portfolios of many large institutions.

To show how the Absorption Ratio can be used for dynamic asset allocation, we use the approach outlined by Kritzman (2013). Specifically, we compute two distinct Absorption Ratios: one across the assets in the portfolio shown above and a second one across the broad equity market. For the latter Absorption Ratio, we use approximately 60 MSCI global equity industries as our assets. Figures 14 and 15 show these two Absorption Ratios, respectively, through time. Intrinsic fragility refers to the Absorption Ratio of portfolio assets whereas extrinsic fragility refers to the Absorption Ratio of the broad equity market.

The shaded regions in these exhibits show whether the Absorption Ratio is rising rapidly (as indicated by a rolling z-score greater than 1.0), falling rapidly (as indicated by a rolling z-score of less than -1.0), or moving sideways. It is evident from visual inspection of these two charts that these two Absorption Ratios are related but not identical.

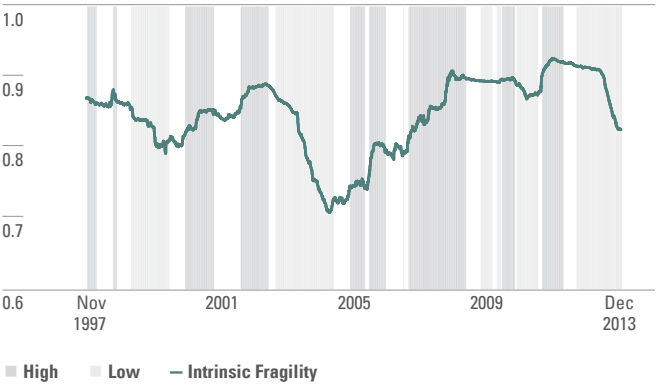
Figure 14: Extrinsic Fragility Through Time



Source: State Street.

The information contained above is for illustrative purposes only.

Figure 15: Intrinsic Fragility Through Time



Source: State Street.

The information contained above is for illustrative purposes only.

To employ the Absorption Ratio for dynamic asset allocation, we need a trading rule. We use the following trading rule from Kritzman (2013). When intrinsic fragility is rising (falling) rapidly, we reduce (increase) liquid equity exposure by 1/4. We employ the same rule, in parallel, for extrinsic fragility. This way, when both measures are rising rapidly, we reduce our liquid equity exposure by 1/2. Figure 16 shows this trading rule.

Figure 17 shows the performance of this strategy relative to a static benchmark portfolio in a backtest.

Figure 18 presents these potential results graphically. By shifting into safer assets when absorption is rising, and into riskier assets when it is falling, we are able to improve the return of a static portfolio allocation while simultaneously

Figure 16: Trading Rules for Dynamic Asset Allocation

Fragility	Exposure	Liquid Equity Exposure*
Extrinsic	Shift > 1 Shift < -1	Reduce Allocation by 1/4 Increase Allocation by 1/4
Intrinsic	Shift > 1 Shift < -1	Reduce Allocation by 1/4 Increase Allocation by 1/4

Source: State Street.

*Liquid equity consists of US large cap, US small cap, EAFE equity, and EM equity.

Figure 17: Backtested Strategy Performance
November 21, 1997 through December 31, 2013

	Static Portfolio	Conditioned Portfolio
Return	7.25%	9.17%
Volatility	12.11%	10.82%
Return/Volatility	0.60	0.85
1-Year Volatility		
Minimum	5.69%	6.15%
Maximum	30.45%	22.38%
3-Year Volatility		
Minimum	6.54%	6.76%
Maximum	20.35%	17.24%

Source: State Street Global Advisors. Data is from 11/21/1997 through 12/31/2013.

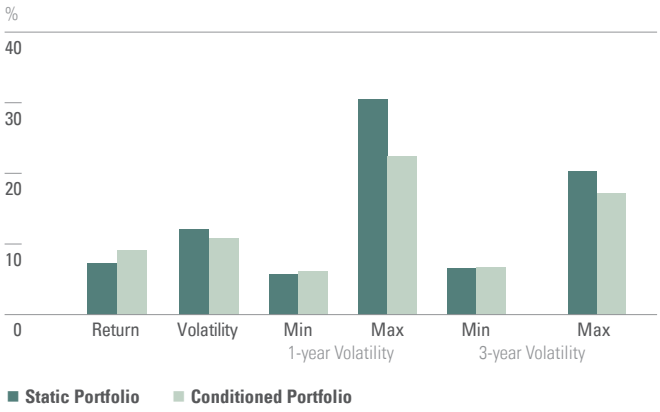
The data displayed is a hypothetical example of back-tested performance for illustrative purposes only and is not indicative of the past or future performance of any SSGA product. Back-tested performance does not represent the results of actual trading but is achieved by means of the retroactive application of a model designed with the benefit of hindsight. Actual performance results could differ substantially, and there is the potential for loss as well as profit. The performance may not take into account material economic and market factors that would impact the adviser's actual decision-making. The performance does not reflect management fees, transaction costs, and other fees expenses a client would have to pay, which would reduce returns. Please reference the disclosures at the end of the document for the model methodology and other important disclosures.

Transaction costs are minimal and not included in this analysis.

Static portfolios are fixed-weight, using weights shown in Figure 13 of this piece. Conditioned portfolios are not fixed weight, and assume that the portfolio is balanced daily, using the trading rules given in Figure 16.

All returns are gross of fees and transactions costs.

Figure 18: Backtest Results



Source: State Street Global Advisors. Data is from 11/21/1997 through 12/31/2013.

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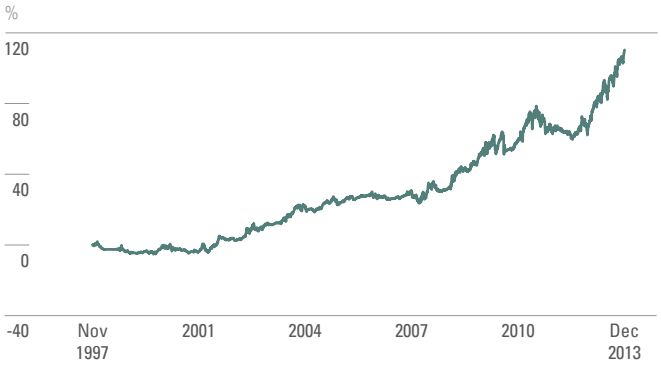
reducing its risk. We are also able to reduce the variation in its risk through time. Figure 19 shows the outperformance of the dynamic portfolio versus the benchmark. Figure 20 shows the model's equity exposure through time, based on intrinsic and extrinsic fragility.

Now we will show how the Absorption Ratio can be used in a non-linear tail risk protection strategy. An investor who is concerned about drawdowns, but would also like to retain upside potential, can purchase S&P 500 put options as insurance against losses. However, maintaining constant protection can be expensive. To reduce the cost of protection, we scale the amount of protection we purchase based on the Absorption Ratio. Specifically, when the z-score is greater than 1.0, we purchase protection. Otherwise, we do not. Figure 21 shows the backtested performance of this strategy at 95% and 90% floor levels. Figure 22 shows the same backtested results where we purchase self-financing S&P 500 collars, instead of puts, to offset the cost of the protection.[7]

Figure 23 presents a graphical comparison of the results of the various strategies.

The preceding exhibits show that the Absorption Ratio can be used as a timing (filter) signal in determining when to purchase tail-risk protection. The outright purchase of puts causes a portfolio return drag over time, hence timing the entry and exit of this protection can potentially improve returns.

Figure 19: Backtested Excess Cumulative Returns Relative to Static Weights



Source: State Street Global Advisors. Data is from 11/21/1997 through 12/31/2013.

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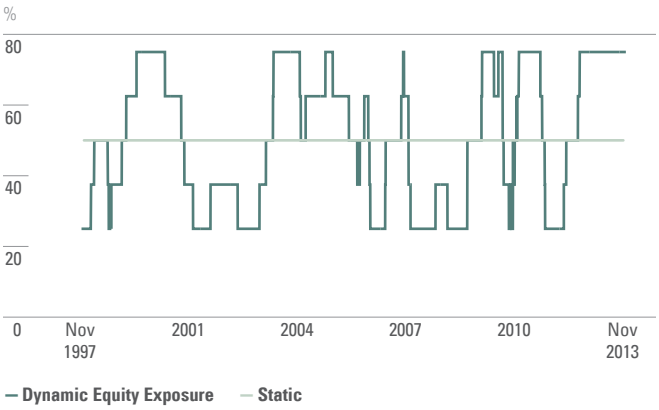
Transaction costs are minimal and not included in this analysis.

Static portfolios are fixed-weight, using weights shown in Figure 13 of this piece. Conditioned portfolios are not fixed weight, and assume that the portfolio is balanced daily, using the trading rules given in Figure 16.

Figure 20: Exposure to Liquid Equities Through Time



Source: State Street.

Factorizing Your Factors: The Case for Smart Beta

While the discussion thus far has been primarily focused on measuring and managing risk, improving returns is another reason investors are focused on factor based approaches. Many institutional pension funds are still underfunded relative to their liabilities. This is particularly so among public pension funds within the US In addition, given the low level of interest rates, and some concerns regarding long-term growth expectations, asset class return expectations for many investors are low, and there may be concern that returns won't be high enough to hit investors' return targets.

A natural starting point to boost returns is to seek active managers who can add value over standard indexes. Managers who add alpha greatly simplify the task of meeting the fund's return goal. However, there are several practical challenges involved in the oversight of an active manager program. Most importantly, the existence of skilled active managers is not sufficient. The investment staff of the asset owner must also be skilled in determining who these managers are. Before launching such a program, the asset owner should articulate their own philosophy, informed by a deep understanding of all the issues involved, including a belief in the merits of market efficiency and the practical costs and benefits of active management.

One particular consideration for an institutional investor is its own size. Smaller institutions, with less than $1 billion in assets, have more flexibility to allocate to concentrated active managers. Of course, smaller funds may also have smaller investment staffs, with less sophistication. This is a constraint in its own right.

We believe that as the size of the fund grows, staff size and sophistication can also grow. However, transaction costs grow accordingly and this can greatly impede an active manager's ability to add value. In many cases, it is impractical to find enough managers with capacity to add meaningful value to the overall plan. In fact, hiring too many managers can then lead to an overly-diversified fund, and in that case the fund can look very much like an expensive index fund.

The desire to boost returns without running a large active manager program can lead institutions down the path of

Figure 21: Backtested Perfomance of Unfiltered and Filtered Put-Only Strategies
November 21, 1997 through August 17, 2013

	Unprotected Portfolio	95% Floor Put	95% Floor Filtered Put	90% Floor Put	90% Floor Filtered Put
Annualized					
Average Return	8.14%	5.74%	8.02%	6.59%	7.81%
Standard Deviation	14.39%	12.44%	12.99%	13.55%	13.68%
Return/Standard Deviation	0.57	0.46	0.62	0.49	0.57
Monthly					
5% cVaR	-10.33%	-7.96%	-8.76%	-9.38%	-9.48%
Minimum Return	-21.57%	-14.09%	-14.09%	-15.86%	-15.86%
Maximum Return	14.44%	12.86%	13.95%	13.50%	13.95%
Change in Average Turnover	—	-0.23%	-0.13%	-0.13%	-0.08%
Success Rate,* 95%	**93.12%**	**94.18%**	**94.71%**	**92.59%**	**93.12%**
Success Rate,* 90%	**97.88%**	**98.94%**	**98.41%**	**98.41%**	**97.88%**

Source: State Street Global Advisors. Data is from 11/21/1997 through 08/17/2013. *Percent of time above threshold.

The data displayed is a hypothetical example of back-tested performance for illustrative purposes only and is not indicative of the past or future performance of any SSGA product. Back-tested performance does not represent the results of actual trading but is achieved by means of the retroactive application of a model designed with the benefit of hindsight. Actual performance results could differ substantially, and there is the potential for loss as well as profit. The performance may not take into account material economic and market factors that would impact the adviser's actual decision-making. The performance does not reflect management fees, transaction costs, and other fees expenses a client would have to pay, which would reduce returns. Please reference the disclosures at the end of the document for the model methodology and other important disclosures.

Transaction costs are minimal and not included in this analysis.

Figure 22: Performance of Unfiltered and Filtered Self-Financing Collars
November 21, 1997 through August 17, 2013

	Unprotected Portfolio	95% Floor Collar	95% Floor Filtered Collar	90% Floor Collar	90% Floor Filtered Collar
Annualized					
Average Return	8.14%	5.51%	8.28%	6.55%	7.93%
Standard Deviation	14.39%	9.68%	11.58%	11.84%	12.65%
Return/Standard Deviation	0.57	0.57	0.72	0.55	0.63
Monthly					
5% cVaR	-10.33%	-6.60%	-7.70%	-8.52%	-8.78%
Minimum Return	-21.57%	-11.42%	-11.42%	-13.93%	-13.93%
Maximum Return	14.44%	8.74%	13.95%	10.54%	13.95%
Change in Average Turnover	—	-0.22%	-0.11%	-0.13%	-0.08%
Success Rate,* 95%	**93.12%**	**96.30%**	**94.71%**	**93.65%**	**93.65%**
Success Rate,* 90%	**97.88%**	**99.47%**	**99.47%**	**98.41%**	**98.41%**

Source: State Street Global Advisors. Data is from 11/21/1997 through 08/17/2013. *Percent of time above threshold.

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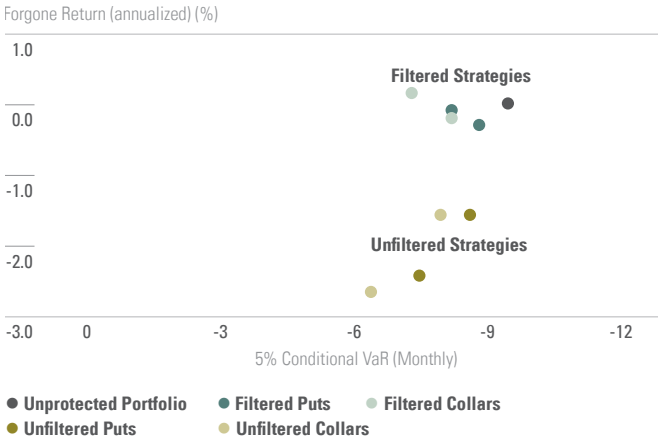
Transaction costs are minimal and not included in this analysis.

Figure 23: Comparison of Various Trading Strategies
November 21, 1997 through August 17, 2013



Source: State Street Global Advisors. Data is from 11/21/1997 through 08/17/2013.

Transaction costs are minimal and not included in this analysis.

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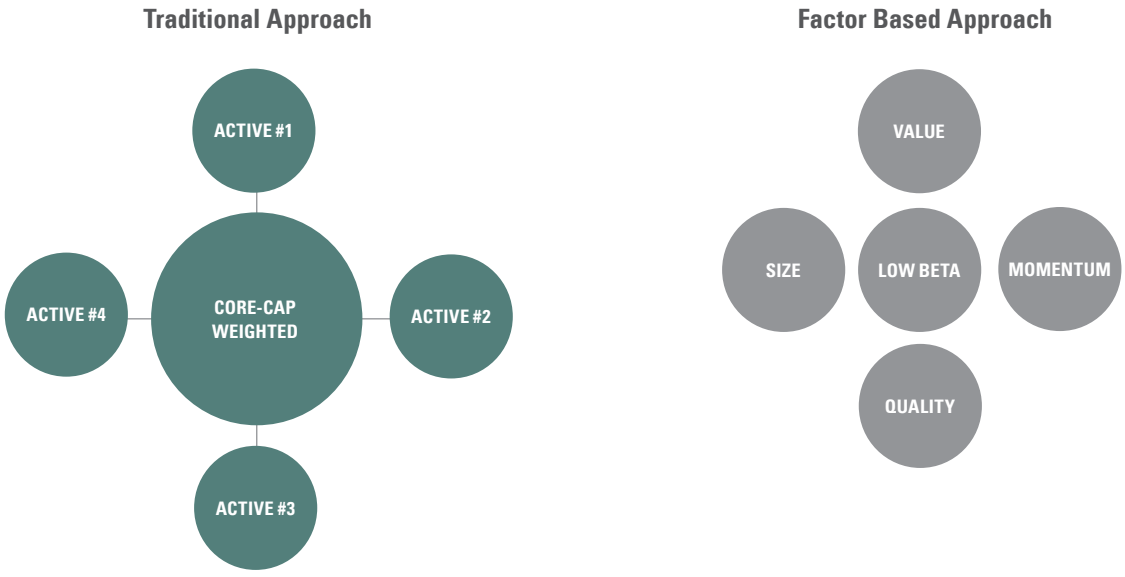
factorizing their equity program and embracing smart beta strategies. Beginning in the early 1970s, a large volume of academic research has uncovered several equity factors showing a persistence to add value over the market. These attributes include small-cap, value, momentum, low-beta, and high quality.

The belief that that these factors will continue to offer positive excess returns has ushered in a wave of equity strategies organized around each of these, and other, attributes. The movement toward smart equity beta can lead to a departure from the traditional core-satellite approach often embraced by institutional investors.

Alternative Risk Premia: Hedge Fund and Private Equity Proxy Strategies

In the quest for higher returns and better diversification, investors are looking outside of equities as well for various factor exposures. For example, within the currency market, it has been shown that higher yielding currencies tend to outperform lower yielding currencies.[8] A market-neutral strategy formed around this concept is often referred to as the "currency carry trade." Within commodities, there are certain indexes, such as the Dow Jones-UBS Commodity Index, which allocate to futures contracts exhibiting positive roll yield (or backwardation). An investor could take advantage of this by going long this index, and shorting out a standard commodity index, thereby seeking to harvest a futures roll premium.

Figure 24: Two Approaches to Equity Allocations



Source: State Street.

For illustrative purposes only.

The carry trade and the commodity roll strategy are two examples of alternative risk premium, and these strategies are often employed by hedge fund managers at high fees. This need not be the case. In fact, we believe a rules-based approach, creating market neutral exposures to smart equity beta, currency carry, commodity roll, and other factors, could plausibly complement, if not substitute for, a diversified hedge fund program.

Some investors allocate to these premia as an overlay on their overall fund. This implies utilizing leverage. One note of caution is that some of these strategies can exhibit positive equity beta in that they tend to work when the equity market is rising, but fail during periods of distress. The carry trade, in particular, tends to work when equity markets are rising. Consequently, rather than diversifying the source of returns, if done incorrectly, without offsetting or additional exposures, large unfunded alterative risk premia strategies could actually increase the Growth exposure and increase total portfolio drawdown risk. For investors moving in this direction, we recommend constructing an Alternative Risk Premia bucket that is orthogonal to the Growth factor. An example of this might be to pair a currency carry strategy with a low beta—high beta market neutral strategy.

Factor based approaches also have applications for illiquid asset classes such as private equity. Private equity managers derive their returns from a number of sources, including equity beta, leverage, industry exposures, illiquidity premiums, and alpha. A regression-based approach can be used to estimate some of these factor exposures, such as industry concentration. Armed with this information, we believe investors can create a mimicking portfolio that more closely tracks private equity returns compared to standard equity indexes. At the very least, a factor approach to private equity may enhance the ability to equitize uncalled capital as investors await for the general partners to find new buyout investment opportunities.

Summary

Today, as always, investors are challenged with finding better approaches to manage risk and harvest returns. State Street Global Advisors' (SSGA) ISG team believes that many are turning toward factor based solutions to help address these needs. Factor based applications to investing are many and their uses are growing. Risk factor decomposition may help investors better quantify if they have a healthy investment diet. Factor analysis may enhance an investor's ability to understand risk, diversification, and sources of return.

Quantifying and managing risk are hardly the only applications for factor based investing. SSGA's ISG team has observed that more and more, investors are attempting to harvest factor returns, complimenting the returns from traditional asset classes. In the case of equities, for example, investors are capitalizing on years of empirical evidence showing that attributes such as "size" and "value" and "momentum" are generally compensated over long investment cycles. The embracement of smart equity beta strategies is an expression of the desire to harvest these returns over long cycles.

Finally, we expect that investors will show a growing appetite for alternative proxy portfolios, both for liquid and illiquid alternative investments. The desire to lower fees and increase transparency naturally leads investors to wonder whether simple rules based mimicking strategies can capture the major factor premiums that explain hedge fund returns. Additionally, investors have a need to equitize the uncalled capital earmarked for private equity placements. Once again, factor based analysis can help, in this case by creating liquid exposure pools that better track the return pattern of private equity managers.

Factor based asset allocation contains many useful and practical applications in the management of a diversified investment plan. Whether investors seek to improve risk control, enhance return, or simplify the understanding of their investments, factor based approaches offer meaningful solutions. Since risk and return are the primary concerns of investing, the role of factor based asset allocation is likely to grow.

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* This AUM includes the assets of the SPDR® Gold ETF (approximately $30.1 billion as of September 30, 2014), for which State Street Global Markets, LLC, an affiliate of SSGA, serves as the distribution agent.

[1] Typically, the vector of weights, or factor loadings, are standardized such that the sum of the squared weights = 1. This simply involves multiplying all of the weights by a constant (scalar), and hence it does not affect the proportion allocated to each asset class.

[2] Mercer Asset Allocation Survey, European Institutional Marketplace Overview, 2013. The survey covers more than 1,200 plans in 13 European countries, representing assets of more than 750 billion euros.

[3] Bridgewater Associates, LP.

[4] These four managers have the longest overlapping returns in the risk parity space.

[5] Transaction costs are minimal and not included in this analysis.

Past performance is not a guarantee of future results. The performance includes the reinvestment of dividends and other corporate earnings and is calculated in US dollars.

[6] Please refer to methodology disclosures at back of document.

[7] The success rate is not 100% when the floor matches the success rate level because of several reasons:

We pay premium to buy put options which combined with the portfolio drawdown may exceed the floor level. Collars are self-financing.

When the non-equity portion (50% of the total) of the portfolio suffers a drawdown greater than the floor level, it may make the portfolio to breach the floor level.

We buy S&P 500 Index options for the whole equity portion of the portfolio, which includes EAFE and EM equities. There is a mismatch between the options and the underlying index, which sometimes causes the options to expire out-of-money, although the drawdown for some equities is greater than the floor level.

[8] Fama, Eugene. "Forward and Spot Exchange Rates." Journal of Monetary Economics 14(3): 319-38. 1984

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Companies with large market capitalizations go in and out of favor based on market and economic conditions. Larger companies tend to be less volatile than companies with smaller market capitalizations. In exchange for this potentially lower risk, the value of the security may not rise as much as companies with smaller market capitalizations.

Bonds generally present less short-term risk and volatility than stocks, but contain interest rate risk (as interest rates rise bond values prices usually fall); issuer default risk; issuer credit risk; liquidity risk; and inflation risk. These effects are usually pronounced for longer-term securities. Any fixed income security sold or redeemed prior to maturity may be subject to a substantial gain or loss.

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Diversification does not ensure a profit or guarantee against loss.

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a time period of 36 months, but the illustrations noted above may reflect a shorter time frame. This may not depict a true historical measure, and shouldn't be relied upon as an accurate assessment of volatility.

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International Government bonds and corporate bonds generally have more moderate short-term price fluctuations than stocks, but provide lower potential long-term returns. Investing in high yield fixed income securities, otherwise known as "junk bonds", is considered speculative and involves greater risk of loss of principal and interest than investing in investment grade fixed income securities. These Lower-quality debt securities involve greater risk of default or price changes due to potential changes in the credit quality of the issuer.Investing in foreign domiciled securities may involve risk of capital loss from unfavorable fluctuation in currency values, withholding taxes, from differences in generally accepted accounting principles or from economic or political instability in other nations.

Investments in emerging or developing markets may be more volatile and less liquid than investing in developed markets and may involve exposure to economic structures that are generally less diverse and mature and to political systems which have less stability than those of more developed countries.

Investing in REITs involves certain distinct risks in addition to those risks associated with investing in the real estate industry in general. Equity REITs may be affected by changes in the value of the underlying property owned by the REITs, while mortgage REITs may be affected by the quality of credit extended. REITs are subject to heavy cash flow dependency, default by borrowers and self-liquidation. REITs, especially mortgage REITs, are also subject to interest rate risk (i.e., as interest rates rise, the value of the REIT may decline).

Hedge funds (or other alternative investment funds) are designed only for sophisticated investors who are able to bear the risk of the loss of their entire investment. An investment in a hedge fund should be viewed as illiquid and interests in hedge funds are generally not readily marketable and are generally not transferable. Investors should be prepared to bear the financial risks of an investment in a hedge fund for an indefinite period of time. An investment in a hedge fund is not intended to be a complete investment program, but rather is intended for investment as part of a diversified investment portfolio. Typically interests in a hedge fund are not registered under the US Securities Act of 1933, as amended ('the Securities Act'), and the fund is not registered as an investment company under the US Investment Company Act of 1940, as amended (the 'Investment Company Act'), and as such, investors will not be afforded the protections of those laws and regulations. A prospective investor should carefully review all offering materials associated with a hedge fund, including the risk factors, and should consult his or her own legal counsel and/or financial advisor prior to considering an investment in a hedge fund.

Increase in real interest rates can cause the price of inflation-protected debt securities to decrease. Interest payments on inflation-protected debt securities can be unpredictable.

Asset Allocation is a method of diversification which positions assets among major investment categories. Asset Allocation may be used in an effort to manage risk and enhance returns. It does not, however, guarantee a profit or protect against loss.

Barclays U.S. Aggregate Bond Index is made up of the Barclays U.S. Government/ Corporate Bond Index, Mortgage-Backed Securities Index, and Asset-Backed Securities Index, including securities that are of investment grade quality or better, have at least one year to maturity, and have an outstanding par value of at least $100 million.

Barclays Global Aggregate Bond Index provides a broad-based measure of the global investment grade fixed-rate debt markets. It is comprised of the U.S. Aggregate, Pan-European Aggregate, and the Asian-Pacific Aggregate Indexes. It also includes a wide range of standard and customized subindices by liquidity constraint, sector, quality and maturity.

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