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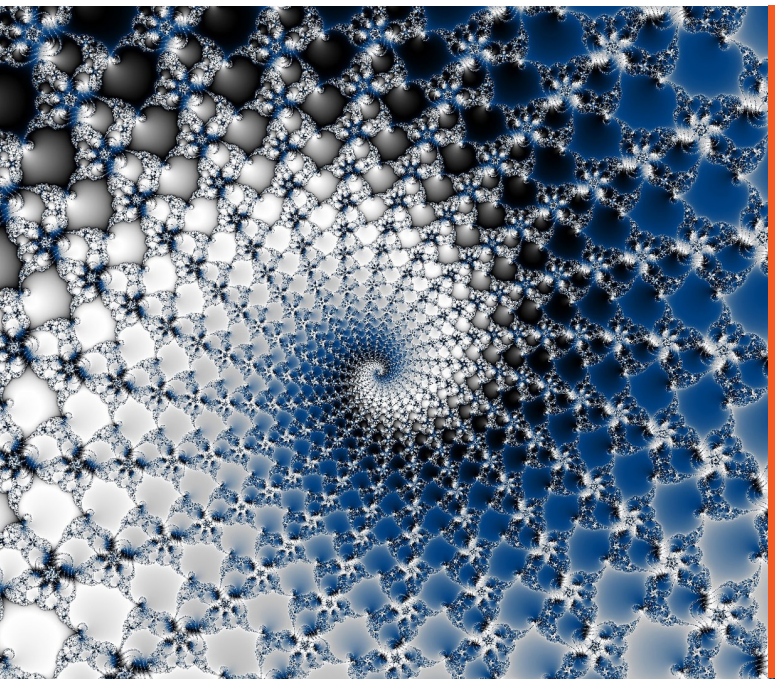

Alternative Investment Analyst Review

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Chosen pieces will be featured in future issues of AIAR, archived on **CAIA.org**, and promoted throughout the CAIA community.

Editor's Letter

A Framework for Risk Analysis of Alternative Assets

What is the proper way of measuring risk characteristics of alternative assets? This note attempts to answer this questions through a simple and yet useful framework.

When asset allocators are asked why they invest in alternative assets, the first response is not typically that they have the highest expected returns or the lowest risks. Those are typical risk-return characteristics of traditional asset classes. While every investment is expected to provide some rate of return, investors also look at other characteristics of alternative investments in order to determine whether an allocation to this asset class is justified.

In the framework presented here, we look at two broad categories of risks – standalone risk and factor exposure risk – to provide a simple framework for characterizing alternative assets along quantitative risk measures. The framework presented here provides focuses on relative measures of risk. That is, given the universe of investments under considerations, the framework ranks the investments in two dimensions: standalone risk and factor exposure risk.

Standalone risk. This characteristic of an alternative investment focuses on the risk of the asset regardless of whether it is held as part of a diversified portfolio or it constitutes the bulk of an investor's portfolio. Even if an alternative asset is held as part of a diversified portfolio, the standalone risk is still relevant. Everything else being the same, the investor would prefer an investment that has lower volatility, lower tail risk, lower historical maximum drawdown, and so on.

Factor exposure risk. This characteristic of an alternative investment focuses on the risk of the asset in a portfolio context. Many investors allocate to this asset class because it is expected to reduce or at least not contribute to the total risk of their portfolios. Furthermore, asset allocators who wish to exercise some degree of tactical asset allocation would want to know how these assets are expected to perform during "risk-on" and "risk-off" regimes.

The framework developed here can be the first step in a decision-making process. There is substantial academic and industry research behind it but is simple and intuitive enough to be used by both institutional and individual investors.

Methodology

The methodology implemented here aggregates various measures of risks along two dimensions: standalone risk and factor exposure risk. All the risk measures are first normalized to account for differences in unit of measurement. For example, while standard deviation is measured using the same unit of measurement as rates of returns, kurtosis is measured in terms of the fourth power of the rates of return. The process of normalizing the risk measures accounts for the relative size of the risk measure within the universe of assets or funds that are being considered. For example, if eventually the standalone risk of a fund is presented to be 10, then this indicates that the asset has the highest standalone risk among all the assets being considered. On the other hand, if the factor exposure risk of the asset is stated to be 8, then this indicates that the asset has a factor exposure risk that is 20% smaller than the fund with the highest factor exposure risk.

Measuring Standalone Risk

As the name implies, this characteristic of an investment focuses on its risks regardless of whether it is held inside or outside of a diversified portfolio. The following measures of risk are used to construct a single measure of standalone risk:

- Annual standard deviation is used to measure the volatility of historical returns
- Two different measures of maximum drawdown are used to measure the ability of the manager to control downside risk
- Skewness is used to construct a measure of tail risk of historical returns
- Kurtosis is used to construct a measure of extreme returns

Once these measures are calculated, they are normalized and then aggregated to create our measure of standalone risk.

Measuring Factor Exposure Risk

This measure focuses on the exposure of a strategy to major sources of risk in the economy and financial markets. We use the following measures of factor exposures to construct our aggregate measure:

- Exposure to equity risk is used to measure the sensitivity of the fund's returns to changes in equity markets
- Exposure to credit risk is used to measure the sensitivity of the fund's returns to changes in credit markets
- Exposure to VIX is used to measure the sensitivity of the fund's returns to changes in VIX, which is often used to gauge the degree of stress in financial markets

Similar to the standalone measure of risk, we normalize the above exposures to create a single measure representing factor exposure risk.

Examples

To illustrate our approach, we apply the above framework to CISDM Hedge Fund Indices and Morningstar Liquid Alternative Indices. Both are peer group benchmarks in the sense that they are calculated using equally weighted returns of managers who follow specific strategies. The results appear in Exhibit 1.

Let's start with Morningstar's Bear Market Benchmark, which represents an interesting case. As expected, this index has the lowest factor exposure risk. That is, funds that follow this strategy are the ultimate diversifiers. On the other hand, this fund has the highest standalone risk. Alternatively, the CISDM Global Macro Index has the lowest standalone risk and has about 40% lower factor exposure risk than the riskiest strategy – Morningstar's Bank Loan Benchmark. Overall, we can see that while there is a great deal of variation in terms of standalone risk among these indices, most of the strategies' factor exposure risks are with 80% of the riskiest strategy. CTA, Global Macro, Equity Market Neutral, and Merger Arbitrage strategies are the only indices that have factor exposure risks that are less than 80% of the riskiest strategy. Finally, we can see that compared to private placement funds, which are represented by CISDM indices, liquid alternatives represented by the Morningstar benchmarks have relatively high factor exposure risks. In other words, these funds are not as effective diversifiers as the private placement funds.

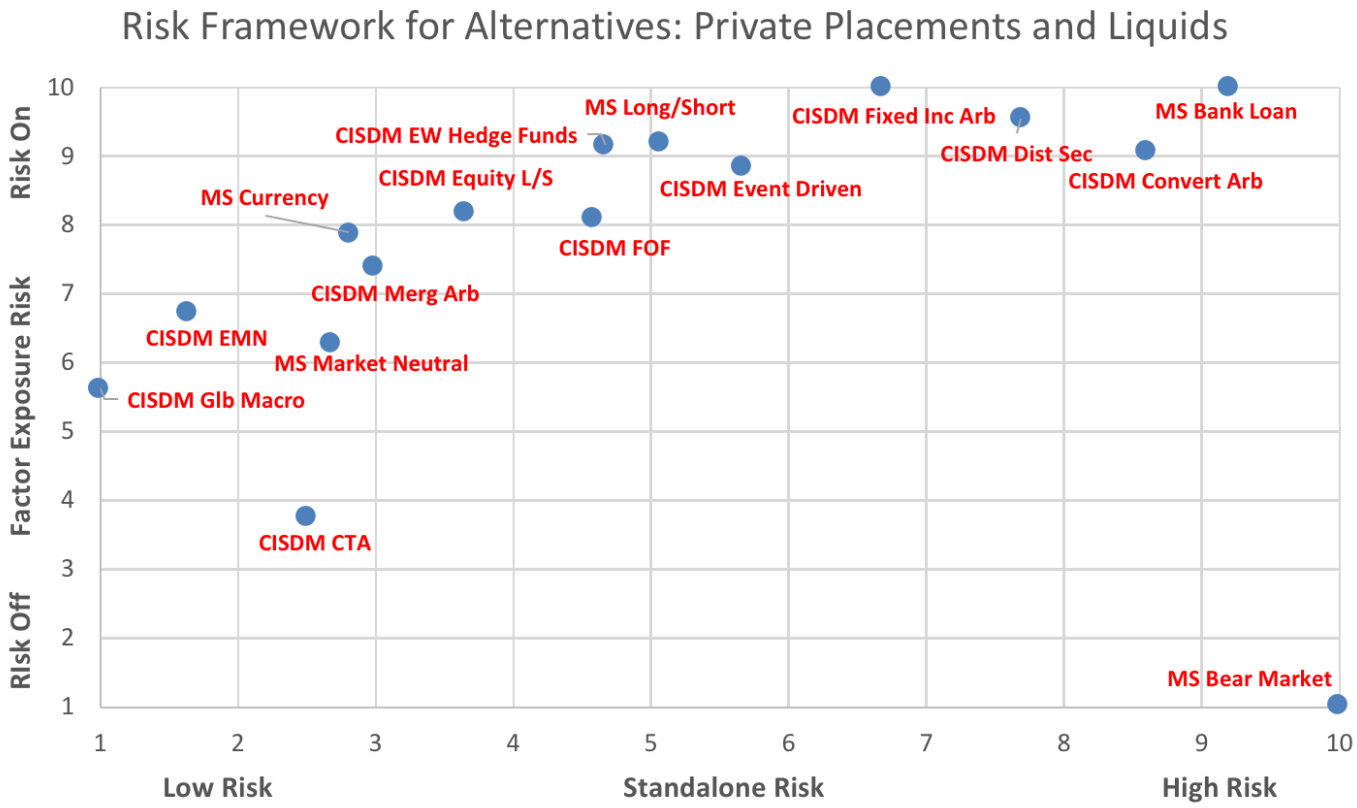

Exhibit 1
Source: CISDM, Morningstar and authors' calculations

Qualitative Due Diligence

The quantitative framework just discussed measures the standalone risk and the factor exposure risk of a variety of hedge fund and liquid alternative indices. While this framework measures the risk of each category or strategy of a fund, the quantitative risk measure of an index does not rank how a specific fund would experience risk and return over the course of a full market cycle. That is, the indices are an average of the performance of a large number of funds, and the experience of any one fund within an index may be more positive or more negative than the performance of the index as a whole.

In order to understand the risks of a specific fund, investors should perform both operational due diligence and investment due diligence.

Investment Due Diligence

Before allocating assets to a specific investment vehicle, investors should make sure that they understand the investment strategy and develop a belief that the portfolio management team has the skills required to manage the fund successfully. While entire books have been written on the due diligence process, a few questions are included here to get the process started.

- What investment strategies has this portfolio management team run in the past? Were those strategies successful? Were those strategies closely related to the investment strategy of the fund currently being considered?
- What is the investment strategy of the fund? Is the strategy substantially similar to one tracked by a CISDM hedge fund index where the risk and return of the index can be appropriately used to understand the characteristics of the fund?
- Does the portfolio management team have the right skills, experience, and incentives to be a cohesive, long-term team that can generate respectable or excess investment performance?
- What are the management fees, incentive fees, and total costs that investors will pay for this fund? How do these fees compare to similar investment products or the expected returns of the fund?

Operational Due Diligence

No matter how strong the investment team, investors also need to examine the operations of a firm before investing in a fund.

- Does the fund management firm have a culture of risk management that is respected by traders and portfolio managers and electronically enforced by the trading systems?
- Does the fund understand the regulatory environment and legal issues and have controls in place for the product to comply with all applicable regulations?
- Does the fund have an appropriately structured team, with separation of duties and the skill to manage compliance, performance measurement and valuation, operations, clearing, and trading? Are procedures in place to ensure the safe custody of client assets?
- Do both the investor and the manager understand how positions will be valued? If the investments are not liquid and exchange traded, are the positions priced using an internal model or an external valuation service?

In summary, the risk of any investment product must be analyzed through both quantitative and qualitative risk measures. Before making any investment, investors should have a strong understanding of the risk and return characteristics of the investment product. While many alternative investments have lower standard deviation risk than a long-only equity index, the complexity of these products requires a heightened level of understanding and due diligence.

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Dr. Hossein Kazemi is the Senior Advisor to the CAIA Association's Program. Dr. Kazemi has been involved with the CAIA Association since its inception as a senior advisor and a managing director. In his current role, he helps with the development of the CAIA program's curriculum and directs the CAIA Association's academic partnership program. In addition, he serves as the editor of *Alternative Investment Analyst Review*, which is published by the Association. He has worked with universities and industry organizations to introduce them to the CAIA program. Dr. Kazemi is Michael and Cheryl Philipp Distinguished Professor of Finance at the Isenberg School of Management, the University of Massachusetts - Amherst. He is the Director of the Center for International Securities & Derivatives Markets, a nonprofit organization devoted to research in the area of alternative investments, a co-founder of the CAIA Association, and home to CISDM Hedge Fund/CTA Database and the *Journal of Alternative Investments*, the official research publication of the CAIA Association. He has over 25 years of experience in the financial industry and has served as consultant to major financial institutions. His research has been in the areas of valuations of equity and fixed income securities, asset allocation for traditional and alternative asset classes, and evaluation and replication of active management investment products. He has a Ph.D. in finance from the University of Michigan.

Thomas Schneeweis, *Ph.D.*
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Thomas Schneeweis, Ph.D., is a founding Board Member of the CAIA Association and a managing partner of S Capital Management, LLC. Until his retirement in May 2013, he was the Michael and Cheryl Philipp Professor of Finance at the Isenberg School of Management at the University of Massachusetts Amherst, where he also launched the Center for International Securities and Derivatives Markets (CISDM) and served as director. He was the founding editor of CAIA's publication, *The Journal of Alternative Investments*.
Tom has served in various advisory at both the Managed Funds Association and the Alternative Investment Management Association. He is also an outside trustee of The AMG Funds. He was on the advisory board for the Dow Jones - AIG Commodity Index, as well as holding a similar position at the London Metals Exchange. He was also Director of Research at an approximately $4 billion hedge fund managed account platform. He has published widely in academic and practitioner journals in the areas of traditional and alternative investment, has been quoted in most major financial publications, and has provided commentary on various US, Europe, and Asian financial news programs.
Tom holds a Ph.D. from the University of Iowa, an M.A. from the University of Wisconsin, and a B.A. from St. John's University.

Keith Black, *Ph.D., CAIA, CFA*
CAIA Association

Keith Black has over twenty-five years of financial market experience, serving approximately half of that time as an academic and half as a trader and consultant to institutional investors. He currently serves as Managing Director of Curriculum and Exams for the CAIA Association. During his most recent role at Ennis Knupp + Associates, Keith advised foundations, endowments and pension funds on their asset allocation and manager selection strategies in hedge funds, commodities, and managed futures. Prior experience includes commodities derivatives trading, stock options research and CBOE floor trading, and building quantitative stock selection models for mutual funds and hedge funds. Dr. Black previously served as an assistant professor and senior lecturer at the Illinois Institute of Technology.

He contributes regularly to *The CFA Digest*, and has published in *The Journal of Wealth Management*, *The Journal of Trading*, *The Journal of Investing*, *and The Journal of Alternatives Investments*, among others. He is the author of the book "Managing a Hedge Fund," as well as co-author of the 2012 and 2015/2016 second and third editions of the CAIA Level I and Level II textbooks.

Dr. Black was named to the *Institutional Investor* magazine's list of "Rising Stars of Hedge Funds" in 2010. Dr. Black earned a BA from Whittier College, an MBA from Carnegie Mellon University, and a PhD from the Illinois Institute of Technology. He has earned the Chartered Financial Analyst (CFA) designation and was a member of the inaugural class of the Chartered Alternative Investment Analyst (CAIA) candidates.

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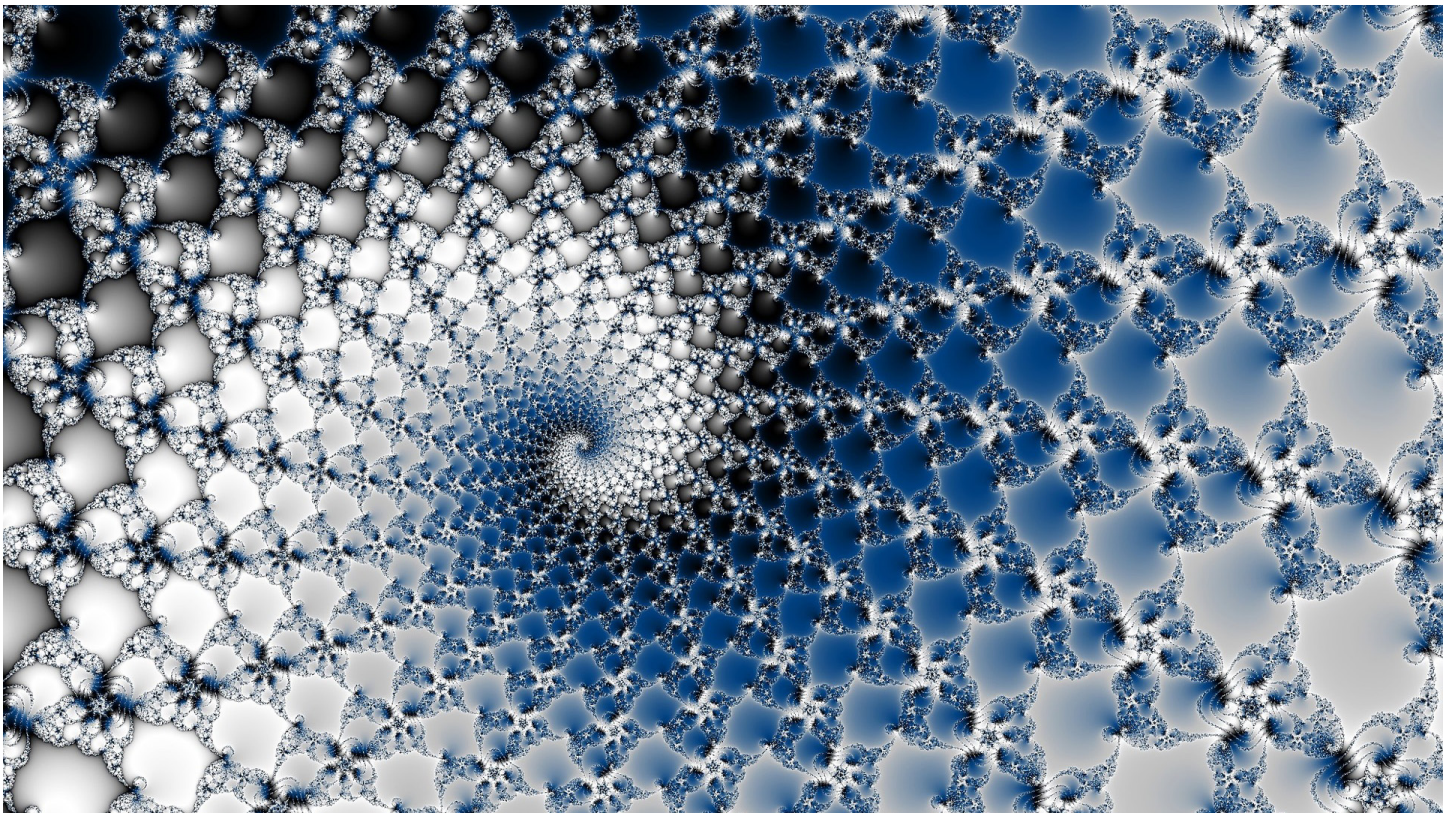

Adding Alpha by Subtracting Beta

A Case Study on How Quantitative Tools Can Improve a Portfolio's Returns

Chris Martin, *CAIA*
Axioma

Executive Summary

Fundamental (discretionary) portfolio managers typically build their portfolios from the bottom up.

That is, they identify stocks they expect to beat the market and combine them to create a portfolio. However, fundamental managers can leverage quantitative tools to help identify and lessen potential issues in their portfolio, while still maintaining their investment views and goals. In this paper, we'll use a "real world" portfolio[1] to illustrate how quantitative tools can improve a portfolio's realized returns.

Introduction

Fundamental investment management is like an iceberg. Although icebergs appear small above water, the majority of their mass is below water and so often unseen. For a fundamental manager, the tip of the exposed iceberg is the portfolio invested in and is the main product they share with the world. Under the water and behind the scenes, analysts pore over balance sheets, analyze industry and country trends, create cash flow models and valuations to help screen the large numbers of potential assets to buy. The fundamental management investment process can add much value by screening out winners, but the challenge still remains on how to translate these extensive "underwater findings" to an "above water" actionable portfolio in line with the manager's investment mandate and convictions on which assets are more attractive investments than others.With all of the work that goes into finding the best companies to invest in, the exact weighting of these various assets is the final hurdle to building a successful portfolio.

A fundamental manager's overall conviction in the stock often drives how much of each name they purchase in the portfolio, outside of simple rules such as making sure their allocations to certain industries, sectors, and/or countries are reasonable. The name they feel

the highest conviction for will often have the largest weight in the portfolio, while the name they feel the lowest conviction for may have the smallest weight in the portfolio. Regardless, the final position weighting of fundamental portfolios is often based on heuristics, and the manager's conviction is the main driver of asset weightings in the portfolio.

Because fundamental managers use a bottom-up investment process, we'd expect their fund's positive performance to come from the outperformance of individual stocks in their portfolio. This is in contrast to quantitative investing, where the managers make systematic factor bets – such as on Value, Momentum, or Profitability – that they expected to add positive return performance to the portfolio. Newer, passive "Smart Beta" products – which are an increasingly competitive threat to attracting investment in fundamental managers' actively managed portfolios – similarly embed systematic factor bets in the portfolio. Smart beta products are more similar to quantitative investment products than they are to the stock pickers' actively managed portfolios.

How can fundamental managers ensure their actual value add is in line with what they promise? What happens if the story they are telling doesn't match the story told by the quantitative tools their own clients and outside consultants are using? Is manager conviction the best way to build a portfolio? We will dive into a high-level review of the tools that quantitative investors typically use and see how fundamental investors can adapt them to help them understand what's driving their portfolios' returns, as well as aid them in making better decisions, avoiding undesired risks, and delivering higher alpha.

Quantitative Tools

Factor Risk Models

Factor risk models are tools to help finance professionals understand the sources of predicted (ex-ante) risk and realized (ex-post) risk and return in a portfolio. The factors that comprise factor risk models are characteristics of individual stocks that tend to lead to cross-sectional differences in returns. For example, smaller stocks tend to perform differently from their larger-cap counterparts, and highly levered stocks may outpace unlevered stocks under certain economic conditions. At their most basic, factor risk models provide a predicted standard deviation of active returns given a portfolio and a benchmark and decompose the sources of those risks across both systematic (i.e., factor) components and an idiosyncratic (i.e., specific) component. Typically, a fundamental manager's value proposition is in identifying those idiosyncratic returns. In other words, they believe they select a stock that is likely to perform better than other stocks in the same industry, size category, valuation level, etc.

Axioma's Worldwide factor risk model (WW4) includes several different factor blocks, including style, industry, country and currency factors, and a market factor – along with a specific risk model. Within the factor blocks, the underlying components (such as Value in the style-factor block or euro/USD in the currency block) are used to help a manager understand the risk in each of the portfolio's bets and determine whether that risk is expected to be compensated.

The factors in a fundamental model are typically based on commonly used and well-understood measures. Style factors include factors comprising market-based measures such as Medium-Term Momentum, Size, and Volatility, and balance sheet and income-statement-based measures such as Value, Leverage, and Growth. Assets with a high Value score behave differently than assets with a low Value score, and the risk model accordingly captures this behavior. Industry factors are driven by the GICS (Global Industry Classification Standard) industry mapping, Country factors by the country membership, and Currency factors by the currency denomination of the asset. Assets with a common industry or country will generally behave more similarly than assets in a different industry, and again the risk model accordingly captures this behavior.

How to Select the Right Factors

To date, more than 350 individual factors, or factor premia, have been identified as potential sources of outperformance, and it is a list that is likely to grow as fund managers turn to more esoteric characteristics in order to stand out in an increasingly competitive marketplace.

But at the heart of factor investing there are eight factors that form the cornerstone of any strategy:

	Explanation	Examples
Value	Undervalued relative to corporate fundamentals	Price-to-book, price-to-earnings
Growth	Above-average earnings growth	Price-to-earnings
Momentum	Rate of acceleration of price	3-month, 6-month, 12-month
Volatility	The dispersion of returns	Volatility, VIX
Size	High or low market capitalisation	Market cap
Liquidity	Low trading volume	ADV
Yield	Income return on investment	Dividend per share, buybacks
Quality	Sustainable profitability	Profitability, margins

This chart and text originally appeared in the article, "Multi-factor Investing Practical Considerations for Portfolio Managers" originally published by Ian Webster in June 2016

Every asset has an exposure to every one of these factors, and each factor not only has its own behavior, but also a correlation with other factors. Any returns that are not captured by the factors are considered "idiosyncratic" or "specific risk" – the risks that stem from the unique business model of the company itself and are not common across the broad market. In other words, a stock's return is explained by summing its exposure to each factor times that factor's return. The difference between that sum and its actual return is its idiosyncratic return.

From an ex-post perspective, factor risk models allow finance professionals to understand what drove their portfolios' realized returns. Fundamental managers expect to see most of their return coming from the "specific risk" described above, but may find they have more factor exposure than they thought, those factor exposures added risk to their portfolios, and may have hurt their returns. The portfolio manager can analyze these realized returns and risks using a factor risk model, which helps decompose realized results across the various factor blocks and the specific block. Factor-based performance attribution can also help portfolio managers understand if factors are helping or hurting their realized performance, so they can make better portfolio management decisions on an ongoing basis.

Stock-specific risk and return is also known as "alpha" and delivers value that factor-based smart beta products and quants don't always deliver. Factor bets, or "beta bets", are getting harder to justify management fees for, whereas specific bets, or "alpha bets", still command a premium.

Optimizers

At a high level, optimizers are tools to help make better decisions – which can apply to almost any facet of life, not just finance. At the core of any optimization is a goal one is trying to achieve (such as minimizing undesired risks), while obeying certain rules that cannot be violated (such as the size of sector overweights). Optimizers are best known in the finance world from Markowitz's Mean-Variance optimization framework, where the goal is to maximize expected return less variance. In this case, the "variance" is quantified by either a factor risk model or a covariance matrix that quantifies asset-asset interactions. The user of an optimizer does not need to understand all the mathematics and mechanics behind the optimizer, just that it can evaluate thousands or millions of combinations of assets and tell the user which combination best meets their objectives.

Axioma's optimizer does not force you into the mean- variance optimization space, which wouldn't make sense for a fundamental manager who is not building quantitative expected returns. Unlike quantitative managers, fundamental managers know the assets they want to buy, and they have an idea of an initial portfolio weighting based on their level of conviction. But the ensuing portfolio weights may be heuristic- based and not necessarily be "tuned" to load up on specific risk and minimize undesired factor risks. In this case study, we were faced with the challenge of staying relatively close to the initial portfolio — so we maintained high weights in high- conviction assets – while attempting to remove unwanted factor risks.

An optimizer is frequently needed for these trade-offs because factor risk models are complex tools. Often, making a small change in the portfolio may help address one factor but force another unintended factor to spring up. Furthermore, because all factors are correlated, risks can also be created from reducing certain factor exposures. For example, we could potentially reduce the risk coming from a single factor like Growth but increase net factor risk because Growth may be negatively correlated with another factor like Value. Optimizers can also account for other critical constraints while making trade-offs, such as making sure one does not trade too much, spend too much on transaction costs, or deviate from certain industry, sector, and country bounds. Any mandate-specific rule can be an input to the optimizer to make sure it is not violated.

Portfolio Construction Case Study

We started this case study by using a global portfolio managed by a bottom-up fundamental investment management firm. We pulled the history of quarterly holdings from the start of 2007 to the end of 2015 for a portfolio that was managed relative to the FTSE All-World Index. We started by analyzing the ex-ante predicted risk and ex-post realized return/risk profile of the fund through the lens of Axioma's WW4 factor risk model.

Current Portfolio Analysis: Ex-Ante Risk

First, we looked at the high-level aggregate active risks across this portfolio:

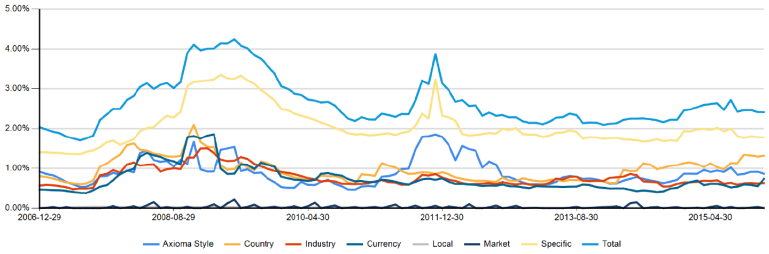

Exhibit 1: Aggregate Active Portfolio Risk

We see that predicted active risk for the portfolio has varied from 1.75% to more than 4% over time, with the largest contribution of active risk coming from active specific risk. Overall, it is good to see that the main driver of the portfolio's risk is stock-specific, as this is the crux of the manager's investment process. But we still see that style, country, industry, and currency bets are prevalent in the portfolio: risks that may have been the result of the bottom-up stock selection process, but not necessarily intended by portfolio's mandate.

Another way to distill the total allocation of the portfolio's risk to factors versus specific risks is the "% of Active Risk" chart. (See below.)

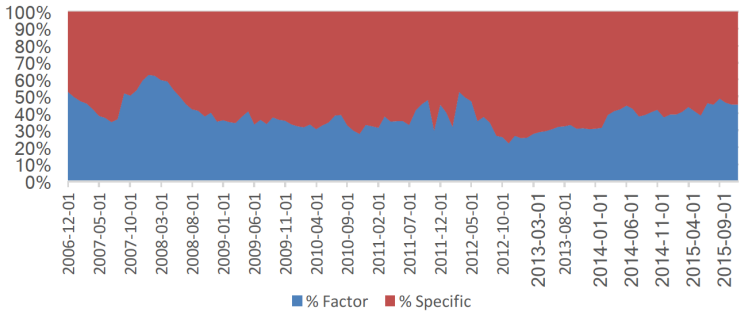

Exhibit 2: Fund: % of Active Risk

Exhibit 2 shows that although the portfolio usually has more specific risk than factor risk, when we add up each of the factor components, we still end up with 40% to 60% of active risk coming from factor bets. This chart verifies that the manager's fundamentally-constructed portfolio is taking a lot of factor risk that is not in line with his intended investment process.

Current Portfolio Analysis: Ex-Post Factor Attribution

The analysis above provides portfolio managers with a view of predicted active risk and what factors are driving these risks. We can illustrate the impact these risks have on the portfolio's performance using factor-based performance attribution.

In Exhibit 3 are the high-level realized results of this portfolio, annualized.

	Return	Risk	IR
Portfolio	3.58 %	18.15 %	
Benchmark	3.86 %	17.60 %	
Active	-0.28 %	2.63 %	-0.11

Exhibit 3: Summary of Results from Axioma's Portfolio Analytics Solutions

Overall, the portfolio has underperformed the benchmark: The portfolio has lower realized returns and more risk than the benchmark, which leads to a negative information ratio (IR). We can then break down the realized active return and risks across specific and factor bets, and then in more detail across the different factor blocks available in the Axioma WW4 factor risk model:

		Return	Risk	IR
Active		-0.28 %	2.63 %	-0.11
Specific		0.31 %	1.92 %	0.16
Factor		-0.59 %	1.69 %	-0.35
	Axioma Style	-1.36 %	1.21 %	-1.12
	Country	0.11 %	0.88 %	0.12
	Industry	0.29 %	0.92 %	0.31
	Currency	0.39 %	0.87 %	0.44
	Local	-0.01 %	0.02 %	-0.50
	Market	0.00 %	0.04 %	0.12

Exhibit 4: Return Decomposition

The first line of this report reiterates what we saw above: The portfolio has a negative active return of -0.28% with a realized active risk of 2.63%, leading to an information ratio of -0.11. The good news is that this manager is adding value through its stock-specific bets (+0.31%) and most of the realized risk is from its stock-specific bets. But the stock-specific gains are more than wiped out by the negative factor returns – especially by the "Axioma Style" block, which also contributes lots of unnecessary risk. The country, industry, and currency bets help add to returns, albeit with relatively low IRs. But generally, given that the overall mandate of this manager is to deliver results via stock-specific bets, many of these factor bets are not necessarily intended – i.e., they are a byproduct of a manual weighting process.

So what is a manager to do? One approach would be to manually re-weight the holdings by trying to reduce exposures to certain factors – especially the Axioma Style factors, given the amount of risk they are contributing to the portfolio and the amount they are detracting from returns. But this manual approach likely requires many iterations, with no guarantee that the changes will actually help improve the risk profile of the portfolio. Furthermore, the various interlinked components of a risk model are nearly impossible for a human to take into consideration when making a decision. We therefore look to an optimizer to help us make trade-offs between maintaining conviction and reducing unwanted factor risks.

Theoretical Portfolio Analysis: Optimal Portfolio Weighting

Trading off reduction in active factor risk and asset-level deviation from the initial portfolio holdings is the challenging part of this exercise. Not allowing too much change in asset holdings relative to the initial portfolio may not make a big enough reduction in the amount of active factor risk of the portfolio, but allowing too much change may dramatically alter the ranking of assets in the portfolio and throw us out of whack with the portfolio manager's convictions.

To better understand how the portfolio would perform under different asset-level weightings, a portfolio manager can run a backtest (i.e., historical simulation) where they make slight changes to the original fundamental portfolio and see how ex-ante and ex-post risk and return change. Four variations of an optimal portfolio were run, weighting where they varied the amount the optimized portfolio can deviate from the original fundamental portfolio. The results are summarized below:

Label	Constraint Description
Fund	Fundamental Portfolio as is
5 bp	Optimized Portfolio weights +/-0.05% relative to Original Fundamental Portfolio
25 bp	Optimized Portfolio weights +/-0.25% relative to Original Fundamental Portfolio
50 bp	Optimized Portfolio weights +/-0.50% relative to Original Fundamental Portfolio
No Limit	Optimized Portfolio is not constrained relative to Original Fundamental Portfolio

Exhibit 5: Backtest Return Variations

In this case, the goal is to find an optimal set of portfolio weights that reduce the potential drag from unwanted factor bets by minimizing active factor risk relative to the FTSE All-World Index. Because the fundamental manager has devoted a great deal of research to the names to be held in this portfolio, we will only allow the optimizer to hold names in the original portfolio. Because there is also conviction information in the holdings as the original portfolio is currently weighted, we probably don't want to dramatically change the asset weights (i.e., an asset with a 0.05% active weight probably should not go to a 4% active weight). The "No Limit" case is an extreme case where the optimizer has the freedom to dramatically change the ranking of assets held and drop the holding of any asset even if it is held at a large weight, purely in pursuit of eliminating factor risk.

We then ran these different optimization strategies on a quarterly basis from the start of 2007 to the end of 2015 and compared how the optimized portfolios performed relative to the original fundamental portfolio.

After looking at some high-level details, we can get a better sense in the differences among some of these portfolios. Exhibit 6 shows the number of names held in the portfolio, which is a portfolio characteristic we did not explicitly constrain.

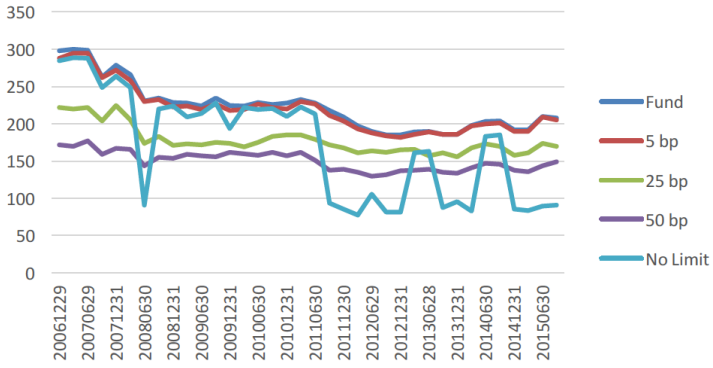

Exhibit 6: Names Held

We see that the number of names held in the "5 bp" portfolio is almost the same as the original fund. As the bounds around the holding of the original fund weights increase, the number of names drops. When a name is dropped, it is only because the holding of that asset in the fund portfolio is less than the specified bounds. For example, when we enforce a limit of +/-25bps change in holdings between the 25bp portfolio and fund portfolio, the only names that are dropped are holdings of 0.25% or less. Such

small holdings likely were low-conviction assets whose risks are relatively large, and we see later that the performance doesn't overly suffer with these assets are dropped from the portfolio. In the "No Limit" case, we see the number of names held can drastically fluctuate as even names held at large positions can be dropped from the portfolio.

Exhibit 7 charts the predicted active risk for all of the backtest variants. We see that as we allow larger changes in weights from the original portfolio, we are able to reduce the amount of active risk we are taking. We see that in the "No Limit" case, sometimes the active risk actually increases, likely because of the sharp reduction in names held. The hope is that lower active risk comes from a reduction in active factor risk – those risks that we are accidently picking up when building the fundamental portfolio.

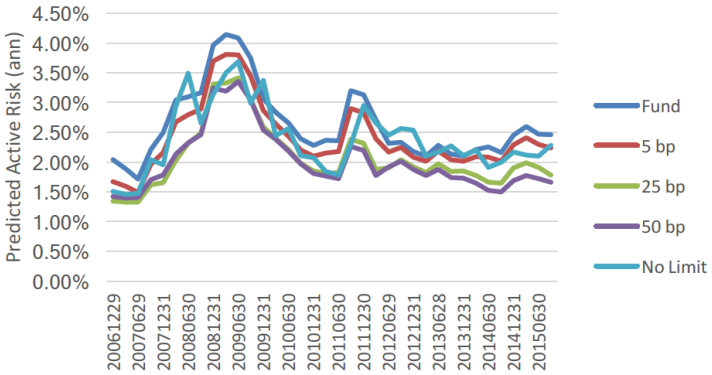

Exhibit 7: Predicted Active Risk

Exhibit 8 summarizes the realized returns and risks of the different backtested strategies, where returns do not include transaction costs or taxes:

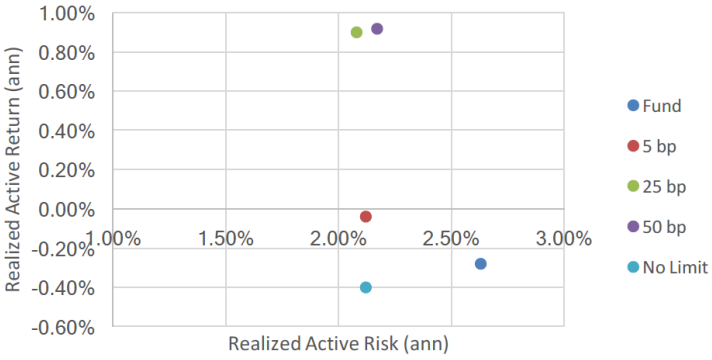

Exhibit 8: Realized Active Frontier: 2007 – 2015

We see that giving the optimizer a mere +/-0.05% room to vary asset weights from the original position size helps us improve active returns and reduce realized active risk. Providing more wiggle room for the optimizer with +/-0.25% and +/-0.50% leads to even more improvements – a large decrease in realized active risk and over 100bp annualized improvement in realized active return! Note that as we open up the bounds too much, as in the "No Limit" case, we drop back down to a negative realized active return, albeit with a smaller amount of realized active risk.

Why do some changes to the portfolio help risk-adjusted performance while other changes hurt it? To answer this question, we can look at the realized factor based performance attribution report. We start by comparing the realized risks and first confirm we are at least reducing the amount of factor risk in the "No Limit" portfolio.

Analytic	Fund	No Limit	Change
Active -	2.63%	2.12%	-0.51%
- Specific -	1.92%	2.03%	0.11%
- Factor -	1.69%	0.39%	-1.30%

Exhibit 9: Annualized Realized Risk Comparison – Performance Attribution Report

We see that the optimizer and risk models are doing their jobs as the realized risk reduction comes almost entirely from the factor block. However, reduced risk at the expense of reduced returns is not acceptable, so we need to identify how the realized returns have changed.

Analytic	Fund	No Limit	Change
Active -	-0.28%	-0.04%	0.24%
- Specific -	0.31%	-0.16%	-0.47%
- Factor -	-0.59%	0.12%	0.71%

Exhibit 10: Annualized Realized Return Comparison – Original Fund Portfolio

In comparing the factor-based performance attribution report of the "No Limit" portfolio to the original fund portfolio, we see that the increase in return comes entirely from harmful factor bets. The portfolio also changes from having a positive specific return contribution to a negative return, which makes sense given how uncorrelated the "No Limit" holdings are relative to the original conviction-weighted fund holdings. Why do we see such a degradation of the realized active specific return?

To dive deeper into this, we look at a period where the fund active return was quite different from the "No Limit" portfolio. On June 29, 2014, in the backtest we see that the "No Limit" portfolio returned -3% less than the fundamental portfolio. In Exhibit 11, Pearson's correlation of the original fund portfolio holdings relative to the holdings of the other strategies, which helps us quantify how similar/dissimilar the fundamental portfolio is to the other portfolio variations.

Fund	5 bp	25 bp	50 bp	No Limit
1.000	0.995	0.894	0.717	0.296

Exhibit 11: Weight Correlation with Fund

Not surprisingly, we see that the less we allow the optimizer to change the holdings from the original portfolio weightings, the more correlated the optimized portfolio is with the original fundamental portfolio. Because the size of the holding is a rough proxy for conviction in a given asset name, keeping the bounds relatively tight to the original portfolio allows us to keep the portfolio manager's conviction in the portfolio. As we allow the

optimizer to re-weight all assets in any direction, their holdings become less correlated with the original portfolio. Ultimately, conviction is diluted and the resulting portfolio is very different from that of what they started with. Assuming the manager's conviction is correct, a loss of conviction results in a loss of realized returns. The goal of the final optimization approach should be to strike a balance between these two competing manager goals: minimize factor risk while respecting conviction Clearly, the diminishing returns are allowing the optimized portfolio to move too far away from the original portfolio, as illustrated best by the low correlation between the holdings of the fund portfolio with the "No Limit" portfolio. This should not be surprising, as we already knew that the stock selection portion of return was positive.

Digging deeper into the realized results, Exhibit 12 shows the differences in turnovers across these cases:

Fund	5 bp	25bp	50 bp	No Limit
32.1%	33.1%	40.4%	49.3%	80.1%

Exhibit 12: Average Quarterly Two-Way Turnover

Although the performance increases for all backtested cases, the higher turnover likely means that we actually could not have realized such high returns on an after-transaction cost basis. It also makes it harder to make a direct comparison of the original fund portfolio relative to the backtested cases and perhaps is the sole reason for outperformance of the backtested portfolios. Accordingly, we focused on the "25 bp" case only and re-ran a new backtest where we constrained the turnover of the "25 bp" case to have the same exact turnover as the original fund portfolio, which we'll refer to as the "25 bp – TO" case.

The results are in Exhibit 13, with only the "Fund," "25 bp," and "25 bp – TO" cases included:

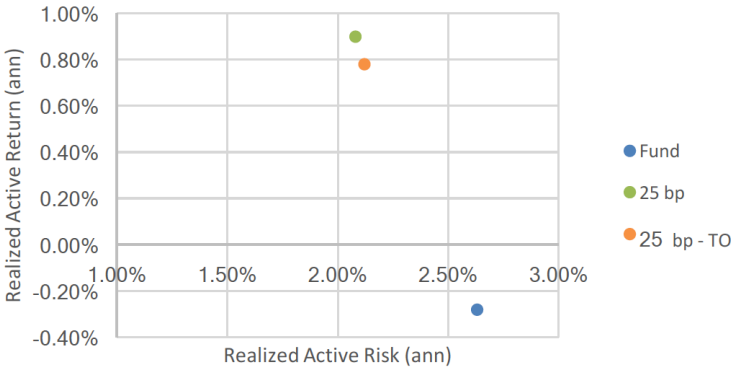

Exhibit 13: Realized Active Frontier: 2007-2015

We see that restricting the turnover of the 25 bp case indeed hurts performance, but not enough to undo the value added by the slight changes to the portfolio.

Now that we've built a portfolio with the same exact amount of quarterly turnover as the fundamental portfolio, we can remove this as a possible source of (unrealizable) outperformance from the backtested results. We will now dig deeper into the reasons behind the increase in performance of the "25 bp – TO" portfolio, relative to the original fund portfolio. To answer this, let's dive into the "25 bp – TO" case in more detail on a predicted risk and perspective on the realized risk and return.

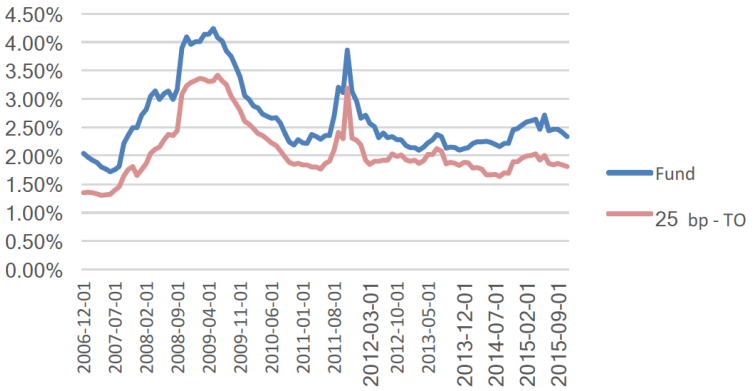

Exhibit 14: Predicted Active Risk

We see that pushing the fundamental portfolio away from unintended factor risks decreases the predicted active risk of the portfolio. The decrease in active risk is potentially a mixed blessing; many times managers are paid to take large amounts of active risk so the reduction in active risk may not be ideal. But on the other hand, taking on extra risk that is unintended simply to increase predicted tracking error is a superfluous activity that will likely only decrease IR.

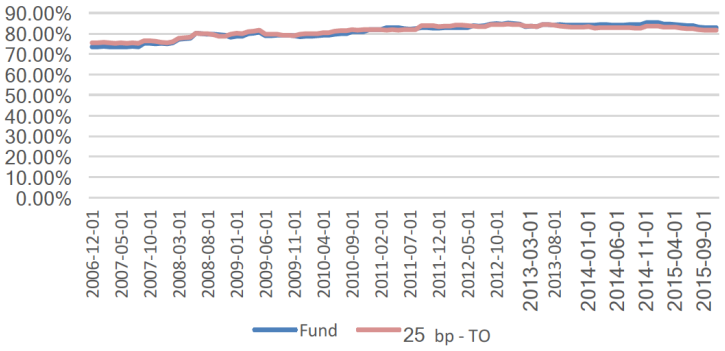

Exhibit 15: Active Share

Active share is the sum of the absolute values of the active bets in the portfolio. When the portfolio holdings are exactly equal to the benchmark holdings, the active share is equal to zero. Because we limit the investible universe to only the assets held by the original portfolio, we see that the active share of the 25bp portfolio is similar on average to the original portfolio. So although the manager's predicted active risk has decreased, they are still taking quite large active positions – just in a more risk-efficient manner.

We've seen that the predicted active risk of the "25 bp – TO" portfolio has decreased, but where is that decrease coming from? In the next Exhibits are charts that decompose the amount of predicted active risk across factor and specific risks for the fund portfolio and "25 bp – TO" portfolio, respectively.

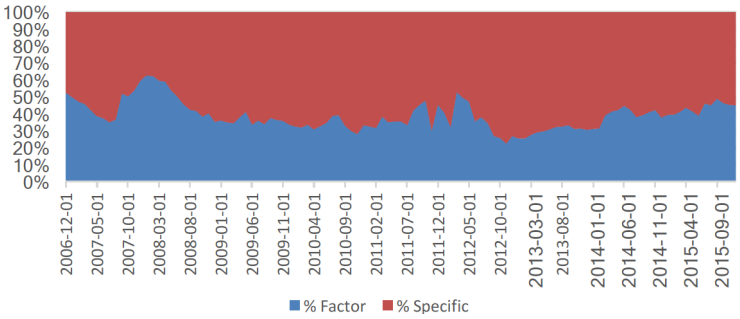

Exhibit 16: Fund: % of Active Risk

We see that the portfolio manager's original fundamental portfolio has 40% - 60% of its active risk coming from factors. We compare this to the amount of predicted active risk across factor and specific risks for the "25 bp – TO" optimized portfolio:

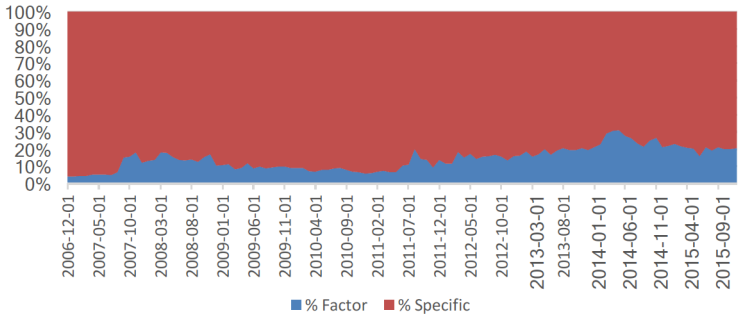

Exhibit 17: 25 bp – TO: % of Active Risk

By reducing the portfolio's unwanted factor bets, we were able to load up more on specific risk – the type of risk that should lead to the returns a stock picker would expect to deliver. Although it reduces factor risks, the +/- 25 bp constraint doesn't completely remove these risks because we still want to maintain the conviction in the assets held in the original portfolio.

We see in Exhibit 17 that the "25 bp – TO" portfolio has much less predicted factor risk than the original fund portfolio, and we've already seen that this portfolio has improved return and risk characteristics. In Exhibit 18 are the factor-based performance attribution results through the lens of Axioma's WW4 factor risk model, which helps us understand where the differences in returns and risks are coming from, starting with the returns:

Analytic	Fund	25 bp - TO	Change
Active -	-0.28%	0.76%	1.04%
- Specific -	0.31%	0.62%	0.31%
- Factor	-0.59%	0.14%	0.73%
- Style	-1.36%	-0.43%	0.93%
- Country	0.11%	0.09%	-0.02%
- Industry	0.29%	0.33%	0.04%
- Currency	0.39%	0.17%	-0.22%

Exhibit 18: Annualized Realized Returns Comparison: Performance Attribution Results

The color scaling helps us quickly identify the sources of the biggest changes in realized returns. We first verify that the "25 bp – TO" portfolio has a much higher realized annualized return – more than 100 basis points higher — with most of the improvement coming from the Style factors. We also see double the amount of stock-specific return from the "25 bp – TO" portfolio as compared with the original fund portfolio. This helps the manager realize more valuable stock-specific "alpha" and better justify the management fees charged. *Overall, the main drivers of improvement in the realized return of the backtested portfolio is an increase in returns from sources consistent with the investment process and a decrease in the drag associated with unwanted factor bets.*

We now look to compare the realized risks of the fund versus the "25 bp – TO" portfolios through the lens of a factor-based performance attribution report using Axioma's WW4 factor risk model:

Analytic	Fund	25 bp - TO	Change
Active -	2.63%	2.12%	-0.51%
- Specific -	1.92%	1.87%	-0.05%
- Factor -	1.69%	0.94%	-0.75%
- Axioma Style	1.21%	0.51%	-0.70%
- Country	0.88%	0.50%	-0.38%
- Industry	0.92%	0.55%	-0.37%
- Currency	0.87%	0.57%	-0.30%

Exhibit 19: Annualized Realized Risk Comparison: 25 bp – TO

In this case, we see the optimization was able to reduce the portfolio's realized active risk by 51 bps annually, with the biggest reduction coming from the factor blocks. We see that the amount of realized specific risk decreased the least of all line items – which is good given these stock-specific risks are the ones the manager wants to take. Overall, all the components of realized risk decrease when they allow the optimizer to make minor suggestions to the original portfolio. This helps managers implement a more efficient portfolio that takes risks in the areas consistent with their investment process.

The increase in realized returns and decrease in realized risks leads to higher IRs across the high-level portfolio, the specific bets, and the factor bets. The higher IR means higher rewards on a risk-adjusted basis from the optimized portfolio, as compared with the fundamentally constructed portfolio.

Analytic	Fund	25 bp - TO	Change
Active	-0.11	0.37	0.48
Specific	0.16	0.36	0.20
Factor	-0.35	0.12	0.47
Axioma Style	-1.12	-1.06	0.06
Country	0.12	0.18	0.06
Industry	0.31	0.76	0.45
Currency	0.39	0.25	-0.14

Exhibit 20: Annualized Information Ratio (IR) Comparison: 25 bp - TO

Conclusion

All investment managers are under pressure to both outperform their benchmarks and prove they are worth the management fees they charge their clients. Axioma's risk models and optimizer are valuable tools that can help fundamental investment managers understand their portfolio risks from a different perspective, make better decisions when sizing assets in a portfolio, while still implementing portfolios consistent with their stated investment process.

Risk models can help managers better understand the ex-ante risks that are embedded in their portfolios, confirm that the risks being taken are in line with their mandate and avoid taking risk where they have no expectation of return. An ex-post factor-based performance attribution report can help managers quantify the risks that led to realized returns to help prove to their clients, prospects, consultants, and internal research teams the value they added during the investment process. When the portfolio risks don't match up with the manager's investment mandate, an optimizer can be used in conjunction with a factor risk model to make slight changes to the fundamentally constructed portfolio to help simultaneously maintain the manager's high conviction in the portfolio, while also minimizing undesired risks.

In the case study, we took a simple real-world portfolio and made some basic assumptions without knowing anything about the fundamental managers besides the fact that they are bottom-up stock-pickers. In real life, fundamental managers can add even more value by adding additional proprietary information into the optimization to help keep their portfolios even more in line with their investment processes. For example, they can force the optimizer to buy a minimum number of all assets on the "buy list," incorporate conviction ratings to make sure the optimizer does not downweight their high- conviction assets, and/or make sure they use the turnover/transaction cost budget as efficiently as possible. Overall, using quantitative tools to incorporate this relatively simple analysis can help a manager focus on generating alpha.

Endnotes

1. Holdings were gathered from the eVestment database.

Author Bio

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Axioma

Chris Martin has worked at Axioma for more than 10 years in a variety of positions. Internally, he works closely with all members of the Axioma team, including: Product, Research, Content, Sales, and Support. This range of experience allows Chris to support the needs of Axioma's clients, whether it be training new users or helping existing users get the most out of Axioma's Risk Models, Optimizer, and Analytics software. Chris received his Masters in Financial Engineering, a joint degree from the Drucker School of Management and Mathematical Sciences at Claremont Graduate University. He received his bachelor's degree in General Engineering with a concentration in Aeronautical and Mechanical Engineering and a Minor in Physics from California Polytechnic State University, San Luis Obispo. Chris is a certified Engineer-in-Training in California and is a CAIA and CIPM charterholder.

Volatility and the Alchemy of Risk

Reflexivity in the Shadows of Black Monday 1987

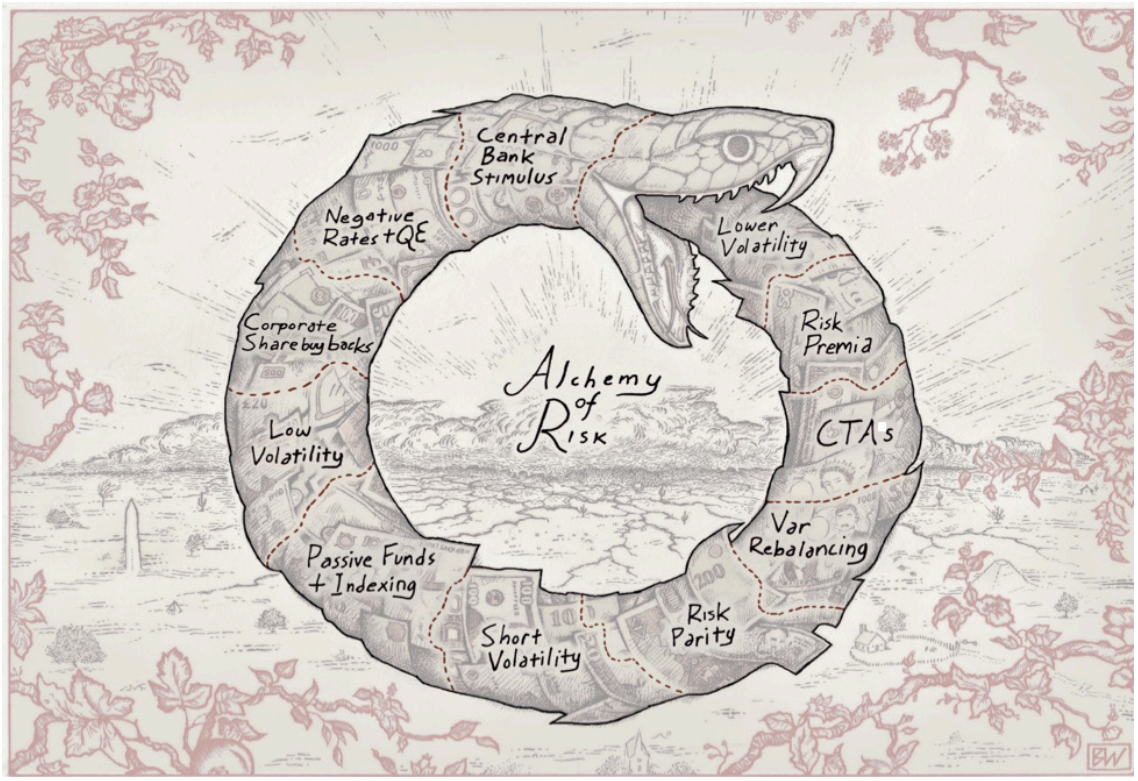
Christopher Cole
Artemis Capital Managment

The Ouroboros, a Greek word meaning 'tail devourer', is the ancient symbol of a snake consuming its own body in perfect symmetry. The imagery of the Ouroboros evokes the infinite nature of creation from destruction. The sign appears across cultures and is an important icon in the esoteric tradition of Alchemy. Egyptian mystics first derived the symbol from a real phenomenon in nature. In extreme heat a snake, unable to self-regulate its body temperature, will experience an out-of-control spike in its metabolism. In a state of mania, the snake is unable to differentiate its own tail from its prey, and will attack itself, self-cannibalizing until it perishes. In nature and markets, when randomness self-organizes into too perfect symmetry, order becomes the source of chaos.[1]

The Ouroboros is a metaphor for the financial alchemy driving the modern Bear Market in Fear. Volatility across asset classes is at multi-generational lows. A dangerous feedback loop now exists between ultra-low interest rates, debt expansion, asset volatility, and financial engineering that allocates risk based on that volatility. In this self-reflexive loop volatility can reinforce itself both lower and higher. In a market where stocks and bonds are both overvalued, financial alchemy is the only way to feed our global hunger for yield, until it kills the very system it is nourishing.

The Global Short Volatility trade now represents an estimated $2+ trillion in financial engineering strategies that simultaneously exert influence over, and are influenced by, stock market volatility.[2] We broadly define the short volatility trade as any financial strategy that relies on the assumption of market stability to generate returns, while using volatility itself as an input for risk taking. Many popular institutional investment strategies, even if they are not explicitly shorting derivatives, generate excess returns from the same implicit risk factors as a portfolio of short optionality, and contain hidden fragility.

The Great Snake of Risk



Volatility is now an input for risk taking and the source of excess returns in the absence of value. Lower volatility is feeding into even lower volatility, in a self-perpetuating cycle, pushing variance to the zero bound. To the uninitiated this appears to be a magical formula to transmute ether into gold…volatility into riches… however financial alchemy is deceptive. Like a snake blind to the fact it is devouring its own body, the same factors that appear stabilizing can reverse into chaos. The danger is that the multi-trillion-dollar short volatility trade, in all its forms, will contribute to a violent feedback loop of higher volatility resulting in a hyper-crash. At that point the snake will die and there is no theoretical limit to how high volatility could go.

Thirty years ago to the day we experienced that moment. On October 19th, 1987 markets around the world crashed at record speed, including a -20% loss in the S&P 500 Index, and a spike to over 150% in volatility. Many forget that Black Monday occurred during a booming stock market, economic expansion, and rising interest rates. In retrospect, we blame portfolio insurance for creating a feedback loop that amplified losses. In this paper we will argue that rising inflation was the spark that ignited 1987 fire, while computer trading served as explosive nitroglycerin that amplified a normal fire into a cataclysmic conflagration. The multi-trillion-dollar short volatility trade, broadly defined in all its forms, can play a similar role today if inflation forces central banks to raise rates into any financial stress. Black Monday was the first modern crash driven by machine feedback loops, and it will not be the last.

A reflexivity demon is now stalking modern markets in the shadows of a false peace… and could emerge violently given a rise in interest rates. Non-linearity and feedback loops are difficult for the human mind to conceptualize and price. The markets are not correctly assessing the probability that volatility reaches new all-time lows in the short term (VIX<9), and new all-time highs in the long-term (VIX>80). Risk alone does not define consequences. A person can engage in highly risky behavior and survive, and alternatively a low risk activity can result in horrible outcomes. Those who defend and profit from the short volatility trade in its various forms ignore this fact. Do not mistake outcomes for control…remember, there is no such thing as control… there are only probabilities.[3]

The Great Snake of Risk

A short volatility risk derives small incremental gains on the assumption of stability in exchange for a substantial loss in the event of change. When volatility itself serves as a proxy to size this risk, stability reinforces itself until it becomes a source of instability. The investment ecosystem has effectively self-organized into one giant short volatility trade, a snake eating its own tail, nourishing itself from its own destruction. It may only take a rapid and unexpected increase in rates, or geopolitical shock, for the cycle to unwind violently. It is unwise to assume that central banks will be able to respond to future financial stress with more stimulus if inflation is rising.

At the head of the Great Snake of Risk is unprecedented monetary policy. Since 2009 Global Central Banks have pumped in $15 trillion in stimulus creating an imbalance in the investment demand for and supply of quality assets.[4] Long term government bond yields are now the lowest levels in the history of human civilization dating back to 1285.[5] As of this summer there was $9.5 trillion worth of negative yielding debt globally. In September 2017 Austria issued a 100-year bond with a coupon of only 2.1%[6] that will lose close to half its value if interest rates rise 1% or more. The global demand for yield is now unmatched in human history. None of this makes sense outside a framework of financial repression.

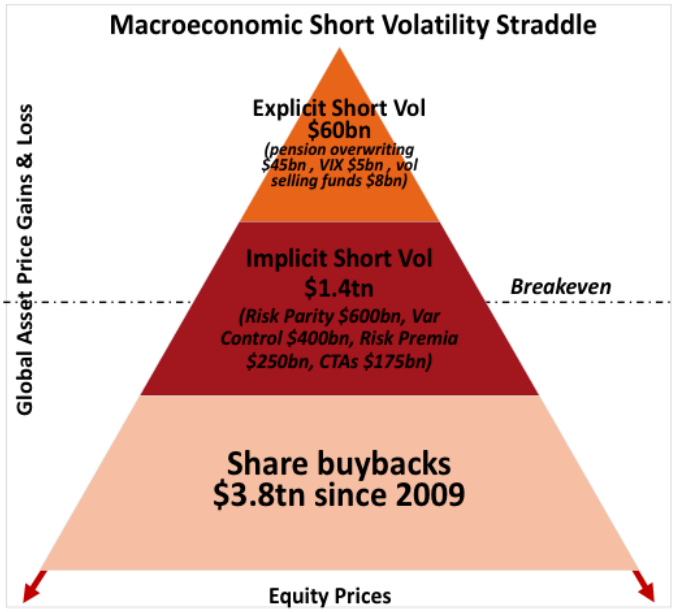


Exhibit 1

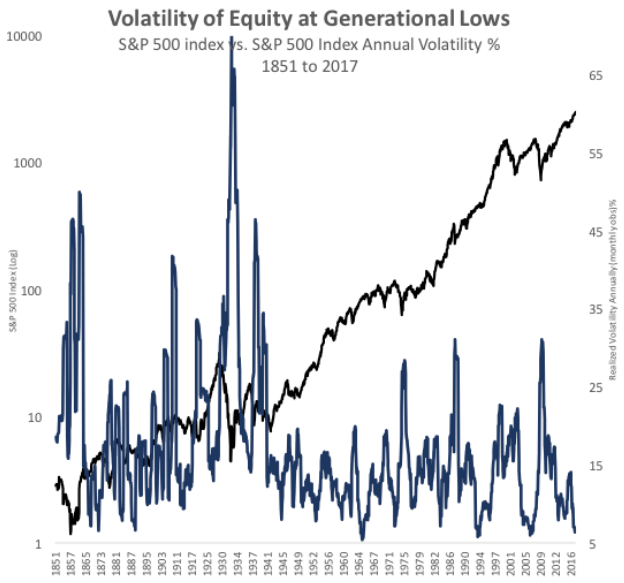


Exhibit 2

Amid this mania for investment, the stock market has begun self-cannibalizing…literally. Since 2009, US companies have spent a record $3.8 trillion on share buy-backs[7] financed by historic levels of debt issuance. Share buybacks are a form of financial alchemy that uses balance sheet leverage to reduce liquidity generating the illusion of growth. A shocking +40% of the earning-per-share growth and +30% of the stock market gains since 2009 are from share buy-backs. Absent this financial engineering we would already be in an earnings recession. Any strategy that systematically buys declines in markets is mathematically shorting volatility. To this effect, the trillions of dollars spent on share buybacks are equivalent to a giant short volatility position that enhances mean reversion. Every decline in markets is aggressively bought by the market itself, further lowing volatility. Stock price valuations are now at levels which in the past have preceded depressions including 1928, 1999, and 2007. The role of active investors is to find value, but when all asset classes are overvalued, the only way to survive is by using financial engineering to short volatility in some form.

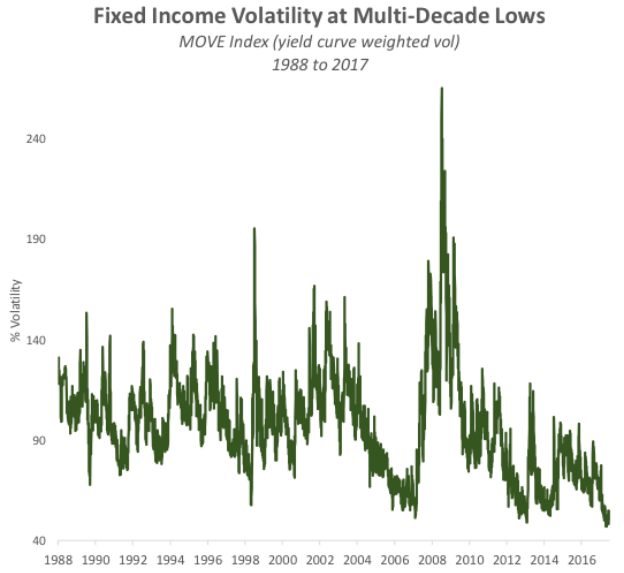


Exhibit 3

Volatility as an asset class, both explicitly and implicitly, has been commoditized via financial engineering as an alternative form of yield. Most people think volatility is just about options, however many investment strategies create the profile of a short option via financial engineering. A long dated short option position receives an upfront yield for exposure to being short volatility, gamma, interest rates, and correlations. Many popular institutional investment strategies bear many, if not all of these risks even if they are not explicitly shorting options. The short volatility trade, broadly defined in all its forms, includes up to $60 billion in strategies that are Explicitly short volatility[2efg] by directly selling optionality, and a much larger $1.42 trillion of strategies that are Implicitly short volatility[2abcd] by replicating the exposures of a portfolio that is short optionality. Lower volatility begets lower volatility, rewarding strategies that systematically bet on market stability so they can make even bigger bets on that stability. Investors assume increasingly higher levels of risk betting on the status quo for yields that look attractive only in comparison to bad alternatives. The active investor that does his or her job by hedging risks underperforms the market. Responsible investors are driven out of business by reckless actors. In effect, the entire market converges to what professional option traders call a 'naked short straddle'… a structure dangerously exposed to fragility.

Volatility is now at multi-generational lows. Volatility is now the only undervalued asset class in the world. Equity and fixed income volatility are now at the lowest levels in financial history. The realized volatility of the S&P 500 Index collapsed to all-time lows in October 2017. The VIX index also touched new lows around the same time. Fixed income implied volatility fell to the lowest level in its 30-year history this past summer. The forward variance swap on the S&P 500 index is now priced lower than the long-term average volatility of the market. In theory, volatility has nowhere to go but up, but lacks a catalyst given the easy credit conditions, low rates, and excess supply of investment capital.

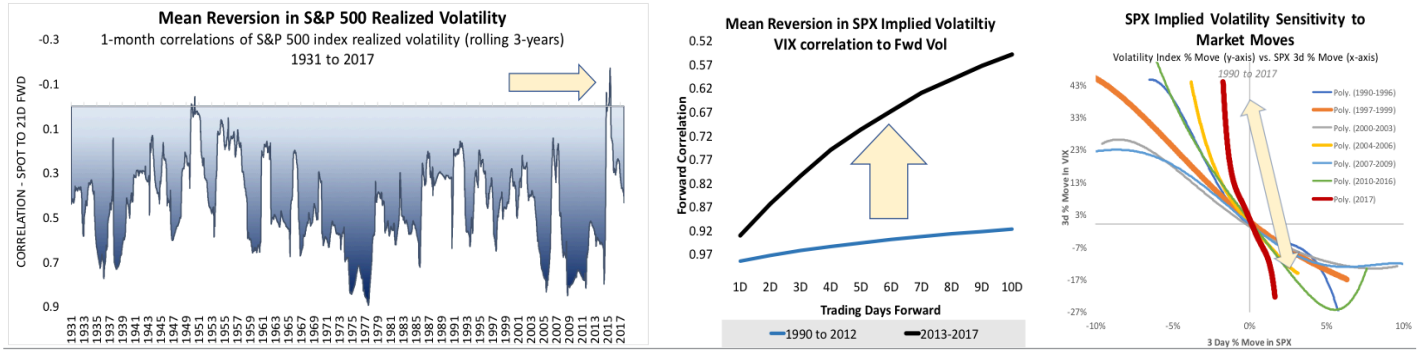


Exhibit 4

Whenever volatility reaches a new low the financial media runs the same clichéd story over and over with the following narrative 1) Volatility is low; 2) Investors are complacent; 3) Insert manager quote saying "this is the calm before the storm".[8] Low volatility does not predict higher volatility over shorter periods, in fact empirically the opposite has been true. Volatility tends to cluster in high and low regimes.

Volatility isn't broken, the market is. The real story of this market is not the level of volatility, but rather its highly unusual behavior. Volatility, both implied and realized, is mean reverting at the greatest level in the history of equity markets. Any short-term jump in volatility mean-reverts lower at unusual speed, as evidenced by volatility collapses after the June 2016 Brexit vote and November 2016 Trump US election victory. Volatility clustering month-to-month reached 90-year lows in the three years ending in 2015. Implied volatility has also been usually reactive to the upside and downside. In 2017, the VIX index has been 3-4x more sensitive to movements in the market compared to the similar low-volatility regime of the mid-2000s and the mid-1990s (see red line in Exhibit 4).

What is causing this bizarre behavior? To find the truth we must challenge our perception of the problem. What we think we know about volatility is all wrong. Modern portfolio theory conceives volatility as an external measurement of the intrinsic risk of an asset. This highly flawed concept, widely taught in MBA and financial engineering programs, perceives volatility as an exogenous measurement of risk, ignoring its role as both a source of excess returns, and a direct influencer on risk itself. To this extent, portfolio theory evaluates volatility the same way a sports commentator sees hits, strikeouts, or shots on goal. Namely, a statistic measuring the past outcomes of a game to keep score, but existing externally from the game. The problem is volatility isn't just keeping score, but is massively affecting the outcome of the game itself in real time. Volatility is now a player on the field. This critical mis-understanding of the role of volatility modern markets is a source of great self-reflexive risk.

Today trillions of dollars in central bank stimulus, share buybacks, and systematic strategies are based on market volatility as a key decision metric for leverage. Central banks are now actively using volatility as an input for their decisions, and market algorithms are then self-organizing around the expectation of that input. The majority of active management strategies rely on some form of volatility for excess returns and to make leverage decisions. When volatility is no longer a measurement of risk, but rather the key input for risk taking, we enter a self-reflexive feedback loop. Low volatility reinforces lower volatility, but any shock to the system will cause high volatility to reinforce higher volatility.

Self-Canibalization of the Market via Share buybacks

The stock market is consuming itself…literally. Since 2009, US companies have spent over $3.8 trillion on what is effectively one giant leveraged short volatility position. Share buybacks in the current market have already surpassed previous highs reached before the 2008. Rather than investing to increase earnings, managers simply issue debt at low rates to reduce the shares outstanding, artificially boosting earnings-per-share by increasing balance sheet risk, thereby increasing stock prices. In 2015 and 2016 companies spent more than their entire annual operating earnings on share buybacks and dividends. Artemis isolated the impact of the share buyback phenomenon on earnings, asset prices, and valuations since 2009 and the numbers are staggering.

The later stages of the 2009-2017 bull market are a valuation illusion built on share buyback alchemy. Absent this accounting trick the S&P 500 index would already be in an earnings recession. Share buybacks have accounted for +40% of the total earning-per-share growth since 2009, and an astounding +72% of the earnings growth since 2012. Without share buybacks earnings-per-share would have grown just +7% since 2012, compared to +24%. Since 2009, an estimated +30% of the stock market gains are attributable to share buybacks. Without share buybacks the S&P 500 index would currently trade at an expensive 27x earnings. Not surprisingly, a recent study found

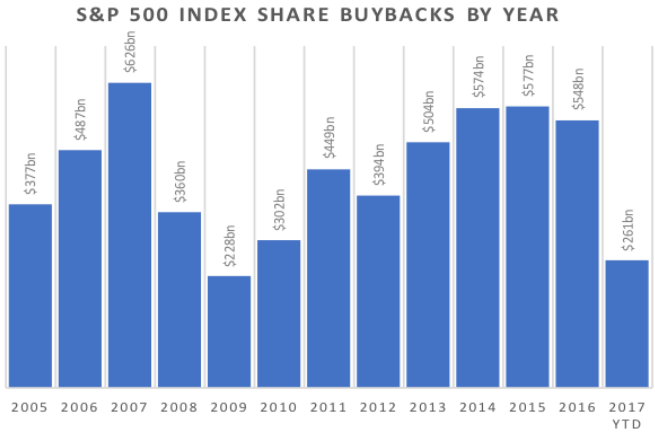


Exhibit 5

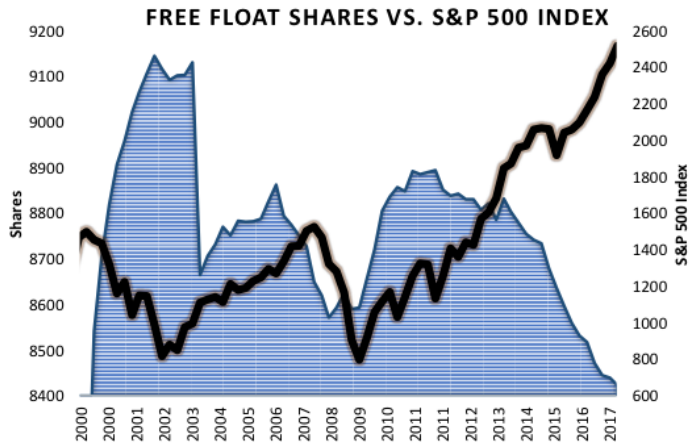
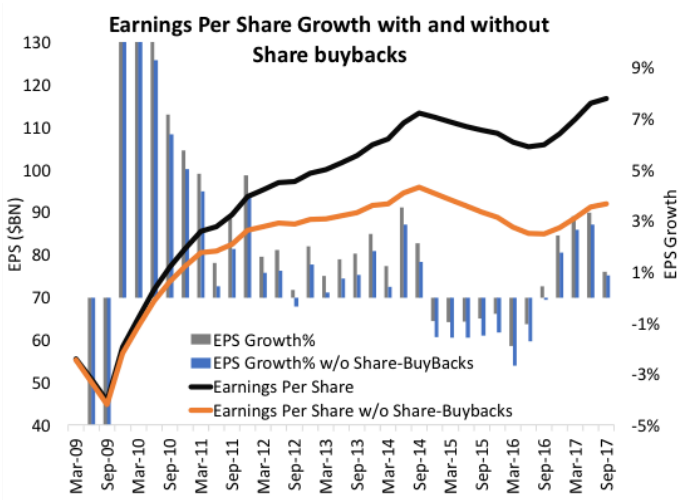


Exhibit 6

Source: Artemis Capital Management, Bloomberg



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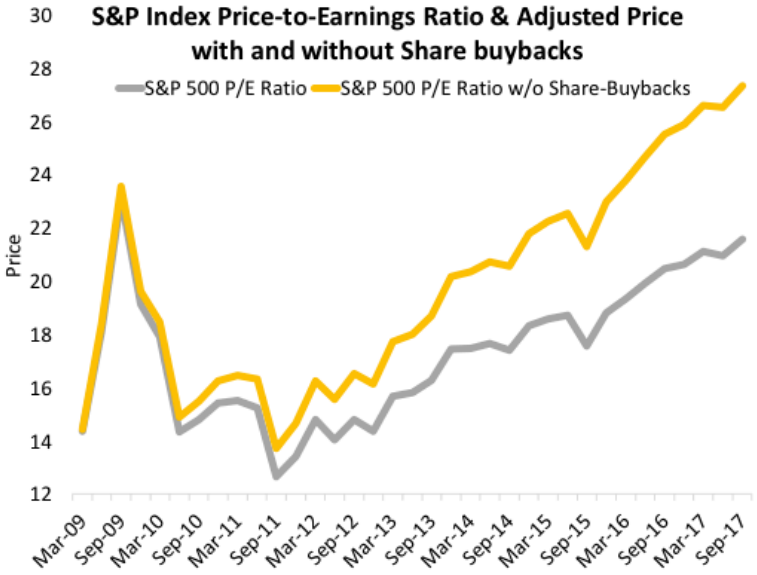


Exhibit 8

a positive relationship between insider equity sales and share repurchases, supporting the idea that buybacks are more about managerial self-interest than shareholder value.[9]

Share buybacks financed by debt issuance are a valuation magic trick. The technique optically reduces the price-to-earnings multiple (Market Value per Share/Earnings per Share) because the denominator doesn't adjust for the reduced share count. The buyback phenomenon explains why the stock market can look fairly valued by the popular price-to-earnings ratio, while appearing dramatically overvalued by other metrics. Valuation metrics less manipulated by share buybacks (EV/EBITDA, P/S, P/B, Cyclically Adjusted P/E) are at highs achieved before market crashes in 1928, 2000, and 2007. Buybacks also remove liquidity. Free float shares and trading volume in the S&P 500 index have collapsed to levels last seen in the late-1990s, despite stock prices more than doubling.

Share buybacks are a major contributor to the low volatility regime because a large price insensitive buyer is always ready to purchase the market on weakness. The key periods are the two to three weeks during and after earnings announcements, when the SEC mandated share buyback blackout period officially ends. The largest equity drawdowns of the past few years (August 2015 and January-Feb 2016) both occurred during the share buyback blackout period. Both times the market rallied to make back all losses when the buyback restriction period expired. The S&P 500 index demonstrates an unusual multi-modal probability distribution during years with high buyback activity. The market flips between a positively or negatively skewed return distribution based on whether the regulatory share repurchase blackout period is in effect. In addition, 6 of the top 10 multi-day VIX declines in history, all 4+ sigma events, have occurred during heavy share buyback periods between 2015 and 2016. Share buybacks result in lower volatility, lower liquidity, which in turn incentivizes more share buybacks, further incentivizing passive and systematic strategies that are short volatility in all their forms.

Like a snake eating its own tail, the market cannot rely on share buybacks indefinitely to nourish the illusion of growth. Rising corporate debt levels and higher interest rates are a catalyst for slowing down the $500-800 billion in annual share buybacks artificially supporting markets and suppressing volatility.[2j]

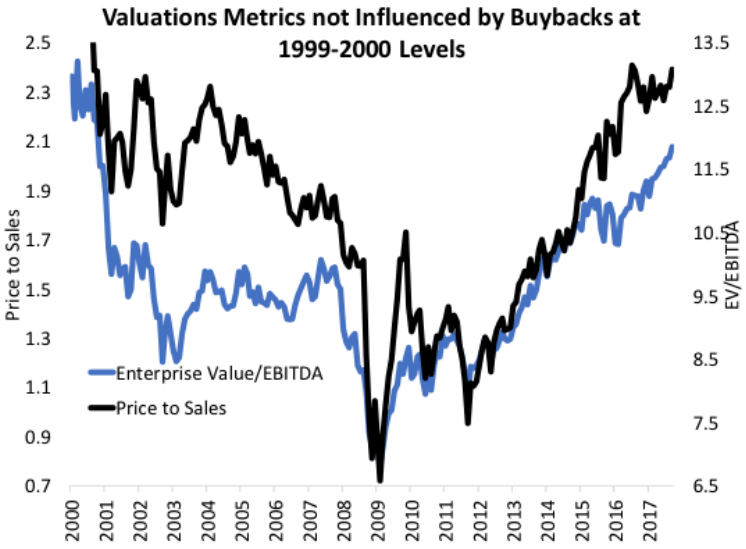


Exhibit 9

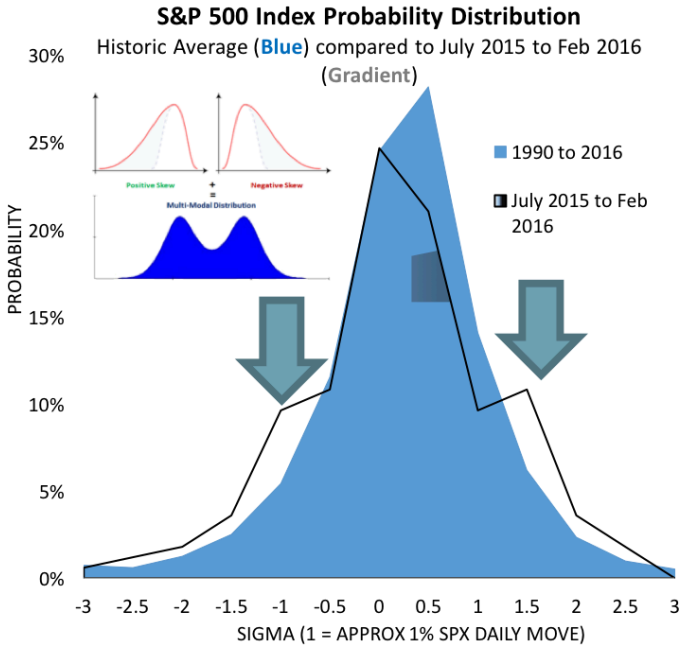


Exhibit 10

Source: Artemis Capital Management LP, Bloomberg

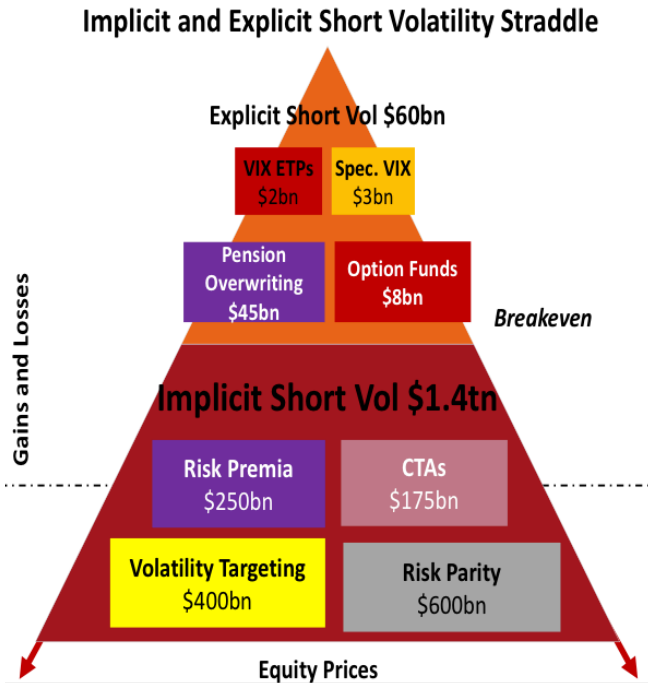
Global Short Volatility Trade

The short volatility trade is any strategy that derives small incremental gains on the assumption of stability in exchange for substantial loss in the event of change, whereby volatility is a critical input to the allocation of risk. Short volatility can be executed explicitly with options, or implicitly via financial engineering. To understand this concept, it is helpful to decompose the key risks. The investor holding a portfolio of hedged short options receives an upfront premium, or yield, in exchange for a non-linear risk profile to four key exposures 1) Rising Volatility; 2) Gamma or Jump Risk; 3) Rising Interest Rates; 4) Unstable Cross-Asset Correlations. Many institutional strategies derive excess returns by implicitly shorting those exact same risk factors despite never trading an option or VIX future. As of 2017, there is an estimated $1.18 to 1.48 trillion dollars[2]

of active short volatility exposure indomestic equity markets. In this paper we will focus on short volatility in US equity markets, however the short volatility trade, in all its forms, is widely practiced across all major asset classes. In world of ultra-low interest rates shorting volatility has become an alternative to fixed income. For the first time in history the yield earned on an explicit short volatility position is competitive with a wide array of sovereign and corporate debt (See Exhibit 12).

Explicit Short Volatility are strategies that literally sell options to generate yield from asset price stability or falling stock market variance. The category includes everything from popular short volatility exchange-traded-products to call and put writing programs employed by pension funds. Despite the headlines, this is the smallest portion of the short volatility trade. Explicit short volatility contains upward of only $60 billion in assets, including $45 billion in short volatility pension put and call writing strategies,[2g] $8 billion in short volatility overwriting funds,[2f] $2 billion in short volatility exchange traded products,[2e] and another $3 billion in speculative VIX shorts.[2e] Explicit short volatility strategies are active in the short term, fading short and intermediate volatility spikes. Volatility spikes that mean revert quickly help the performance of these strategies (August 2015). Explicit short volatility is most harmed by an extended period of high volatility that fails to mean revert, such as in 1928 or 2008, or a super-normal volatility spikes such as the Black Monday 1987 crash.

Implicit Short Volatility are strategies that, although not directly selling options, use financial engineering to generate excess returns by exposure to the same risk factors as a short option portfolio. Many investors, and even practitioners, are ignorant or in denial that they are holding a synthetic short option in their portfolio. In current markets, there is an estimated $1.12 to $1.42 trillion in implicit short volatility exposure, including between $400 billion in volatility control funds,[2b] $400 to $600



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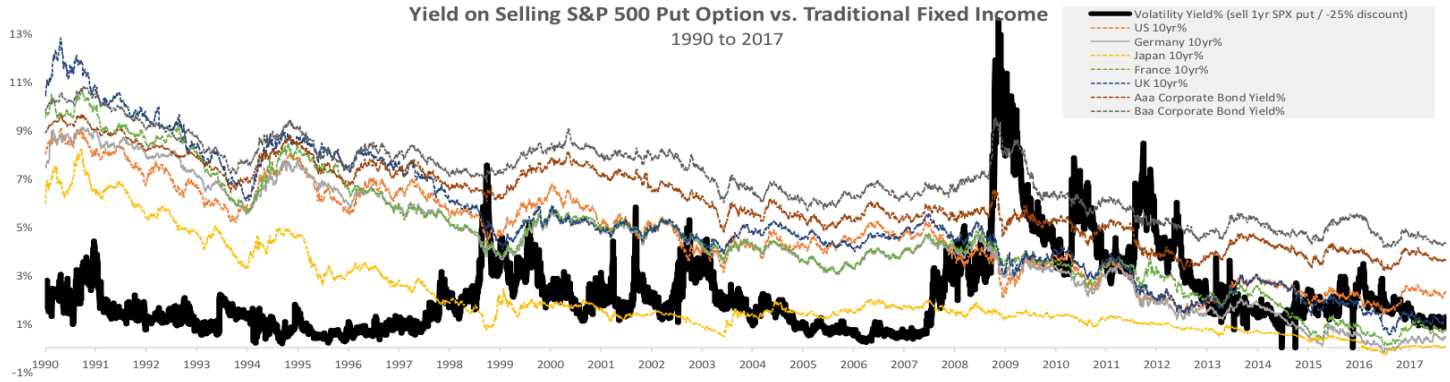


Exhibit 12
Source: Artemis Capital Management LP, Bloomberg

billion in risk parity,[2a] $70-175 billion from long equity trend following strategies,[2c] and $250 billion in risk premia strategies.[2d] These strategies are similar to a short option position because they produce efficient gains most of the time, but are subject to non-linear losses based on variance, gamma, rates, or correlation change. The strategies tend to have longer time horizons for rebalancing than explicit short volatility. In practice, exposure to equities is reduced based on the accumulation of variance over one to three months.

The next few pages will focus on some of the hidden risks in the short volatility trade, both explicitly and implicitly.

Gamma Risk

Imagine you are balancing a tall ruler vertically on your palm. As the ruler tilts in any one direction, you must to overcompensate in the same direction to keep to the ruler balanced. This is conceptually very similar to a trader hedging an option with high gamma risk. The trader must incrementally sell (or buy) more of the underlying at a non-linear pace to re-hedge price fluctuations.

A short gamma risk profile is not unique to option selling, and is a hidden component of many institutional asset management products. The portfolio insurance strategy credited with causing the 1987 Black Monday Crash is a classic example of a short gamma profile gone awry. When large numbers of market participants are short gamma, implicitly or explicitly, the effect can reinforce price direction into periods of high turbulence. Risk parity, volatility targeting funds, and long equity trend following funds are all forced to de-leverage non-linearly into periods of rising volatility, hence they have synthetic gamma risk. At current risk levels, we estimate as much as $600 billion in selling pressure would emerge from implicit short gamma exposure if the market declined just -10% with higher vol.[10] Many of these strategies rely on accumulation of one to three month realized variance to trigger that de-leveraging process. Hence the short gamma buying and selling pressure operates on a time lag to the market. During the drawdowns in the fall of 2015 and early-2016, share buybacks helped the market rebound quickly minimizing the effect of 'short-gamma" de-leveraging. This further emboldened explicit short volatility traders to continue to fade any volatility spikes. If the first leg of a crisis is strong enough to sustain a market loss beyond -10%, short-gamma de-leveraging will likely kick-start a second leg down, causing cascading losses for anyone that buys the dip.

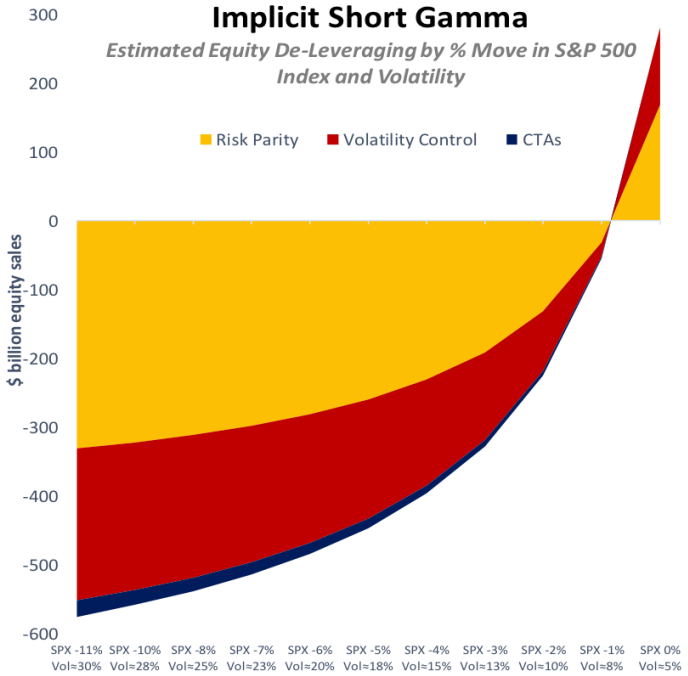


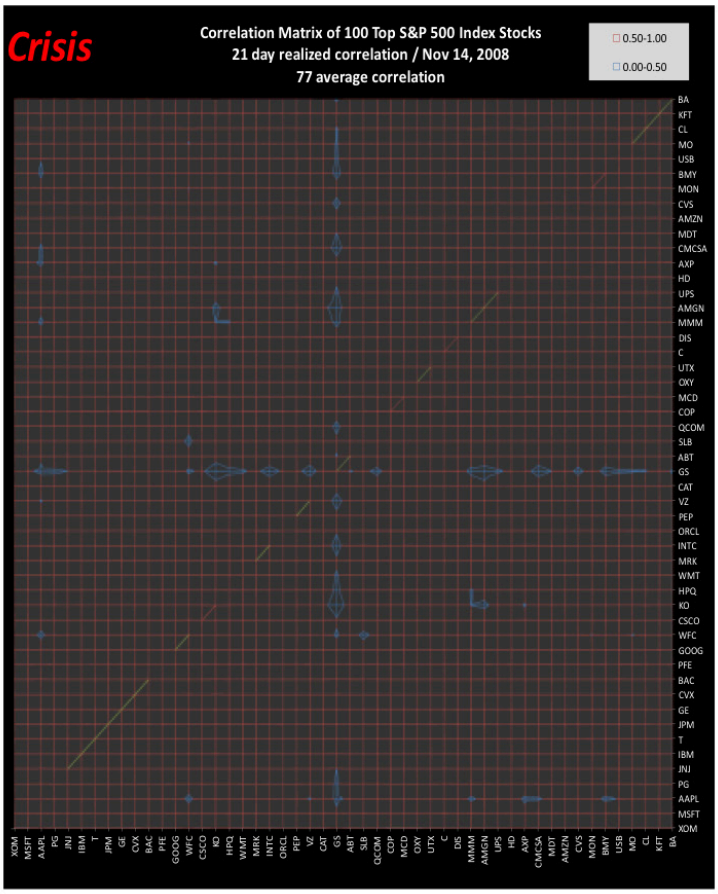
Exhibit 13
Source: Artemis Capital Management LP, Bloomberg

Correlation and Interest Rate Risk

The concept of diversification is the foundation of modern portfolio theory. Like a wizard, the financial engineer is somehow able to magically reduce the risk of a portfolio by combining anti-correlated assets. The theory failed spectacularly in the 2008 crash when correlations converged. You can never destroy risk, only transmute it. All modern portfolio theory does is transfer price risk into hidden short correlation risk. There is nothing wrong with that, except for the fact it is not what many investors were told, or signed up for.

Correlation risk can be isolated and actively traded via options as source of excess returns. Volatility traders on a dispersion desk will explicitly short correlations by selling the variance of an index and going long the weighted variance of its constituents. When correlations are stable or decreasing, the strategy is very effective, but when correlations behave erratically large losses will occur. The graph in Exhibit 14 (on the next page) shows the collapse of correlations between normal and stressed markets.

Many popular institutional investment strategies derive excess returns via implicit leveraged short correlation trades with hidden



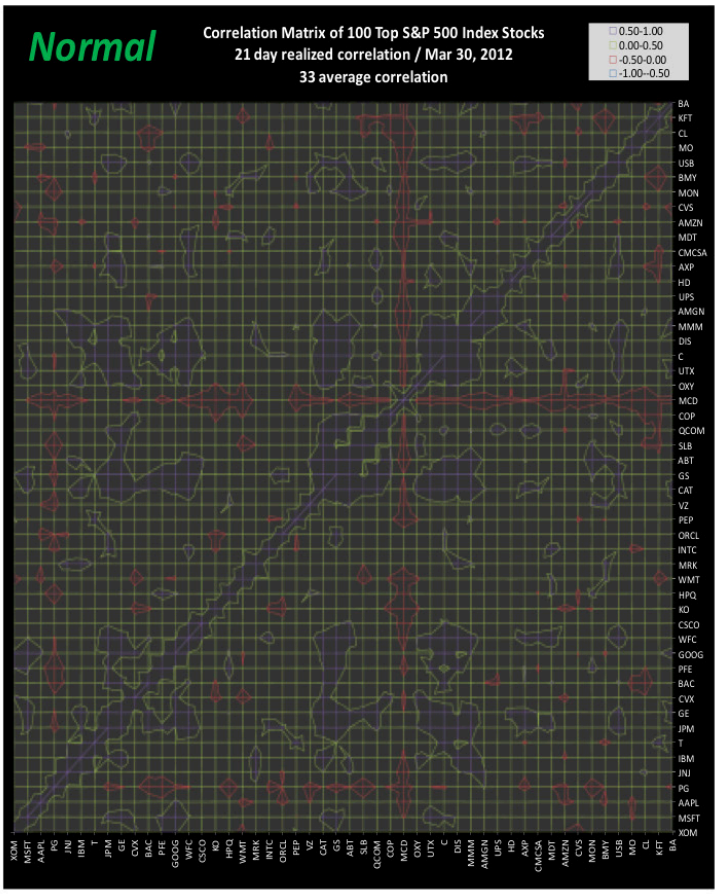


Exhibit 14

fragility. Risk parity is a popular institutional investment strategy with close to half a trillion dollars in exposure.[2a] The strategy allocates risk and leverage based on variance assuming stable correlations. To a volatility trader, risk parity looks like one big dispersion trading desk. The risk parity strategy, decomposed, is actually a portfolio of leveraged short correlation trades (alpha) layered on top of linear price exposure to the underlying assets (beta). The most important correlation relationship is between stocks and bonds. A levered short correlation trade between stocks and bonds has performed exceptionally well over the last two decades including in the last financial crisis. From 2008 to 2009 gains on bonds offset losses in the stock market as yields fell. To achieve a similar benefit in a crisis today, the 10-year Treasury Note would need to collapse to from 2.32% to -0.91%. This is not impossible, but historically there is a much higher probability that bonds and stocks rise or fall together when rates are this low.

The truth about the historical relationship between stocks and bonds over 100+ years is illuminating (please see our 2015 paper "Volatility and the Allegory of the Prisoner's Dilemma" for more detail). Between 1883 and 2015 stocks and bonds spent more time moving in tandem (30% of the time) than they spent moving opposite one another (11% of the time).[11] Stocks and bonds experienced extended periods of dual losses every 50 years. It is only during the last two decades of falling rates, accommodative monetary policy, and globalization that we have seen an extraordinary period of anti-correlation emerge. At best the anti-correlation between stocks and bonds may cease to be a source of alpha, and at worst it may the driver of significant reflexive losses.

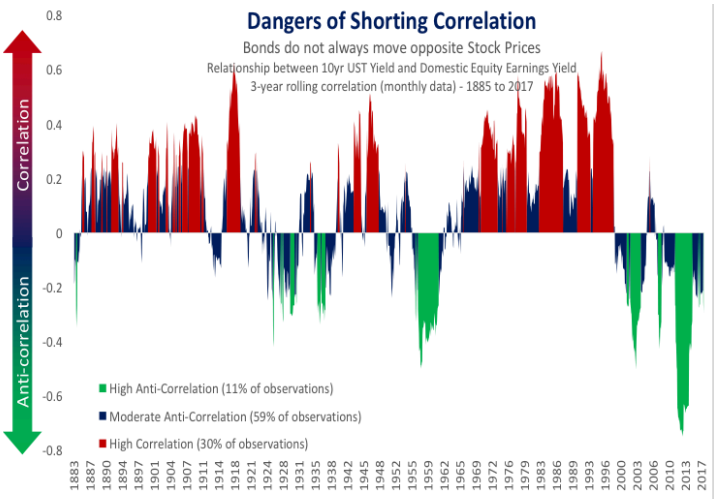


Exhibit 15
Source: Artemis Capital Management LP, Global Financial Data, Robert Schiller

Volatility Risk

With interest rates at all-time lows shorting volatility has become an alternative to fixed income for yield starved investors. The phenomenon is not new to Japan. For nearly two decades banks

packaged and sold hidden short volatility exposure to Japanese retirees via wealth products called Uridashi. Uridashi notes pay a coupon well above the yield earned on Japanese debt based on knock-out and knock-in levels to the Nikkei index. In 2016 there was an estimated $13.2 billion USD in Uridashi issuance.[12] Now that low rates are global the short volatility trade is expanding to retail investors beyond Japan.

In the US short volatility has emerged as a get-rich-quick scheme for many of these smaller investors. The short VIX exchange traded complex, at approximately $2 billion in listed assets, is the smallest but most wild segment of the global short volatility trade. In the past you had to be a big Wall Street trading desk ('Bear Stearns') or hedge fund ("LTCM") to blow yourself up shorting volatility. Not anymore. The emergence of listed VIX products democratized the trade. A story in the *New York Times* details the exploits of an ex-Target manager who made millions shorting a 2x leveraged VIX ETP.[13] Such stories harken back to the dotcom bubble of the late 1990s when day-traders quit their jobs to flip internet stocks before the crash.

When everyone is on one side of the volatility boat, it is much more likely to tip over. Short and leveraged volatility ETNs contain implied short gamma requiring them to buy (sell) a non-linear amount of VIX futures the more volatility rises (falls). The risk of a complete wipe out in the inverse-VIX complex in a single day is a very real possibility given the wrong shock (as Artemis first warned in 2015). The largest one day move in the VIX index was the +64% jump on February 27, 2007. If a similar move occurred today a liquidity gap would likely emerge. The chart in Exhibit 16 estimates the volatility notional required for a +60% shock in the VIX given supply-demand dynamic over the past five years. For a +60% move in VIX we estimate ETPs would be required to buy $138 million in vega notional in the front two contracts alone, equivalent to 142k VIX contracts.[12] This is over 100% of the average daily trading volume. In this event, inverse-VIX products will experience an "unwind event" resulting in major losses for scores of retail investor. Those shorting leveraged VIX products will have unmeasurable losses. The products are a class-action lawsuit waiting to happen.

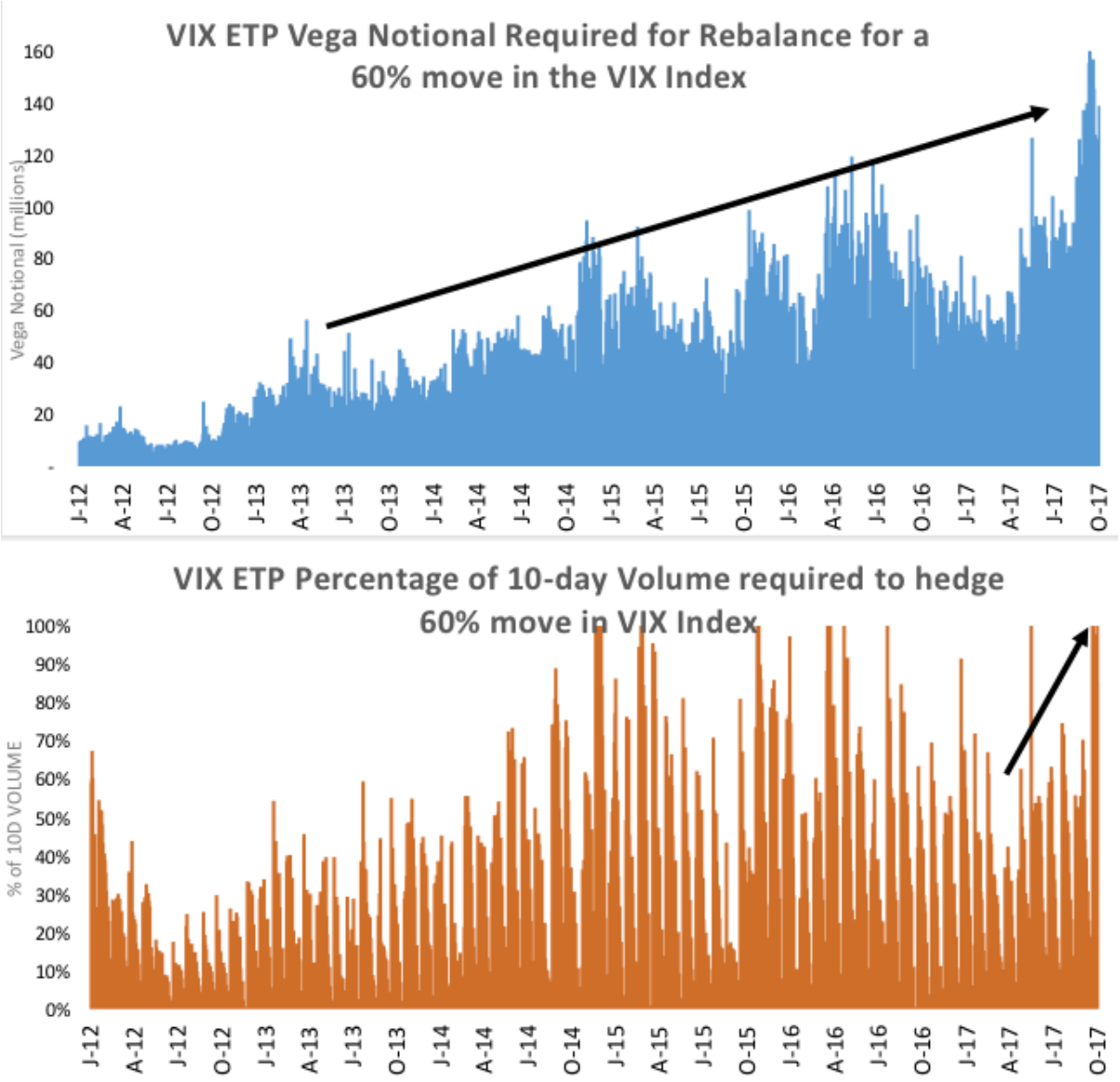


Exhibit 16
Source: Artemis Capital Management

Shadow Risk in Passive Investing

Peter Diamandis, the entrepreneur and founder of the X prize, said it best, "If you want to become a billionaire, find a way to help a billion people." The purpose of efficient markets is to allocate capital to institutions that add the most value. In a market without value, the only thing left to do is to allocate based on liquidity. The massive stimulus provided by central banks resulted in the best risk-adjusted returns for passive investing in over 200 years between 2012 and 2015. Today investors are chasing that historical performance. By the start of 2018, 50% of the assets under management in the US will be passively managed according to Bernstein Research. Since the recession $2 trillion in assets have migrated from active to passive and momentum strategies according to JP Morgan.

Passive investing is now just a momentum play on liquidity. Large capital flows into stocks occur for no reason other than the fact that they are highly liquid members of an index. All stocks in the index go up and down together, regardless of fundamentals. In effect, the volatility of the entire stock market can become dominated by a small number of companies and correlation relationships. For example, the top 10 stocks in the S&P 500 index, comprising only 2% of index membership, now control upward of 17% of the variance of the entire market. The largest 20 companies, or 4% of companies, are responsible for 24% of the variance.

The shift from active to passive investing is a significant amplifier of future volatility. Active managers serve as a volatility buffer, willing to step in and buy undervalued stocks when the market is falling, and sell overvalued stocks when the market is rising too much. Remove that buffer, and there is no incremental seller to control overvaluation on the way up, and no incremental buyer to stop a crash on the way down.

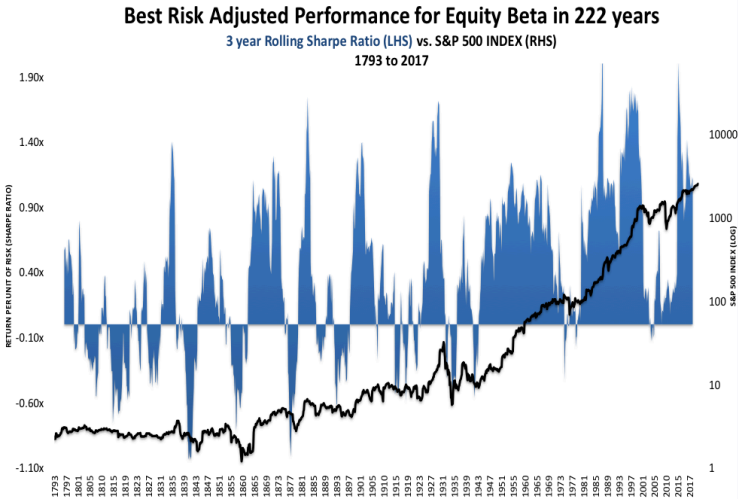


Exhibit 17
Source: Artemis Capital Management LP, Global Financial Data

Shadow Risk in Machine Learning

Let's pretend you are a programmer using artificial intelligence ("AI") to develop a self-driving car. You "train" the AI algorithm by driving the car thousands of miles through the desert. AI learns much faster than any human, so after a short period, the car is able to drive at 120 miles per hour with perfect precision and safety. Now the car is ready for a cross-country trip. The self-driving car works flawlessly, driving with record speed through the city, desert, and flatlands. However, when it reaches the steep and twisting roads of the mountain the car drives right off a cliff and explodes. The fatal flaw is that your driving algorithm has never seen a mountain road. AI is always driving by looking in the rear-view mirror.

Markets are not a closed system. The rules change. As machines trade against machines, self-reflexivity risk is amplified. 90% of the world's data across history has been generated over the last two years. It is very hard to find quality financial data at actionable time increments going back past 20 or even 10 years. Now what if we give all the available data, most of it extremely recent, to a machine to manage money? The AI machine will

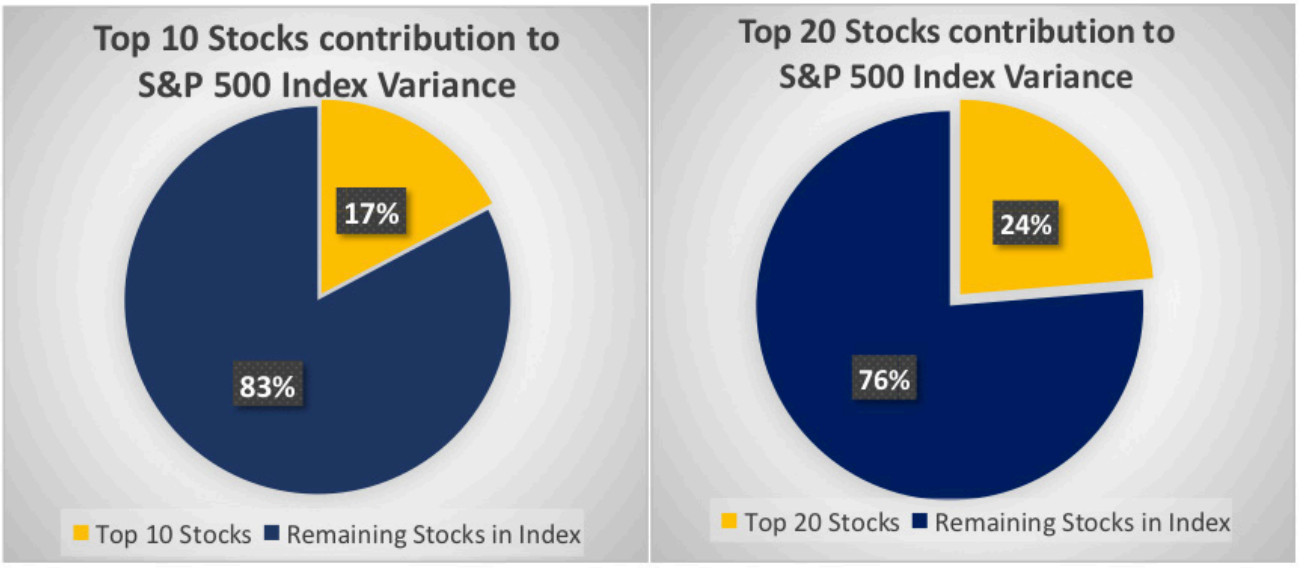


Exhibit 18
Source: Artemis Capital Management

optimize to what has worked over that short data set, namely a massively leveraged short volatility trade. For this reason alone, expect at-least one major massive machine learning fund with excellent historical returns to fail spectacularly when the volatility regime shifts… This will be a canary in the coal mine.

Conceptual Mistakes in Shorting Volatility

"I can't wait for the next crisis because I can sell volatility at even higher levels!" said one institutional asset manager at a conference. This is a commonly held but very dangerous assumption. Many investors compare shorting volatility to selling insurance. The option seller collects an upfront premium with frequent gains but large negative exposure to uncommon events. It is typical to erroneously conclude that selling volatility can never lose money if you keep systematically rolling the trade forward. The flaw in this logic is the assumption risk events are independent and probabilities consistent. In markets this is never the case.

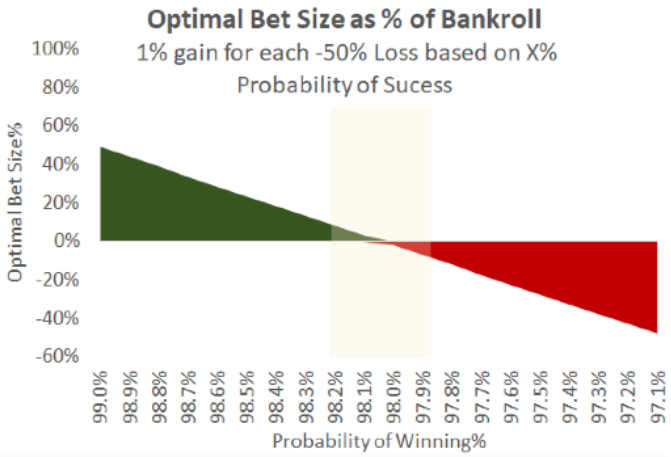
Let's play a game. You get to bet on a rigged coin with a 99% probability of landing on heads in your favor. If the coin lands on heads, you win +1% of your bankroll, but if it lands on tails, you lose -50%. Do you play? Yes, the game has a positive expected return, and given the law of large numbers you will always succeed if you keep playing. Consider that if the probabilities decrease to a 98% success rate, the game becomes a net loser. Remarkably, a 1% change in probability is the only thing that separates a highly profitable strategy from cataclysmic loss (see the statistics in Exhibit 19). Small changes in probabilities have an outsized effect on the profitability of any strategy with small frequent gains and large infrequent losses.

The coin game is similar to a systematic short volatility strategy, except in life you never know which coin, positive or negative, you are betting on at any given time. Worse yet, in self-reflexive markets the probabilities between coin flips become correlated based on outcomes. For each loosing coin flip, the likelihood for another loss increases and vice versa! You start with 99% odds and a positive expected strategy, but after the first loss, the odds reduce to 90%. After two losses in ten, the odds fall to 50%. It is not the first loss, or leg down in markets that hurts you, but rather the second and third. Systematic short volatility without accounting for shifting probabilities is akin to doubling down at a casino into bad odds. Don't fool yourself… this is exactly how financial crises develop.

Shorting volatility, in of itself, is not necessarily a bad thing if executed thoughtfully at the right margin of safety. In our 2012 paper "Volatility at World's End" we correctly argued, against our self-interest, for the overvaluation of portfolio insurance in what we coined a "Bull Market in Fear" between 2009 and 2012. At the time tail risk hedging was very popular and investors shorting volatility had a high margin of safety. For the reasons detailed in this paper, we believe the exact opposite today.

Intrinsic Value and Volatility

This past summer the ever-wise Jim Grant of Grant's Interest Rate Observer asked for my thoughts on the low volatility regime. In the middle of my explanation on the short volatility trade, out of nowhere, Jim says, "What does any of this have to do with intrinsic value?" I was floored…I honestly didn't know how to answer his question. The truth…the short volatility trade is about



Optimal Bet Size as % of Bankroll

Probability of Gain (%) \ % Loss of Capital for 1% gain	-10%	-20%	-30%	-40%	-50%	-60%	-70%	-80%	-90%
99.5%	95%	90%	85%	80%	75%	70%	65%	60%	55%
99.00%	89%	79%	69%	59%	49%	39%	29%	19%	9%
98.50%	84%	69%	54%	38%	23%	8%	-7%	-22%	-37%
98.00%	78%	58%	38%	18%	-2%	-22%	-42%	-62%	-82%
97.50%	73%	47%	22%	-3%	-28%	-53%	-78%	-103%	-128%
97.00%	67%	37%	7%	-23%	-53%	-83%	-113%	-143%	-173%
96.50%	62%	26%	-9%	-44%	-79%	-114%	-149%	-184%	-219%
96.00%	56%	16%	-24%	-64%	-104%	-144%	-184%	-224%	-264%
95.50%	51%	5%	-40%	-85%	-130%	-175%	-220%	-265%	-310%
95.00%	45%	-5%	-55%	-105%	-155%	-205%	-255%	-305%	-355%

Exhibit 19
Source: Artemis Capital Management

the absence of value. In a bull market, when investors can't find value in traditional assets, they must manufacture yield through financial engineering. In a mania the system begins to devour its own tail.

The difference between risk and outcomes…

Imagine your friend invites you over for dinner. In his dining room is a barrel of highly explosive nitroglycerin.

You: "What is that barrel of explosive nitroglycerin doing in your living room!"

Friend: "Oh that, no big deal."

You: "It's DANGEROUS! That could blow up the entire block!!! Where did you even get that?"

Friend: "Calm down, the bank pays me good money to store it here, it's the only way I can afford the mortgage."

You: "WHAT! ARE YOU CRAZY? All it takes is a small fire to set that thing off!"

Friend: "What fire? There is no fire. Look, it's been here for five years without a problem."

Risk alone does not guarantee any outcome, it only effects probabilities. The global short volatility trade, in all of its forms, is like a barrel of nitroglycerin sitting in the market portfolio. It may or may not explode. What we do know is that it can potentially amplify a routine fire into an explosion. The real question is what causes the fire?

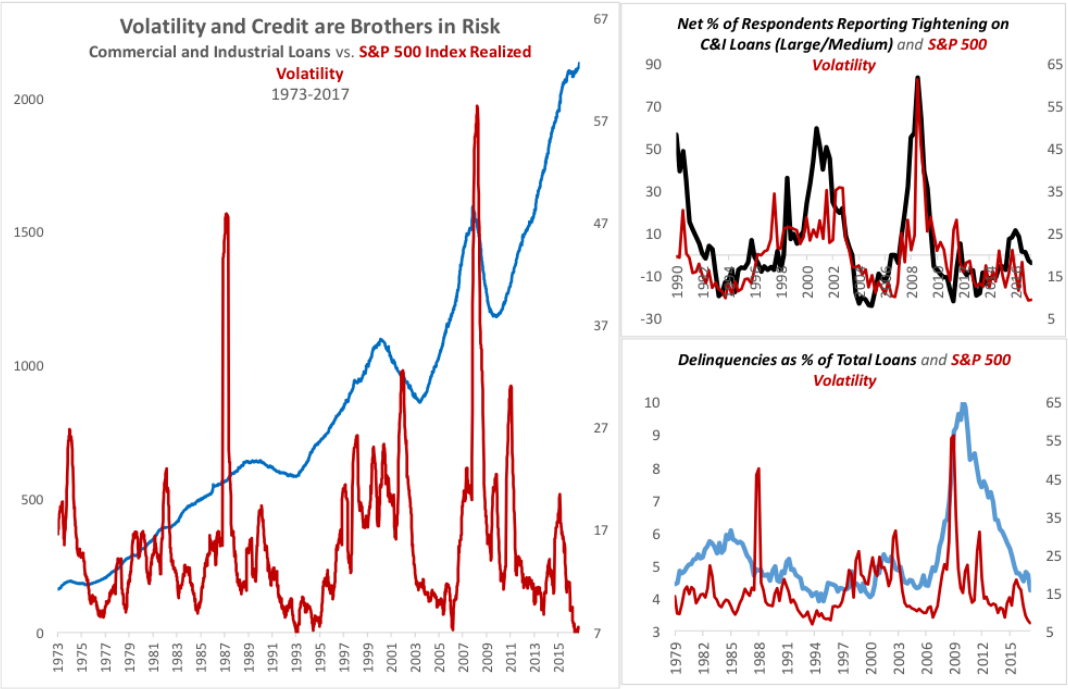


Exhibit 20
Source: Artemis Capital Management

The Death of the Snake

Volatility fires almost always begin in the debt markets. Let's start with what volatility really is. Volatility is the brother of credit and volatility regime shifts are driven by the credit cycle. Volatility is derived from an option on shareholder equity, but equity itself can be thought of as a perpetual option on the future success of a company. When times are good and credit is easy, a company can rely on the extension of cheap debt to support its operations. Cheap credit makes the value of equity less volatile, hence a tightening of credit conditions will lead to higher equity volatility. When credit is easily available and rates are low, volatility remains suppressed, but as credit contracts, volatility rises.

In the short term we do not see the credit stress required for a sustained expansion of volatility, but this can change very quickly. Storm clouds are gathering around 2018-2020, as rising interest rates, rich valuations, and corporate debt roll-overs all converge as potential triggers for higher stress and volatility. The IMF warned that 22% of U.S. corporations are at risk of default if interest rates rise. Median net debt across S&P 500 firms is close to a historic high at over 1.5x earnings, and interest coverage ratios have fallen sharply.[15] Between 2018-2019 an estimated $134 billion of high yield debt[16] must to be rolled-over, presenting a catalyst for higher volatility in the form of credit stress.

Reflexivity in the Shadow of Black Monday 1987

Thirty years ago, to the day, financial markets around the world crashed with volatility never seen before or equaled again in history. On October 19th, 1987 the Dow Jones Industrial Average fell more than -22%, doubling the worst day from the 1929 crash. $500 billion in market share vaporized overnight. Entire brokerage firms went bankrupt on margin calls as liquidity vanished. It was not a matter of prices falling, there were no prices. You couldn't exit a position. Trading desks refused to pick up the phone. Black Monday appeared to come out of nowhere as it occurred in the middle of a multi-year bull market. There was no rational reason for the crash. In retrospect, financial historians blame portfolio insurance, ignoring the role of interest rates, inflation, and the Federal Reserve. The demon of that day still haunts markets, and 30 years later the crash is still not well understood. Black Monday 1987 was the first post-modern hyper-crash driven by machine feedback loops, but it all started in a very traditional way.[17]

Today every central bank in the world is trying to engineer inflation, but inflation was the hidden source of the 1987 financial crash. At the start of 1987 inflation was at 1.5%, which is lower than it is today! From 1985 and 1986 the Federal Reserve cut interest rates over 300 basis points to off-set a slowdown in growth. That didn't last for long. Between January and October 1987 inflation violently rose 300 basis points. Nominal rates jumped even higher, as the 10-year US treasury rose 325 basis points from 6.98% in January 1987 to 10.23% by October 1987. The Fed tried to keep pace by raising rates throughout the year but it was not fast enough. The quick increase in inflation was blamed on the weak dollar, falling current account balance, and rising US debt-to-GDP levels. None of this hurt equity markets, as the stock market rose +37% through August 25th, 1987. Then the wheels fell off.

First the fire, then the blast. In 1987 portfolio insurance was a popular strategy ($60 billion in assets) that involved selling incrementally greater amounts of index futures based on how far the markets fell (see short gamma risk, see Exhibit 13 page 22). The *WSJ* ran an article on October 12th that warned portfolio insurance "could snowball into a stunning rout for stocks." [17,18] Nobody paid attention.

Exhibit 21

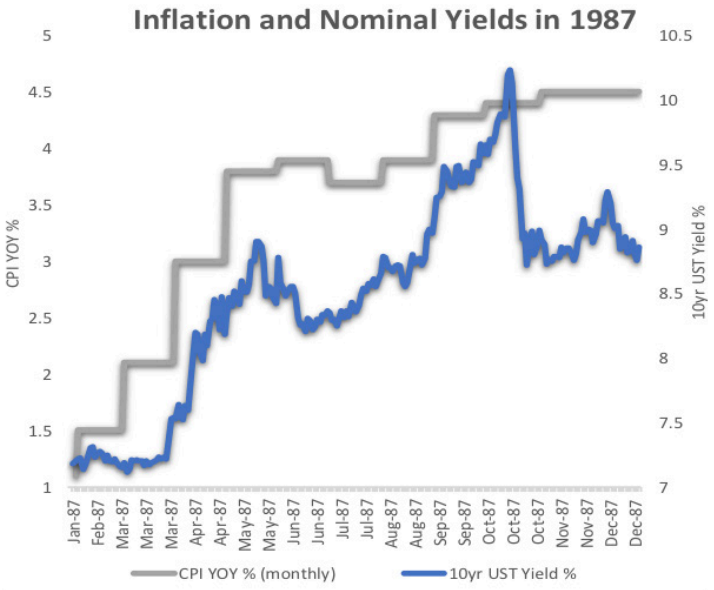


Exhibit 22

Exhibit 23

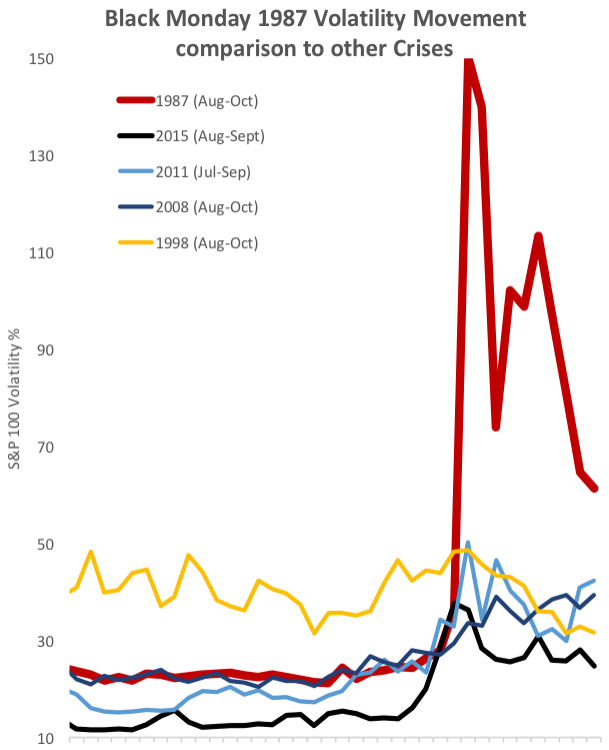


Exhibit: 24

Source: Bloomberg, Artemis Capital Management LP

Although equity markets continued to rise into the summer, the credit markets began to suffer from a liquidity squeeze. The spread between interbank loans and Treasury Bills spiked 100 basis points in the month of September alone, and then rose another 50 basis points in October leading up to the crash. Corporate yields exploded 100 basis points the month leading up to the Black Monday crash, increasing of over 200 basis points since earlier in the year. By the late summer the equity markets got the memo. Between August 25th and October 16th, the S&P 500 index fell -16.05%. S&P 100 volatility moved from 15 in August to 36.37 on October 16th. That was just the beginning.

On Black Monday the market lost one fifth of its value and volatility jumped to all-time highs of 150 (based on VXO index, predecessor to the VIX index). In total, from August to October 1987 the market lost -33% and volatility exploded an incredible +585%. Black Monday is best understood as a massive explosion that occurred within a traditional fire. Rising inflation started a liquidity fire in credit, that spread to equities, and reached the nitroglycerin of computerized trading before exploding massively. Central bankers were not able to cut rates at the onset of the crisis to stop the fire due to rising inflation. The same set of drivers exist today, but on steroids. Higher rates combined with $1.5 trillion in self-reflexive investment strategies are a combustable mix. It is important to realize that the 1987 Black Monday crash was comparable to any other market sell-off until it wasn't. The only difference in 1987, volatility just kept going higher and markets lower. The Exhibit 24 shows the movement in volatility leading up to crises in 1987, 1998, 2008, 2011, 2015. The point is that if you are a volatility short seller, how do you know whether you will get a 2015 outcome, when markets rallied, or a 1987 outcome? You don't! In 1987 inflation started the volatility fire, but, program trading amplified that fire into a cataclysmic conflagration. The

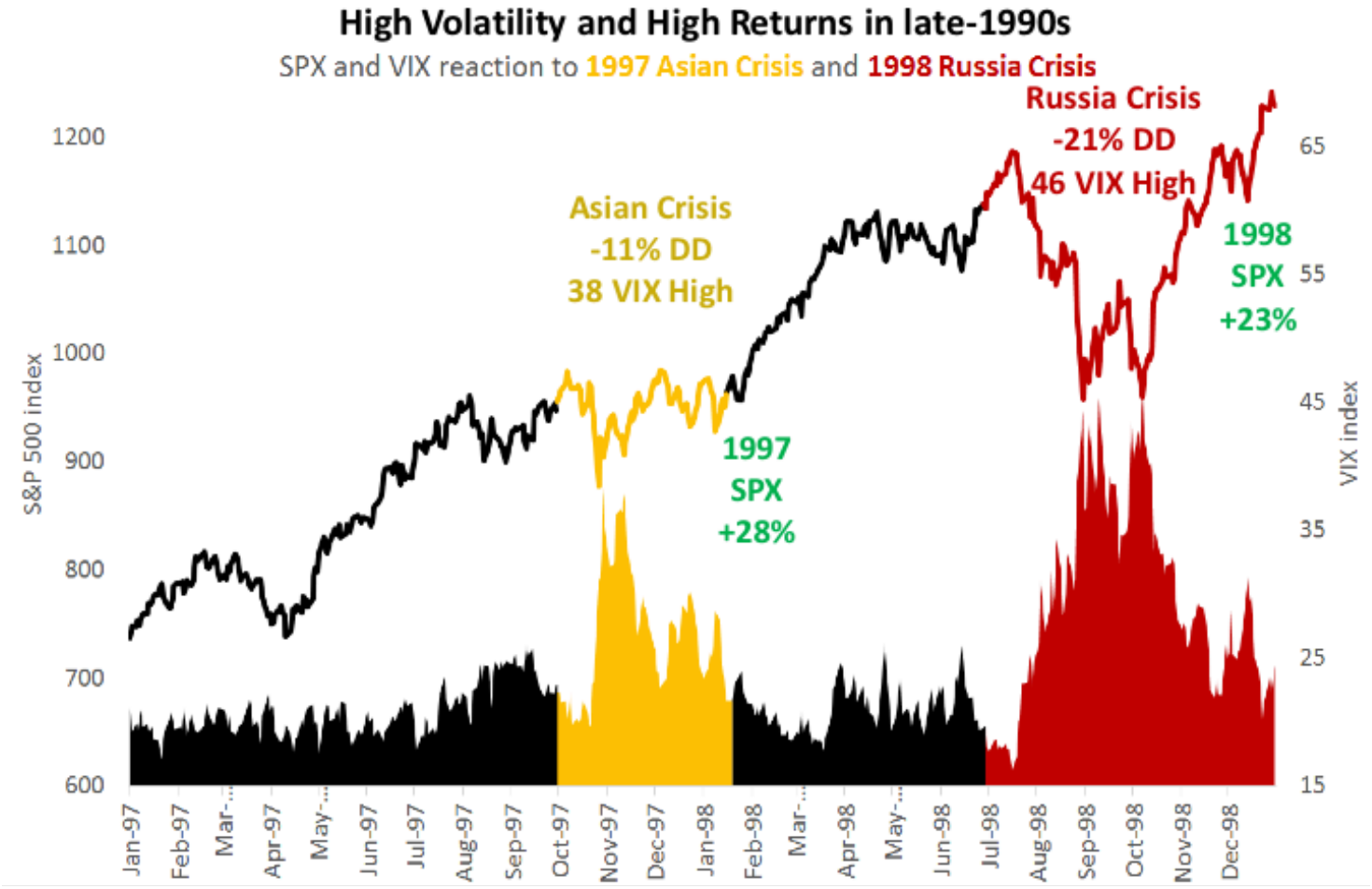


Exhibit: 25
Source: Artemis Capital Management LLC, Bloomberg

$1.5 trillion short volatility trade, in all its forms, can play a very similar role now if rising inflation causes tighter credit conditions, but also limits central banks from reacting.

Melt-up Risk

Never underestimate the will of global central banks to risk overvaluation in asset prices to achieve inflation. For this reason, a speculative melt-up in prices on par with the late 1990s dot-com bubble is possible if policy makers support markets perpetually amid low inflation and growth. In fact, one legitimate argument for raising rates is simply so they can lower them before the business cycle turns. High volatility and high equity returns often coincide in the final phases of a speculative market. Very few investors realize that between 1997 and 1999 the stock market experienced both rising volatility and returns at the same time. For example, during this period the S&P 500 index was up close to +100% but with over five times the volatility we are experiencing today. The recent stock market bubble in China also was an example of high volatility and high returns. Yes, stocks are overvalued, but if rates stay low coupled with dovish monetary policy and supply-side tax reform it could touch a frenzy in speculation. For this reason alone, sitting on the sidelines presents business risk for professional managers.

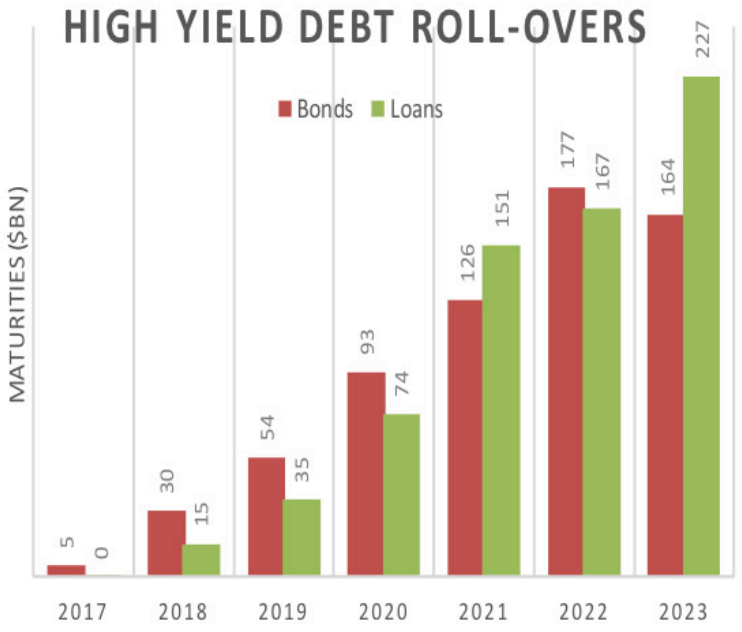


Exhibit: 26

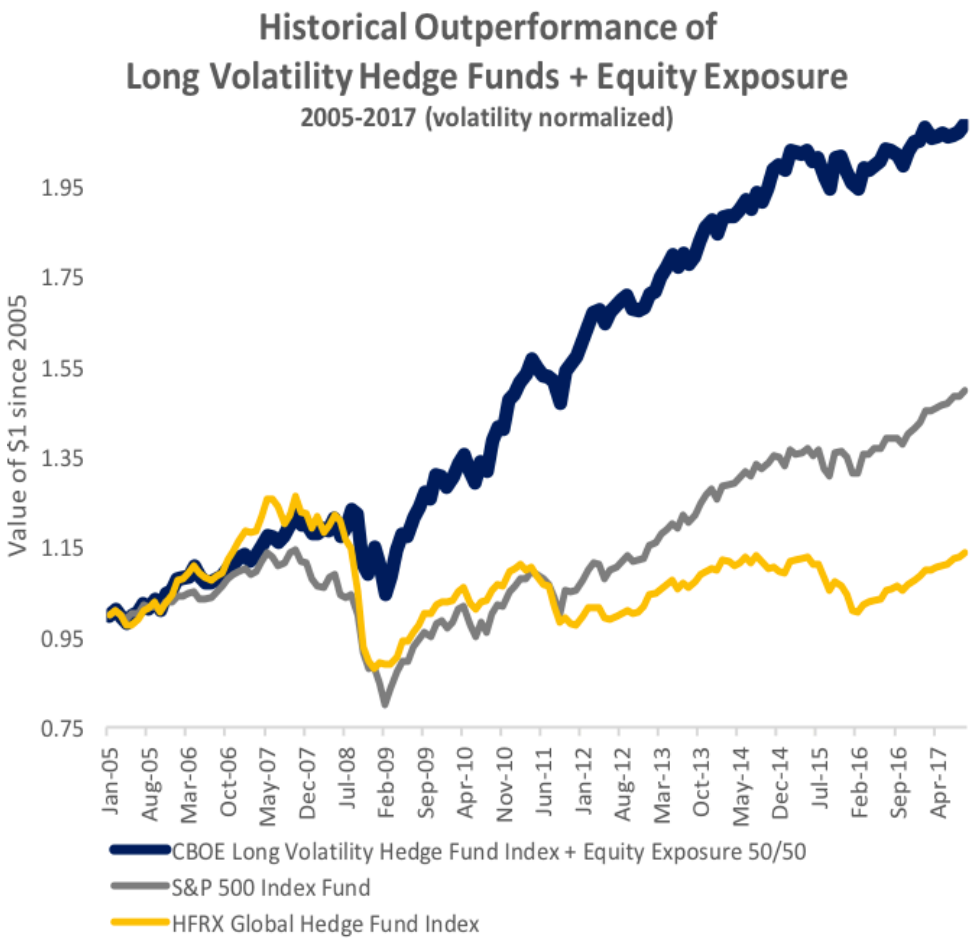


Exhibit: 27
Source: Bloomberg, Artemis Capital Management LP

How Does an Investor Survive the Ouroboros?

The markets are not correctly assessing the probability that volatility reaches new all-time lows in short term (VIX <9 in 2017), and new all-time highs in the long term (VIX > 80 in 2018-2020).

Reflexivity in both directions is very hard to conceive. Volatility is low and can go lower this year absent any catalyst. Rising interest rates, wage inflation, and credit issuance are very real catalysts in the long-term. Between 2018 and 2020 high yield issuers will re-test markets by rolling over $300 billion in expiring debt. U.S. average hourly earnings are rising at fastest pace since pre-recession putting pressure on inflation. If these debt-roll overs occur into rising inflation and higher rates this could easily be the fire that sets off the global short volatility explosion.

If you are going to short volatility, do it with a long-volatility mindset, namely a limited loss profile. Short-dated VIX put options that payoff with the VIX below 10 are currently 5-10 cents. Forward variance out one year is cheap and should be bought into any period of rising interest rates, inflation, or credit stress.

Fixed income volatility is at all-time lows at a time when the Federal Reserve is raising rates. Something must give, inflation or deflation, but you don't have to be smart enough to know what if you bet on the volatility of fixed income.

Active Long Volatility and Stocks Will Outperform Over the Next Five Years

Long volatility is a bet on change, as opposed to direction. At a time when central banks are removing stimulus, the world has never been more leveraged to the status quo. For this reason, long volatility combined with traditional equity exposure is an effective portfolio for the new regime. Historically a 50/50 combination of the CBOE Long Volatility Hedge Fund Index and the S&P 500 Index outperformed the average hedge fund by +97% since 2005. The inclusion of long volatility reduced equity drawdowns from -52% to -15% in 2008 while improving risk-adjusted returns.

The value-add of active long volatility management is to minimize losses in stable markets while making portfolio changing returns in the event of a market crash. The smart long volatility fund can offer protection at a limited or even positive cost of carry. The combination of active long volatility and equity has historically protected a portfolio from a deflationary crash like 2008, but can also profit if high volatility and high equity returns co-exist in melt-up like 1997-1999. Long volatility may be your only line of defense if stock and bonds decline together. At this stage in the cycle, you want to position yourself on the other side of the global short volatility trade.

Endnotes

1. Ouroboros" Wikipedia | https://en.wikipedia.org/wiki/Ouroboros
"Ouroboros" Token Rock | https://www.tokenrock.com/explain-ouroboros-70.html.

2. Artemis Capital Management LP gathered estimates for exposure to the "short volatility trade" from a variety of different sources deemed reliable including money center banks, research, and data services. The exact numbers are extremely difficult to discern given the breadth of participants and required knowledge of the operations for thousands of private institutions. To that effect, the results provided are a best efforts compilation based on reputable sources.

Implicit Short Volatility Exposures

a. Risk Parity exposure estimated at $500 billion by J.P. Morgan Cross Asset Derivatives Research Teams between 2015 and 2016 based on research notes by Marko Kolanovic. $400-600 billion estimate is provided by the *Financial Times* as of 2016. "Little Known Trading Strategy Exacerbates Market Turmoil," *Financial Times* October 14, 2016 / Wigglesworth.

b. Volatility Control Funds/Variable Annuity Funds exposure estimated at $400 billion in 2015 by Equity UBS AG Equity Derivatives Research Notes as distributed by Davide Montoni. J.P. Morgan Cross Asset Derivatives Research Teams estimated this exposure at $200-$300 billion in 2015-2016 based on research notes by Marko Kolanovic.

c. Managed Futures equity exposure estimated at $70-175 billion based on May 2017 research note by Bank of America. "If Vol-Neutrals are Finally Liquidating, Could They Crash the Market? Here is the Math" http://www.zerohedge.com/news/2017-05-17/if-vol-neutrals-are-finally-liquidating-could-they-crash-market-here-math.

d. Low Vol Risk Premia strategies exposure estimated at $250 billion by Rob Arnott of Research Affiliates based on 2017 interview in *Grant's Interest Rate Observer*.

Explicit Short Volatility Exposures

e. $2 billion in VIX exchange-traded-product AUM, $2 billion in VIX short interest, and $3-4 billion in speculative VIX shorts based on data compiled from the CFTC, Bloomberg, and calculations by Artemis Capital Management.

f. $8 billion in exposure from option writing funds estimated by Macro Risk Advisers in April 7, 2017 derivatives research by Pravit Chintawongvanich.

g. $45 billion in pension short volatility overwriting programs estimated as of 2017 from Deutsche Bank as distributed in 2017 Tail Risk Monitor. $32 billion estimated as of 2012 from *Financial Times* (via Deutsche Bank) "Search for yield leads to derivatives funds," *Financial Times* September 24, 2012 / Wigglesworth and Makan.

Share buybacks

h. Data provided by Bloomberg.

i. $780 billion in 2017 share buybacks estimated by David Kostin of Goldman Sachs, http://www.marketwatch.com/story/share-buybacks-will-return-with-a-vengeance-next-year-2016-11-21.

3. Special thanks to Akshobhya Mann for her illuminating ideas on this concept.

4. "Major central banks to turn up policy heat despite low-burn inflation" Reuters, July 20 2017 / Karunakar https://www.reuters.com/article/us-global-economy-poll/major-central-banks-to-turn-up-policy-heat-despite-low-burn-inflation-reuters-poll-idUSKBN1A50FQ.

5. Global Financial Data

6. "The world is awash in $9 trillion of bonds that are guaranteed to lose money," Quartz June 14, 2017 https://qz.com/1005720/negative-interest-rates-the-world-is-awash-in-9-trillion-of-bonds-that-are-guaranteed-to-lose-money/.

7. Bloomberg.

8. The author has this made, probably more than once.

9. "Managerial Self-Interest and Strategic Repurchases: Evidence from Equity Vesting Schedules" by David Moore / University of Kentucky 2017.

10. Gamma estimated are best efforts based on analysis of rebalancing strategies employed by Risk Parity, CTAs, and volatility control funds. Author referenced the following papers for guidance "Leverage Aversion and Risk Parity" by Asness, Frazzini, and Pederson *Financial Analysts Journal* 2012, "Portfolio Rebalancing Common Misconceptions" by Huss and Maloney AQR Capital Management LLC.

11. Global Financial Data / Robert Shiller.

12. "High-Risk Investments Make a Comeback in Japan" by Kim and Vaghela, Bloomberg March 28, 2017.

13. "Day Trading in Wall Street's Complex 'Fear Gauge' Proliferates" by Landon Thomas Jr. / *New York Times* August 28th, 2017.

14. Based on models derived by Artemis Capital Management LP from Bloomberg Data.

15. International Monetary Fund Global Stability Report "Getting the Policy Mix Right" April 2017.

16. Estimated by Bank of America.

17. "A Brief History of the 1987 Stock Market Crash with Discussion of Federal Reserve Response," by Carlson / Finance and Economics Discussion Series 2007-2013.

18. *A Demon of Our Own Design* by Richard Bookstaber / Wiley and Sons 2007.

Artwork

1. "Volatility and Alchemy of Risk" artwork by Bredan Wiuff based on concept created by Brendan Wiuff and Christopher Cole

2. Early alchemical ouroboros illustration with the words "ἕν τό πᾶν" ("one is the all") from the work of Cleopatra the Alchemist (c. third century, Egypt). | Wikipedia | "Ouroboros"

3. *New York Times* on October 19th, 1987

Author Bio

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Artemis Capital Managment LP

Christopher R. Cole, CFA is the founder of Artemis Capital Management LP and the CIO of the Artemis Vega Fund LP and Artemis Callisto LP. Mr. Cole's core focus is systematic, quantitative, and behavioral based trading of exchange-traded volatility futures and options. His decision to form a fund came after achieving verified proprietary returns during the 2008 financial crash trading volatility futures. Mr. Cole's research letters and volatility commentaries were influential in derivatives circles and thereafter widely referenced and quoted by the mainstream financial media, academic, and institutional asset management communities. He has been widely quoted by publications such as the Wall Street Journal, Financial Times, Bloomberg, The Economist (Economic Intelligence Unit), DROBNY, 13D, Grant's Interest Rate Observer, International Financing Review, CFA Magazine, and Forbes. He previously worked in capital markets and investment banking at Merrill Lynch. During his career in investment banking and pension consulting he structured over $10 billion in derivatives and debt transactions for many high profile issuers. Mr. Cole holds the Chartered Financial Analyst designation, is an associate member of the NFA, and graduated Magna Cum Laude from the University of Southern California.

Market Timing: Opportunities and Risks

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Introduction

Asset allocation decisions, particularly those involving market timing, create both opportunities and pitfalls for investors. In the aftermath of the crash of October 1987, many investors sought protection of capital through market timing or tactical asset allocation strategies. Since then, the popularity of tactical asset allocation has increased both for professional investment managers and individual investors alike.

In this paper, I explore opportunities for enhancing returns using tactical asset allocation and market timing, as well as the challenges posed by market timing, including higher costs and the risk of missing the best- performing days of the market. I examine whether investors can succeed using tactical asset allocation and market timing strategies and look to behavioral finance concepts to explain why investors continue to embrace market timing in their investment process.

I find that strategic asset allocation was the most important driver of long-term investment success. This is because most market timers typically fail to accurately predict important equity market swings. The long-term odds are not in favor of market timing strategies.

Opportunity for Enhancing Returns

Academic research reveals that investment returns can be enhanced significantly using tactical asset allocation and accurate market timing. Exhibit 1 shows the value of $1 invested in U.S. large caps (S&P 500 Index), Treasury Bills (30-day T-Bills), long-term government bonds (20-year U.S. Treasury Bonds), and a tactical asset allocation strategy capturing only the best-performing asset classes between December 1925 and December 2015. In this scenario, I allocated once every year to the coming year's best-performing asset class at the beginning of each year (without transaction costs). Returns are calculated on an annual basis before inflation. Exhibit 1 indicates that the

Ending Capital of $1 Invested (1926-2015)	
Inflation	$13
Cash (30-Day T Bills)	$21
Bonds (20-Year Government)	$132
Stocks (S&P 500 Index)	$5,421
Best Asset Class	$3.7 million

Exhibit 1
Source: Ibbotson & Ass. (www.martincapital.com)

investor who allocated 100% of his assets into the best-performing asset class each year would have a portfolio value of about $3.7 million at the end of the period. It's also worth noting how poorly T-bills and long-term government bonds performed relative to inflation over this period.

Market Timing Hurdles: Running with the Bulls and Bears

While the lure of market timing strategies may be powerful, accurate market timing poses significant challenges. Poor investment decisions can result in excessive trading and opportunity costs. Additionally, over the long term, the U.S. equity market, as measured by the S&P 500 Index, has consistently shown an upward trend; much debate exists over the impact of missing the best parts of a bull market or remaining invested during the worst parts of a bear market. Using monthly data for the S&P 500 Index (drawing on Bloomberg for the monthly returns data, the full extent was December 1927 to December 2015) reveals that a disproportionate percentage of total bull market gains occurred at the beginning of a market recovery. In fact, the average gain during the first three months after a market downturn was 21.4%. Here, a market downturn is defined as a drop of 20% or more.[1] Yet I believe most market timers tend to be concentrated in cash during the first three months just after a crash—so, market timers typically have missed most of a recovery's upside.

An interesting study published in 1986 by finance researchers Jess Chua and Richard Woodward questioned whether poor results achieved by market timing result from an inability to avoid bear markets or the tendency to miss the early part of a market recovery. Their research showed that to achieve investment success, it was more important to correctly forecast bull markets than to correctly forecast bear markets. Their study showed that from 1926 to 1983 average returns achieved by predicting just 50% of bull markets underperformed buy-and-hold strategies, even when bear markets were forecasted with perfect accuracy.[2] They concluded that for market timing to pay off, investors required accurate forecasts in at least:

- 80% of the bull and 50% of the bear markets; or
- 70% of the bull and 80% of the bear markets; or
- 60% of the bull and 90% of the bear markets.

The 25 Best and Worst Trading Days in the Stock Market

Believers in market timing argue that returns can be increased dramatically by avoiding the worst days in the stock market. On the flip side, non-believers argue that missing the best days in the stock market decimates long-term returns. I tested both hypotheses by examining monthly returns for the S&P 500 Index from January 1961 to the end of December 2015.

As shown in the Exhibit 2 (next page), the results are compelling. The buy-and-hold investor would have realized an annual return of 9.87%. The perfectly accurate market timer who avoided the 25 worst trading days would have generated an annual return of 15.27%, before fees and taxes. However, the investor who missed the best 25 days realized an annual return of only 5.74%.

Long-Term Trends Have Been Against the Market Timer

My analysis of monthly returns for the S&P 500 Index from December 1927 until December 2015 shows:

- 12 bear markets (defined as more than 20% losses in the equity market)
- 13 bull markets
- Average bull market gain of 179.8%
- Average bear market loss of -35.75%
- Average bull market lasted 66 months
- Average bear market lasted 16 months
- 27% of monthly returns during bear markets were positive

U.S. stocks represented by the S&P 500 Index. The launch date of the S&P 500 Index was March 4, 1957. All information prior to the index launch date is back-tested. Back-tested performance is hypothetical and not actual performance. The back-test calculations are based on the same methodology in effect when the index was officially launched. Returns include dividends but do not reflect effects of taxes or fees. Past performance is not a guarantee of future results. Please note that all indices are unmanaged and are not available for direct investment.

Avoiding the Worst Days Would Have Outperformed Buy and Hold
The Results of Market Timing for the S&P 500 Index (1/1/1961 to 12/31/2015)

	Annualized Return (%)	Growth of $100
Missing 25 Best Days	5.74	$831
Missing 25 Worst Days	15.27	$21,886
Buy and Hold	9.87	$3,550
Missing Worst & Best Days	10.94	$5,125

Exhibit 2 *
Source: S&P 500 Index via Bloomberg, as of 12/31/15.

The results show that long-term returns were actually realized in very short periods of time. Extending the analysis, returns for the best 81 trading days during the period (out of 13,844 trading days) would have equaled the total return for a buy-and-hold investor over the entire period. In other words, with perfect foresight, being invested only 0.59% of the time would produce the same results as if an investment were held over the entire 55-year period. Or, from a different perspective, had one missed these 81 best- performing days, the annualized return during the period would fall to a meager 0.03%.

Given the significantly better returns noted above if one were able to avoid the market's worst-performing days, I attempted to answer the question of whether such market timing is actually possible. Exhibit 3 shows the 25 worst- and 25 best-performing days for the S&P 500 Index from January 1961 to the end of December 2015; note the best and worst days tended to cluster, as indicated by the matching colors. Almost half of these fifty days (the 23 light gray cells) show the worst and best trading days surrounding the market crash of 2008. While there were many days surrounding the crash in which the market realized superior gains, missing the market's worst days seems to increase the likelihood of also missing its best days. Only the white-colored cells (or cells without color) indicate daily market movements that do not appear tied to sharp market moves in the opposite direction.

Looking back at Exhibit 2, an investor who missed both the 25 best- and worst-trading days would have realized an annual return of 10.94%, greater than the buy-and-hold investor. However, in my opinion, an investment strategy that attempts to miss both the best and the worst days is flawed. I disagree with researchers such as Mebane Faber who wrote in "Where the Black Swans Hide and The 10 Best Days Myth"[3] that: "We continue to advocate that investors attempt to avoid declining markets where most of the volatility lies and conclude that market timing and risk management is indeed possible, and beneficial to the investor." My concern with this line of thinking stems from my observation that the best trading days, as shown in Exhibit 3, often follow the worst trading days. I believe many investors panic when they see a bad trading day and sell, thus locking in their losses and eliminating the potential to participate in subsequent rebounds. Further, I do not believe that it is possible to consistently predict market performance—especially during these days when volatile returns (both up or down) have tended to cluster.

Exhibit 4 (next page) shows the same best- and worst-performing days featured in Exhibit 3 (next page), but arranged chronologically. There are a number of periods in which the stock market started with a sell-off followed by a recovery. Investors who sold after that first market correction likely missed the subsequent best- performing days and ended up with very poor long-term returns. The colored cells (blue for positive and gray for negative) reflect days when I considered positive and negative returns to "cluster."

Market research firm Dalbar has conducted an annual study, "Quantitative Analysis of Investor Behavior," that measures the impact of market timing on short- and long-term performance. The study concludes that most stock market investors' underperformance is generated during the market's best- and worst- performing months. Exhibit 5 (page after next) shows the performance of the S&P 500 Index and the average equity investor's return in the same months; it shows that investors tended to underperform the market during months when returns were positive and negative.[4]

Transaction Costs and Opportunity Costs Count

Excessive market timing decisions can result in unnecessary transaction and opportunity costs. Moving money in and out of cash may trigger front-and back-loaded fees for certain mutual funds, commission costs for stock and exchange-traded fund (ETFs) trades, as well as capital gains taxes, all likely resulting in lower returns.

Exhibit 6 (page after next) shows the impact on pre-tax capital accumulation a hypothetical investor may face as annual transaction costs and other expenses increase. For example, if annual costs of 1.5% lower returns from 8.0% per annum to 6.5% per annum, then the final capital accumulated would be 31.1% lower after 20 years.

Opportunity costs may occur when the market timer is not invested as the market rallies. For example, during the 2009 rally in the stock market, described by many investors as a bear-market or sucker's rally, many investors stayed on the sidelines, convinced that equity markets would return back to the low levels seen in March 2009. These investors likely missed a large part of the bull market.

The Best and Worst Trading Days Have Tended to Cluster Clusters of S&P 500 Index Returns (1/1/1961 to 12/31/2015) Shown by Magnitude			
25 Worst-Performing Days		25 Best-Performing Days	
10/19/1987	-20.5%	10/13/2008	11.6%
10/15/2008	-9.0%	10/28/2008	10.8%
12/1/2008	-8.9%	10/21/1987	9.1%
09/29/2008	-8.8%	03/23/2009	7.1%
10/26/1987	-8.3%	11/13/2008	6.9%
10/09/2008	-7.6%	11/24/2008	6.5%
10/27/1997	-6.9%	03/10/2009	6.4%
08/31/1998	-6.8%	11/21/2008	6.3%
01/08/1998	-6.8%	07/24/2002	5.7%
11/20/2008	-6.7%	09/30/2008	5.4%
05/28/1962	-6.7%	07/29/2002	5.4%
08/08/2011	-6.7%	10/20/1987	5.3%
10/13/1989	-6.1%	12/16/2008	5.1%
11/19/2008	-6.1%	10/28/1997	5.1%
10/22/2008	-6.1%	09/08/1998	5.1%
04/14/2000	-5.8%	05/27/1970	5.0%
10/07/2008	-5.7%	01/03/2001	5.0%
01/20/2009	-5.3%	10/29/1987	4.9%
11/05/2008	-5.3%	10/20/2008	4.8%
11/12/2008	-5.2%	03/16/2000	4.8%
10/16/1987	-5.2%	08/17/1982	4.8%
11/06/2008	-5.0%	08/09/2011	4.7%
09/17/2001	-4.9%	10/15/2002	4.7%
02/10/2009	-4.9%	05/29/1982	4.6%
09/11/1986	-4.8%	08/11/2011	4.6%

Exhibit 3 *

Note: Cells in this table are color coded; days in close proximity are shaded the same. Cells without color occurred in isolation. One cannot invest directly in an index. Source: S&P 500 Index via Bloomberg, as of 12/31/15.*

Best- and Worst-Performing Days Have Tended to Cluster Clusters of S&P 500 Index Returns (1/1/1961 to 12/31/2015) Shown Chronologically			
05/28/1962	-6.68%	09/29/2008	-8.79%
05/29/1962	4.65%	09/30/2008	5.42%
05/27/1970	5.02%	10/07/2008	-5.74%
07/17/1982	4.76%	10/09/2008	-7.62%
09/11/1986	-4.81%	10/13/2008	11.58%
10/16/1987	-5.16%	10/15/2008	-9.03%
10/19/1987	-20.47%	10/20/2008	4.77%
10/20/1987	5.33%	10/22/2008	-6.10%
10/21/1987	9.10%	10/28/2008	10.79%
10/26/1987	-8.28%	11/05/2008	-5.27%
10/29/1987	4.93%	11/06/2008	-5.03%
01/08/1988	-6.77%	11/12/2008	-5.19%
10/13/1989	-6.13%	11/13/2008	6.92%
10/27/1997	-6.87%	11/19/2008	-6.12%
10/28/1997	5.12%	11/20/2008	-6.71%
08/31/1998	-6.80%	11/21/2008	6.32%
09/08/1998	5.09%	11/24/2008	6.47%
03/16/2000	4.76%	12/01/2008	-8.93%
04/14/2000	-5.83%	12/16/2008	5.14%
01/03/2001	5.01%	01/20/2009	-5.28%
09/17/2001	-4.92%	02/01/2009	-4.91%
07/24/2002	5.73%	03/10/2009	6.37%
07/29/2002	5.41%	03/23/2009	7.08%
10/15/2002	4.73%	08/08/2011	-6.66%
		08/09/2001	4.74%
		08/11/2011	4.63%

Exhibit 4 *

*Source: S&P 500 Index via Bloomberg, as of 12/31/15.**

10 Months with the Most Acute Investor Underperformance
(1/1/1985 to 12/31/2014)

Rank	Month	S&P 500 Index Return	Avg[5] Equity Mutual Fund Investor Return	Underperformance (Avg Investor Return Minus Index Return)
1	October 2008	-16.80%	-24.21%	-7.41%
2	March 2000	9.78%	3.72%	-6.06%
3	October 1987	-21.54%	-26.87%	-5.33%
4	January 1987	13.47%	9.35%	-4.12%
5	August 1998	-14.46%	-18.47%	-4.01%
6	September 2008	-8.91%	-12.75%	-3.84%
7	November 2000	-7.88%	-11.33%	-3.45%
8	April 1997	5.97%	2.75%	-3.22%
9	November 1997	4.63%	1.48%	-3.15%
10	July 1989	9.03%	5.91%	-3.12%

Exhibit 5 *According to DALBAR, the method used to calculate the average equity mutual fund investor return, "captures realized and unrealized capital gains, dividends, interest, trading costs, sales charges, fees, expenses and any other costs."
Source: Quantitative Analysis of Investor Behavior, DALBAR, 2015 (for the 30-year period ended 12/31/14)

Reduction in Pre-Tax Capital Appreciation Due to Annual Costs
(1/1/1985 to 12/31/2014)

		With Annual Costs of 1.0%, the Effective Reduction on Capital Appreciation from 8% to 7% and 15% to 14%		With Annual Costs of 1.5%, the Effective Reduction on Capital Appreciation from 8% to 6.5% and 15% to 13.5%		With Annual Costs of 2.0%, the Effective Reduction on Capital Appreciation from 8% to 6% and 15% to 13%	
		8 to 7	**15 to 14**	**8 to 6.5**	**15 to 13.5**	**8 to 6**	**15 to 13**
Holding Period In Years	**5 Years**	-14.1%	-8.5%	-21.1%	-12.6%	-27.9%	-16.7%
	10 Years	-16.6%	-11.1%	-24.3%	-16.3%	-31.8%	-21.4%
	15 Years	-19.1%	-14.0%	-27.6%	-20.4%	-35.7%	-26.4%
	20 Years	-21.6%	-17.1%	-31.1%	-24.6%	-39.7%	-31.5%

Exhibit 6 *
Source: This table based on an idea from David M. Darst's book The Art of Asset Allocation. New York: McGraw Hill, 2003, pp. 179. This is a hypothetical illustration based on my calculations. Your actual results may vary.

Evidence from Market-Timing Newsletters: The Story of the Motley Crew

It is often said that there are two kinds of investors: those who don't know where the market is going and those who don't know what they don't know. Advice from market-timing newsletters seems to support this claim.

John Graham and Campbell Harvey performed an exhaustive review in 1994, published in the Journal of Financial Economics, of 237 market-timing newsletters. Their research showed that from 1980 to 1992 less than 25% of the recommendations made in the newsletters were correct, and that several of the newsletters' predictions were incorrect with astonishing regularity. One well-known market-timing advisor produced a 5.4% loss during a 13-year period when the S&P 500 Index produced an annual return of 15.9%.[6]

Based on additional research published by CXO Advisory Group at its website, 42 of the 68 gurus (61.8%) tracked were accurate less than 50.0% of the time between 1999 and 2012. These results are based on the firm's ongoing "guru grades" available at its website, www.cxoadvisory.com. (These conclusions were based on data I analyzed at the site on August 17, 2016). Between 2005 and 2012, CXO Advisory Group "…collected 6,582 forecasts for the U.S. stock market [as measured by the S&P 500 Index] offered publicly by 68 experts, bulls and bears employing technical, fundamental and sentiment indicators. Collected forecasts include those in archives, such that the oldest forecast in the sample is from the end of 1998." The best market timer made accurate predictions 68.2% of the time. This means that after transaction costs, no single market timer was able to make money.

The Evidence from Fund Managers

In his book Investment Fables Aswath Damodaran conducted some interesting research on cash levels held by investment managers during the period 1980 to 2001. He noted that cash balances seemed to increase after bad years for the market and to decrease after good years, but he found little predictive power in the level of cash holdings.[7]

Damodaran also noted that after the crash of 1987, many mutual fund managers claimed that they could have saved investors

money by steering them out of equities before the crash. They argued they could have moved between stocks, bonds and T-bills in advance of major market movements and this would have allowed investors to earn higher returns. Yet during the '90s, returns delivered by these funds fell short of their promises. Analyzing returns between 1994-1998 and 1989-1998, he shows that the "S&P 500" (which reflected the performance of the overall stock market), delivered a higher average annual return (more than 15.0% annualized in the 5- and 10-year periods studied) vs. 12 so-called "Asset Allocation" funds that sought to avoid losses and deliver better-than-stock market returns (which gained about 12.0% and 10.0% annualized during the 5- and 10-year periods, respectively).

These results underscore the notion that buy-and-hold strategies historically have outperformed efforts to time the market. Another much broader study of returns for more than 400 U.S. mutual funds between 1976 and 1994 found "no evidence that funds have significant market-timing ability."[8]

Evidence in the Market

In a 1994 article titled "The Folly of Stock Market Timing," R.H. Jeffrey examined the effects of moving assets between the S&P 500 Index and Treasury bills between 1975 and 1982 (using annual timing intervals) and concluded that the potential downside vastly exceeded the potential upside. (While Jeffrey focused much of his attention on this 8-year period, he also analyzed market-timing results between 1926 and 1982 and several periods within that multi-decade span.) Summarizing his findings, he wrote, "The point of these charts and statistics is simply to emphasize that a market-timing strategist has tremendous natural odds to overcome, and that these odds increase geometrically with the length of the time frame and with the frequency of the timing interval." In fact, he determined that the process of allocating assets from stocks to cash and back may result in missing out on the best years of the market.

Using a measure Jeffrey called the "compression effect," he quantified "…the degree to which the overall positive real return from the S&P [500 Index] depended on 'being present' in equities during the few periods when real equity returns were high." His compression effect was calculated at the end of the period by removing sequentially the best quarter's returns for the S&P 500 Index in his study, then the second-best quarter and so on. In essence, the compression rate refers to the percentage of holding periods with the most influence on the results from perfectly timing the market. Missing these periods would have yielded a return below that of a buy-and-hold investor. The smaller this figure, the more difficult it was to beat a buy-and-hold strategy. Jeffrey added that the rationale for being fully invested lay not in the frequency with which stocks outperformed cash, but rather that most of the gains in his study were "…compressed into just a few periods, which (perversely but understandably) tend to follow particularly adverse times for stocks." Summing up one of the many challenges for investors seeking to time the market, success "…depends on buying stocks when the prevailing view is that they should be sold, and vice versa," Jeffrey wrote.[9]

Further evidence of the difficulty in effectively timing the market is provided in a detailed 1992 study conducted on the South African stock exchange. In this study, academics researched the results of perfectly accurate market timing (0%-100% equity) between South African T-bills and the JSE All Share Index (AS) over the period 1967–1989. Rebalancing was calculated on a monthly, quarterly and annual basis. A buy-and-hold strategy in the JSE All Share Index would have yielded 20.1% annually; T-bills would have yielded 8.9% annually. Perfectly accurate market timing on a monthly basis would have increased the returns to 48.8% annually. The less one rebalanced (quarterly or annually), the lower the results were.

Consistently incorrect timing (on a monthly basis) would have resulted in an annual loss of 23.6%. (The results of incorrect timing were better when rebalancing on an annual basis.) The spread between perfect correct timing and incorrect timing was a spectacular 72.4%. The loss/gain ratio was always greater than 1.0, indicating an investor could have lost much more than he could have gained with market timing. In order to be a perfectly accurate market timer, investors needed to reverse their investment course on 42% of the observations. The compression rate in this study was always about +/-10%. In other words, in order to gain with perfect market timing, you would have needed to be accurate in at least 87.4% of the switches. If you were right in 68.3% of the cases, your return would have equaled a passive buy-and-hold strategy.[10]

Evidence from Mutual Fund Investors

Revisiting Dalbar's research (See Exhibit 7 on the next page), for the 30 years ended 2015, the S&P 500 Index earned 10.35% annually, but the average equity fund investor earned just 3.66%. Underperformance also occurred for fixed income investors. In fact, inaccurate market timing in fixed income investments resulted in lower returns (+0.59% annualized) than inflation (+2.60%).[11] It is also worthwhile to notice the poor performances generated by shareholders in tactical asset allocation funds, in which returns lagged inflation over the 30-year period.

Evidence from Technical Indicators

Patterns revealed using technical analysis to evaluate stock prices show trend reversals over short- and long-term periods and more consistent trends over medium-term periods. Yet academic studies do not find similar evidence when it comes to the broader market.

As shown in Exhibit 8 (next page), during two-year periods when the market has risen significantly, there has been neither evidence nor clear patterns indicating that future returns will be negative. There is, however, some evidence for price momentum over one-year periods (in an up year to be followed by an up year) and price reversal (highest return coming after a down year). We can conclude that there is limited information that we can see in past returns that allow us to make reasoned judgments about the future.

Another study, "Technical Analysis Around the World," looked at over 5,000 popular technical trading rules applied to 49 MSCI Country Indices from 2001 to 2007. The study found that technical analysis was not consistently profitable once data mining bias was accounted for. The authors concluded that applying more than 5,000 trading rules did not add value to investment performance.[12]

Are We Better Than Our Competitors?

Many academics describe market timing as a losing investment

Ann. Returns (in %) for the "Average" Investor vs. Inflation and Indices Over Various Periods (through 12/31/2015)

	"Average" Investor Returns			Inflation and Indices		
	Equity Funds	Asset Allocation Funds	Fixed Income Funds	Inflation	S&P 500 Index	Barclays Agg. Bond Index
30 Years	3.66	1.65	0.59	2.60	10.35	6.73
20 Years	4.67	2.11	0.51	2.20	8.19	5.34
10 Years	4.23	1.89	0.39	1.88	7.31	4.51
5 Years	6.92	3.28	0.10	1.58	12.57	3.25
3 Years	8.85	3.81	-1.76	1.07	15.13	1.44
12 Months	-2.28	-3.48	-3.11	0.95	1.38	0.55

Exhibit 7 *According to DALBAR, the method used to calculate the average equity mutual fund investor return, "captures realized and unrealized capital gains, dividends, interest, trading costs, sales charges, fees, expenses and any other costs."
Source: Quantitative Analysis of Investor Behavior, DALBAR. 2016, page 5.

S&P 500 Index Returns Have Shown Mixed Momentum Signals
Average Returns Following Up and Down Markets Over 1- and 2-Year Periods (1/1/1961-12/31/2015)

	Number of Occasions	Average % in Following Year	% of Up Years the Following Year
After 2 Down Years	8	1.42	50.00
After 1 Down Year	29	9.28	65.52
After 1 Up Year	57	6.48	66.67
After 2 Up Years	38	3.44	57.89

Exhibit 8 *
Source: S&P 500 Index via Bloomberg, as of 12/31/15.

strategy. On the other hand, many investment professionals continue to believe they can be successful market timers. The school of behavioral finance cites two reasons to explain this dichotomy: (1) the folly of forecasting and (2) overconfidence. Investment professionals and laymen investors alike have been proven to not be successful forecasters. Yet many investment professionals tend to be overconfident in their own forecasting abilities and continue to use market timing as the core of their investment processes. James Montier provides evidence of this in his book *Behavioural Investing*.[13]

When investors forecast markets incorrectly, it becomes increasingly difficult for them to reverse their bets the longer they wait. The reason is that they must admit that they were wrong. According to behavioral finance concepts known as anchoring and Prospect Theory (or the tendency to treat losses differently than gains), investors' perception of their losses is reference dependent. Once a bet turns against them, their natural reaction is to reverse their course of action the next time they see the reference point. Unfortunately, in many cases, this never happens and investors don't learn from their past mistakes.

Conclusion

My belief is in line with those who believe market timing is detrimental to a sound and disciplined investment process. For example, economist J.M. Keynes believed that deviating from strategic asset allocation decisions was impractical and counterintuitive to achieving positive long-term results. In fact, deliberate short-term deviations from policy targets, he wrote, introduce substantial risks to the investment process:

"The idea of wholesale shifts is for various reasons impractical and indeed undesirable. Most of those who attempt to, sell too late and buy too late, and do both too often, incurring heavy expenses and developing too unsettled and speculative a state of mind."[14]

David Swensen, manager of the Yale Endowment Fund, wrote,"Market timing explicitly moves the portfolio away from long-term policy targets, exposing the institution to avoidable risks. Because policy asset allocation provides the central means through which investors express return and risk preferences, serious investors attempt to minimize deviations from policy targets. To ensure that actual portfolios reflect desired risk and return characteristics, avoid market timing and employ rebalancing activity to keep asset classes at targeted levels."[15]

My research reveals that investors tend to be overconfident in their attempts to time the market and that market timing strategies actually underperform in the long run due to transaction costs, opportunity costs and poor investment decisions. The results of the Firer, Sandler and Ward study cited earlier revealed how difficult market timing has been: a perfect market timer needed to reverse his investment course about 40% of the time. However, the compression rate was always around 10%, indicating that the ideal periods to switch were concentrated. The accuracy rate reveals a market timer needed to be right in about 70% to 80% of investment decisions; otherwise,

he lost money due to transaction costs. One must also consider the gain/loss ratio, which was 1.5 or higher, meaning one could have lost more than one gained when attempting to time the market.

While many successful investors attribute their successes to superior stock picking or adherence to a sound investment discipline, I know of no single Wall Street guru who made his or her fortune using market timing. Elaine Garzarelli became a superstar on Wall Street by predicting the Wall Street crash of 1987 a few weeks in advance, and was ranked for 11 years on the "first team" in Quantitative Analysis in Institutional Investor's all-star poll. Looking back, that was a great run. But by 1998, BusinessWeek asked, "Remember Elaine Garzarelli? Two years ago, the investment strategist—who made her name by turning bearish a month before the 1987 crash—yelled 'sell!' at Dow 5400. Six months later and 1200 points higher, she turned bullish. But too late: Her bad call took Garzarelli out of the guru game."[16] Fifteen years later, in a special issue of BusinessWeek published in Spring 2003, Garzarelli predicted, "The stock market is stuck in a holding pattern for years."[17] That predication came shortly before a prolonged multi-year bull market.

It is my belief that sound investment philosophy should be based on strategic asset allocation decisions, with limited flexibility to make tactical moves. If one wishes to engage in tactical moves, they must adhere to a strict discipline. For example, a balanced portfolio may have the flexibility to deviate from 50% equity/50% fixed income to a 45% equity/55% fixed income weighting, but not be permitted to deviate further. I strongly advise against more extreme market timing decisions and always encourage decision makers to keep top of mind the trust our clients put in us to provide the best advice possible.

**Past performance is not a guarantee of future results. One cannot invest directly in an index. Exhibits do not reflect the effects of fees and taxes.*

Endnotes

Andrew Duncan and William Massina contributed to this report.

1. Based on analysis of monthly returns for the S&P 500 Index (from Bloomberg) between Dec. 1927 and Dec. 2015. The launch date of the S&P 500 Index was March 4, 1957. All information prior to the index launch date is back-tested. Back-tested performance is hypothetical and not actual performance. The back-test calculations are based on the same methodology in effect when the index was officially launched. Returns include dividends but do not reflect effects of taxes or fees. Past performance is not a guarantee of future results. One cannot invest directly in an index.

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Wim Antoons is Head of Asset Management at Bank Nagelmackers. In this role, he oversees the investment process for the private banking and fund of funds businesses. He established the firm's value investment philosophy and its open architecture fund platform. He is also co-manager of the Nagelmackers Funds and manager of the Nagelmackers Privilege Fund. Before joining Nagelmackers, he worked for 6 years in the unit-linked business at BNP Paribas Bank, responsible for the selection of value equity funds. He earned a Master of Commercial and Financial Sciences at the Hogeschool-Universiteit Brussel (EHSAL) and has 22 years of investment experience.

Designing the Future of Target-Date Funds:
A New Blueprint for Improving Retirement Outcomes

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AllianceBernstein (AB)

Executive Summary

Target-date funds are the key to the future of retirement savings for American workers. While these funds have seen tremendous asset growth over the past decade, their investment design hasn't kept pace with available innovations. The result: many target-date strategies may fail to guard against today's heightened retirement risks.

It's time to revisit target-date fund designs and single-manager structures. Most retirement plans still use traditional designs that were adopted years ago, but fiduciary standards have changed. In fact, the US Department of Labor (DOL) has issued "Target Date Retirement Funds: Tips for ERISA Plan Fiduciaries," which highlights the need for plan sponsors to have a solid process for selecting and monitoring their target-date choice.

The investment environment has changed, too. A broader range of strategies is now available and time-tested, beyond traditional equity and fixed income. These strategies can help reduce sensitivity to market, interest-rate and inflation risks at different points in the glide path. And diversifying against these risks can improve overall outcomes versus a traditional glide path roughly 80% of the time.

We see five key areas (Exhibit 1, next page) for evolving the state of target-date design:

- Moving from a single investment manager to a multi-manager or open-architecture format to access best-of-breed managers and reduce concentration risk
- Diversifying the underlying investment mix from a traditional stock/bond glide path to incorporate nontraditional asset classes, too
- Providing greater flexibility to respond to short-term market fluctuations with a dynamic, rather than static, approach

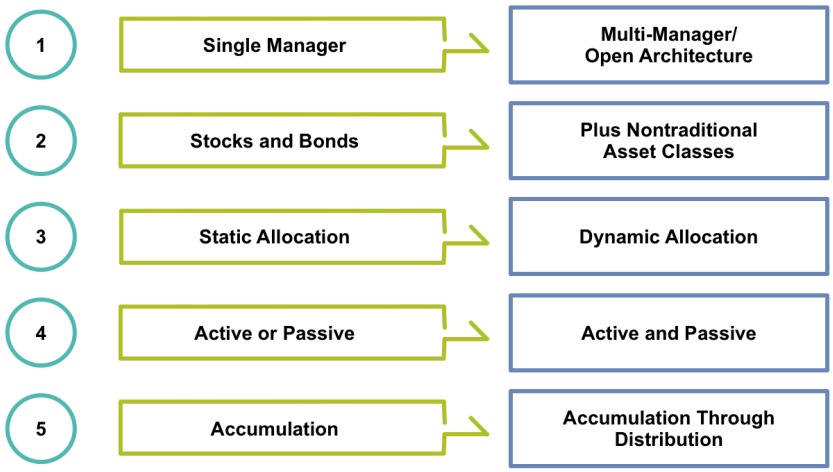


Exhibit 1: What Will the Next Generation Target-Date Funds Look Like?
The Evolution of Target-Date Design

- Mixing active and passive investing strategies to enhance risk-adjusted returns and manage costs
- Calibrating the glide path to deliver better results in the distribution phase of a retirement plan—a critical but often overlooked component of any retirement solution

AB has already applied these research insights to create better target-date solutions for large institutional retirement plans. We believe that this design will be the future of target-date funds for plans of all sizes.

Updating Retirement Reality

Ten years ago, we published our first blueprint for target-date design. It was based on thorough research and a detailed analysis of what we found to be best practices for constructing a sensible glide path. A lot has changed since then. There are new tools available—new asset classes, new approaches to handling volatile market conditions and new interest in open-architecture structures that accommodate multiple investment managers. Most importantly, the Pension Protection Act of 2006 and regulations from the DOL gave new support to three types of all-in-one portfolios—target-date funds, balanced funds and managed accounts. These steps essentially blessed these asset-allocation investments as qualified default investment alternatives (QDIAs) with safe-harbor protections.[1]

Selecting the Right Default: The Central Decision for DC Plans

QDIAs will increasingly define the retirement savings path for many workers—and the future of most companies' retirement plans. As older workers retire and companies automatically enroll new employees into a QDIA, defined contribution (DC) plan assets will increasingly move out of core menu options and into the default option. Just through this normal workforce turnover, within a decade the majority of many DC plans' assets will likely be invested in the plan's QDIA.

The projected dominance of QDIAs makes selecting or upgrading a DC plan's target-date offering more important because it is, by far, the most prevalent QDIA (Exhibit 2). Of course, every addition to or deletion from the investment menu should be done carefully and thoughtfully, but the stakes are even higher in selecting a target-date offering. It's arguably the most important decision facing plan sponsors. A target-date fund will likely shape the retirement future of most employees in a plan—and the ultimate success of the retirement plan itself.

In the past, increasing plan-participation rates was the primary success measure for many DC plans. But that benchmark has changed. In our recent plan-sponsor survey, the most common measure of success is having employees feel confident about their prospects for a comfortable retirement.[2] That means that plan sponsors need to put more energy into finding effective ways to help participants achieve that confidence. Essentially, plan sponsors need to use improved methods to provide a better, more reliable level of income replacement in retirement.

We feel it's time to revisit target-date funds and assess what we can do to make their glide paths and overall design work more effectively for the long-term retirement needs of workers. If the target-date fund isn't enhanced over time, it can't be best positioned to meet the needs of a growing number of participants who rely on it for their retirement confidence.

Target-Date Market: Quick to Grow...Slow to Innovate

Target-date funds have grown sharply over the past decade—more DC plans offer them, more participants use them, and asset totals reflect their popularity. During that same time, investing strategies and vehicles have continued to evolve.

Target-date design has not kept pace, failing to reflect best practices adopted by other big pools of assets overseen by fiduciaries, such as pensions and endowments. Those best practices include:

- Using multiple investment managers to enhance diversification at several levels
- Independent fund selection
- Nontraditional investments, such as commodities, real estate and other liquid and illiquid alternatives
- Dynamic methods for muting the most damaging effects of extreme market volatility

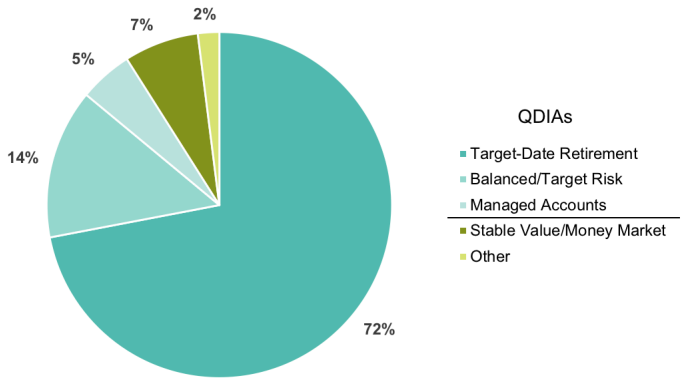


Exhibit 2: Target-Date Funds Are the Most Popular Plan Default
Current Plan Default Investment
Source: Callan Associates

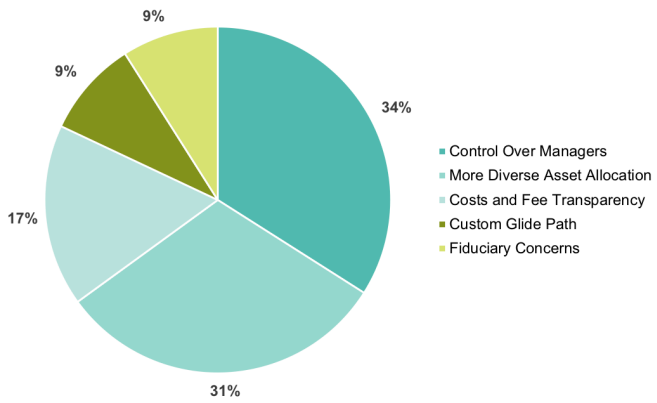
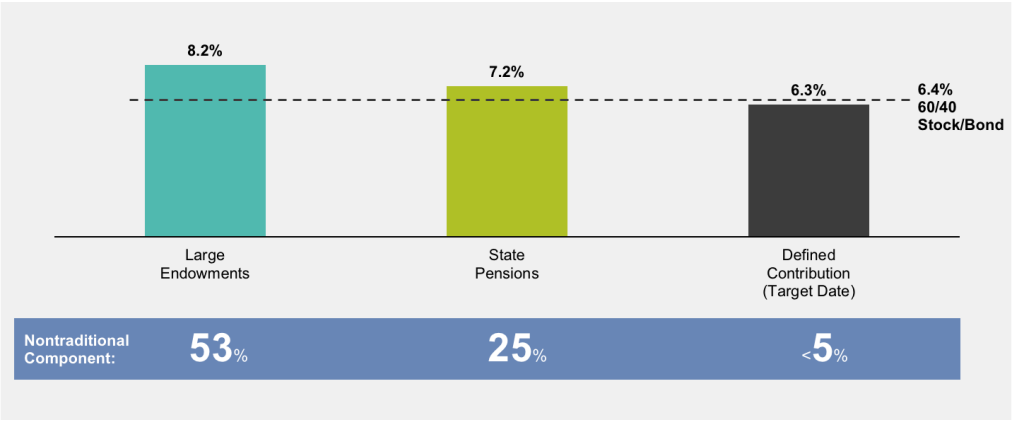


Exhibit 3: Why Large Plans Customize Target-Date Funds
Factors Mentioned by Sponsors in Selecting Custom Target Date
Source: Casey Quirk, Target-Date Retirement Funds: The New Defined Contribution Battleground, November 2009



Large endowment sample consists of 78 endowments with assets greater than $1 billion and totaling $310 billion in assets; target-date sample consists of 17 target-date funds with 10-year track records totaling $475 billion in assets and spanning 2020/30/40 vintages.

Exhibit 4: Diversification Helps Boost Returns
Median 10-Year Returns for Large Endowments, State Pensions and Target-Date Funds (Ended June 30, 2013)
Source: Cliffwater, eVestment, National Association of College and University Business Officers/Commonfund and AB

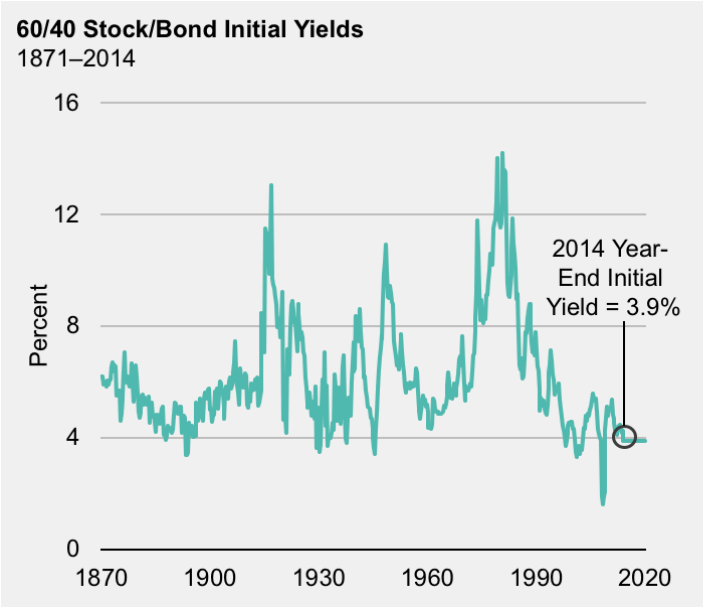
Why has the target-date landscape been slow to innovate? One factor may be that the top three target-date fund providers account for roughly three-fourths of the assets in the market—due in large part to their strong, historically bundled recordkeeping operations. No other large asset pool has such heavy concentration among so few providers—not retail mutual funds, high-net-worth investors, defined benefit (DB) plans, sovereign funds or endowments.

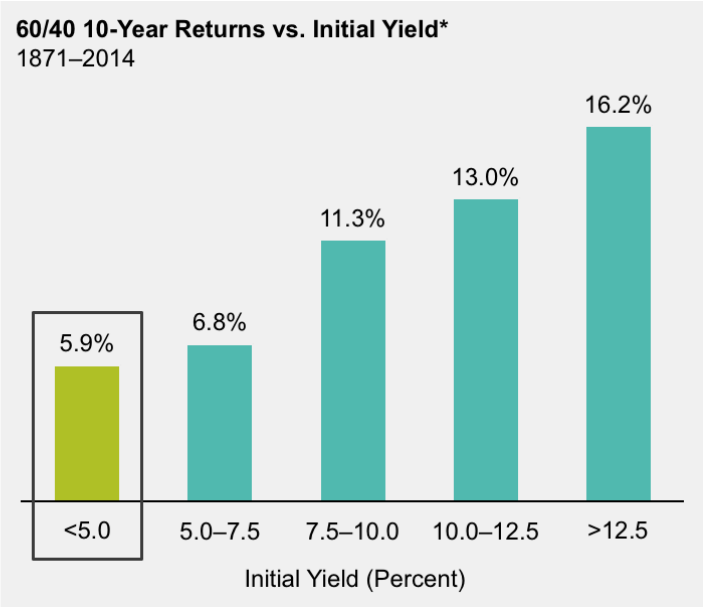
Another, perhaps bigger, concern is glide path diversification. The glide paths of these dominant providers aren't well diversified, by today's standards. A hypothetical average blend of the three dominant glide paths is composed almost entirely of stock and bond portfolios, with some cash and other short-term instruments in participants' later years. There's a nod to nontraditional investments, but it's only a minimal sliver of real assets such as commodities and real estate. It's also mostly limited to real estate investment trusts (REITs)—perhaps the most traditional investment in the nontraditional arena.

In sharp contrast, the largest DC plans have taken note of institutional best practices and gravitated toward customizing their target-date funds, tailoring the asset allocation to participant demographics. But DC plan sponsors have found that customization provides bigger benefits: control over underlying managers and a more diverse mix of asset classes (Exhibit 3).

That diverse mix often incorporates a range of alternatives and nontraditional investments to further diversify traditional stock/bond allocations. For some investors, alternatives carry an undeserved stigma of outsize risk, but nontraditional investments (beyond simple stocks and bonds) are helpful in a comprehensive, long-horizon retirement investment. They help reduce risk and generate return, which is important, given the more challenging return environment enhanced use of diversifying asset classes has been highlighted as a key reason that both large endowments and state pension plans outperformed target-date funds (Exhibit 4).

We may see an acceleration in the gradual migration toward customized and multi-manager solutions in the next few years, partly due to the DOL's suggestion that fiduciaries look into custom or nonproprietary target-date funds (see "US Department of Labor: Focused on Target-Date Oversight," page 46). The DOL's recommendation is significant, given the heavy asset concentration among the major traditional target-date fund providers.





Historical analysis does not guarantee future results.
*Initial yield = 60% S&P 500 E/P and 40% 10-year US Treasury yield

Exhibit 5: Today's Low Initial Yields Have Historically Resulted in Subpar Long-Term Investment Growth
Source: Bloomberg and Global Financial Data (GFD)

Hurdles Ahead for Traditional Glide Paths

There is a growing investment rationale for updating target-date designs. As we see it, traditional glide paths that rely exclusively on traditional stock and bond allocations will be less likely to deliver enough investment growth. On their own, they're not able to combat the four key risks that can derail an individual's retirement prospects:

1. Subpar investment growth
2. Market risk
3. Inflation risk
4. Increasing longevity

Subpar Investment Growth: The Long-Term Savings Risk

Below-normal investment growth is usually the first risk that investors confront—and the longest-lasting one. The failure to generate enough performance in the accumulation years has always shaped investment decisions and will likely become an even bigger challenge in the next decade. Investors will face relatively unfavorable market conditions for both stocks and bonds because quantitative easing by developed-market central banks has pushed down yields on both asset classes toward historical lows.

If we look at a hypothetical portfolio of 60% stocks (as represented by the S&P 500 Index) and 40% bonds (the 10-year US Treasury yield) over the past 150 years, initial yields of 3.9% (as of December 31, 2014) are about as low as they've ever been. That's not a good sign because those current yields may paint a dismal picture for returns ahead. Historically, when the initial yield has been under 5%, the forward 10-year return on a 60%/40% stock/bond portfolio has been well below historical averages (Exhibit 5).

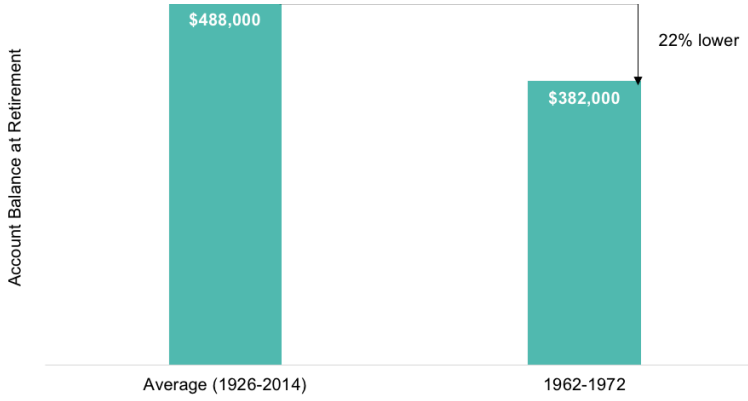


Exhibit 6: Difficult Markets Near Retirement Can Severely Impact Savings
1962-1972 is About 22% Lower than Average
Source: AB

To illustrate the impact that subpar investment growth can have on retirement savings, we can study the hypothetical experience of retirees through history. For example, let's turn to the early 1960s— when yields were comparable with today's.

A participant who was 55 years old in 1962 would have had 22% less savings at retirement than the median 10-year outcome for participants aged 55 during the 1926–2004 period (Exhibit 6). These lower savings would have been depleted within just 10 years after retirement. As we've noted, current market conditions mean that future growth rates are likely to be challenged. So we believe that while growth risk may always be an issue for investors, it's likely to be on the rise today.

Market Risk: Not Enough Risk Reduction

Most individual investors want to avoid drastic short-term equity market plunges—especially in the period right before retirement,

US DEPARTMENT OF LABOR:
FOCUSED ON TARGET-DATE OVERSIGHT

The DOL is the primary regulator in the retirement plan space. In 2013, it issued "Target Date Retirement Funds: Tips for ERISA Plan Fiduciaries," which included helpful best-practices ideas. Because of the DOL's stature, many plan sponsors take the hint and follow the guidance as fiduciary best practices.

These tips, combined with the DOL's recommendations for DC plans in the Pension Protection Act of 2006 and subsequent guidance, have boosted the growth in target-date assets. The tips are also the DOL's further recognition of the important role that target-date funds play in the future of American workers' ability to retire comfortably—and when they want to retire.

It's likely that many plan sponsors didn't do a lot of due diligence when they selected the original target-date funds for their plans. In many cases, it may have been the only target-date choice recommended—or even allowed—by the recordkeeper. With new target-date fund designs and solutions available in the marketplace, the DOL is suggesting that plan sponsors have a solid process for selecting and monitoring their target-date choice.

Most of the DOL's tips focus on process and review—a list of commonsense practices that a plan investment committee should go through:

- + Establish a process for comparing and selecting target-date funds
- + Establish a process for periodically reviewing them
- + Understand the fund's investments and the glide path
  - + The strategy of the fund and underlying investments
  - + Does the glide path reach its most conservative allocation at target retirement date or later
- + Review the fund's fees and investment expenses
- + Develop effective employee communications
- + Take advantage of the growing body of commercially available information on target-date funds
- + Document the selection and review process, including how fiduciaries reached decisions about individual investment options.

None of those tips were unexpected. But the DOL included one other tip that was more forward-looking: Inquire about whether a custom or nonproprietary target-date fund would be a better fit for your plan.

We find it interesting—and encouraging—that the DOL voiced its support for open-architecture, or at least independent, target-date fund design.

when they're about to start withdrawing income from their retirement accounts. If new retirees start drawing down funds even as markets are falling, that one-two punch could prevent their remaining capital from recovering enough to meet their long-term retirement needs.

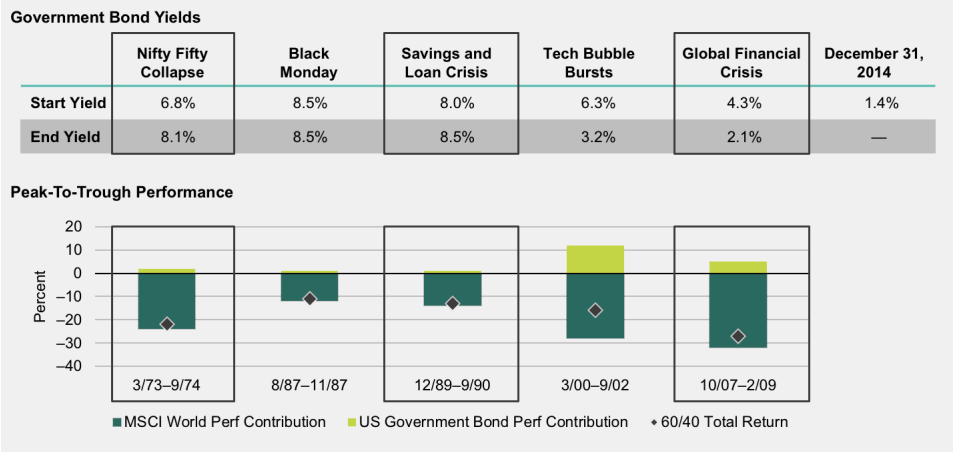
Typically, bonds are the classic offset to equity risk, so it can be effective to reduce a glide path's equity exposure toward more of an even balance between stocks and bonds as an investor nears retirement. In fact, that approach has worked well during the last two decades, when the correlation between bonds and equities was sharply negative. For example, in the aftermath of the tech bubble and global financial crisis, bond yields fell significantly, resulting in very strong bond returns, giving a balanced portfolio a meaningful cushion against equity market declines. Yields dropped over 300 basis points (from 6.3% to 3.2%) between 2000 and 2002 and 200 basis points (from 4.3% to 2.1%) through the 2007–2009 period (Exhibit 7, next page).

But bonds haven't always provided a large risk-reduction benefit when stocks have suffered steep declines. That was true for three earlier equity bear markets: the collapse of the "Nifty Fifty" large-cap US stocks in 1973, Black Monday in 1987, and the savings and loan crisis in late 1989. During the aftermath of those three, bond yields either stayed the same or rose, so they delivered returns that hardly made a dent in the severely negative equity returns.

How bonds may respond in the next bear market is very difficult to predict. But one thing is certain: With yields near historical lows (1.4%, as of December 31, 2014), they would have little or no room to fall before hitting a 0% floor. So bonds aren't likely to return much during an equity market plunge and be as effective a shock absorber as they've been in the recent past. It's prudent for glide path managers to explore additional ways of reducing the potential losses from another equity market plunge.

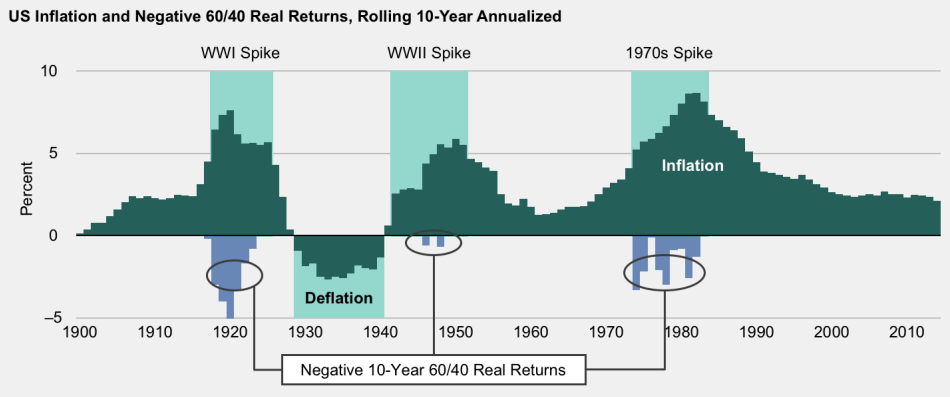
Inflation Risk: The Bane of Retirees

We've had a remarkable 30-year run of declining interest rates and modest inflation. As a result, most of today's investors have little or no experience with the damaging effects of rising inflation on a portfolio. But even though extremely accommodative monetary policy hasn't ignited inflation yet, it does raise the odds of inflation picking up in the not-too-distant future. When inflation—or even concern about inflation—starts to rise, traditional stock/bond portfolios can turn on investors.



*60–40% total return comprises 60% stocks and 40% bonds; stocks are represented by MSCI World Index and bonds by AB data through 1987 and Bloomberg Barclays US Treasury Index thereafter.

Exhibit 7: Bonds Haven't Always Offset Market Risk When Equities Plunged
Source: Bloomberg Barclays, Bloomberg and AB



Through December 31, 2014.
*This hypothetical portfolio comprises 60% stocks and 40% bonds; stocks are represented by the S&P 500 (with Global Financial Data extension) and bonds by 10-year Treasuries through 2009 and Bloomberg Barclays US Treasury 7–10 Year Total Return Index thereafter. Inflation is measured by the US consumer price index, US city average; all items, not seasonally adjusted, through December 2014.

Exhibit 8: Only During Periods of High Inflation Has a Traditional 60/40 Portfolio Delivered Negative 10-Year Real Returns
US Inflation and Negative 60/40 Real Returns, Rolling 10-Year Annualized
Source: Bloomberg Barclays, GFD, US Bureau of Labor Statistics and AB

The last time US inflation surged was during the 1970s and 1980s (Exhibit 8). Many investors fled bonds to avoid being tied to fixed-income payments when interest rates were rising and inflation was eating away their spending power. But they also demanded a bigger discount rate on equities, so both asset classes declined. This produced an extended period of negative returns for a traditional 60/40 portfolio. When inflation rises, the benefits of traditional diversification can break down, exposing participants to potential larger-than-expected downside risks.

That's why inflation breakouts have historically been among the most destructive influences on a traditional stock/bond portfolio's returns. In Exhibit 8, we look at that influence over time. The green bars show the annual percentage change in the Consumer Price Index when the rolling 10-year annualized return for a traditional stock/ bond portfolio was negative in real (inflation-adjusted) terms. Those periods happened only when inflation was rising, making inflation a crucial risk that any glide path design should consider. But glide paths haven't paid much attention to this issue. However, inflation protection is cheap today, so its inclusion is both appealing and compelling.

Increasing Longevity: A Life Benefit, A Portfolio Risk

The last risk on our list is a problem that most people would like to have: a long life. In the past century, the average life span in the US has increased by nearly 50%—from 55 years in 1900 to 79 in 2000 for females, and from 54 to 74 for males. Those are just the averages.

Few participants realize that half of today's 65-year-old men will live beyond age 89 and that half of 65-year-old women will live past 90. For a couple reaching age 65, there's a 50% chance that at least one of them will live beyond age 94—and a 25% chance that one of them will live past age 98 (Exhibit 9, next page).

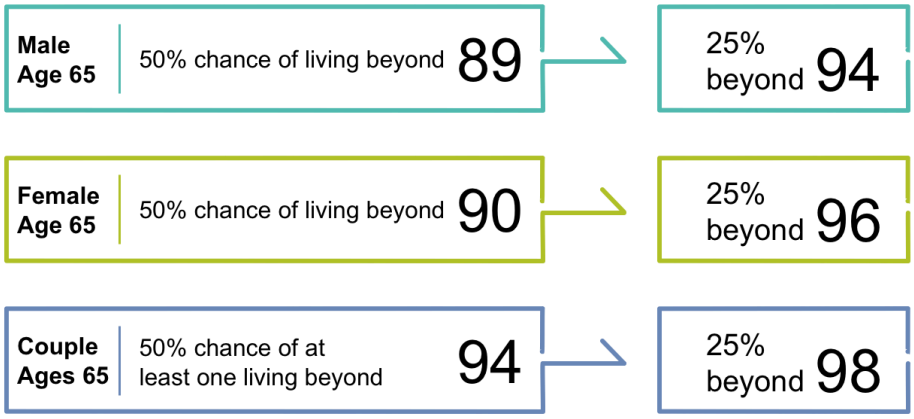
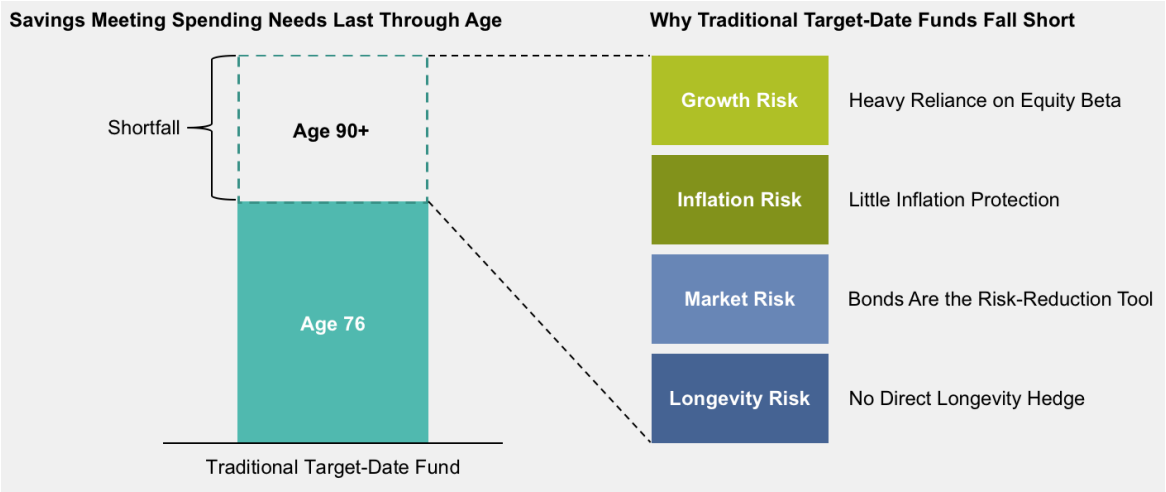


Exhibit 9: Financing Longer Living is a Growing Portfolio Risk for Investors
Source: Risks and Process of Retirement Survey Report, Society of Actuaries, 2012



Since 1973, starting with $500,000 at age 65, spending of 50% as replacement ratio, hypothetical target-date fund created by averaging the top three target-date mutual fund provider offerings

Exhibit 10: Traditional Target-Date Funds are Falling Short

And the longevity trend keeps rising: one estimate suggests that half the children in the developed world born after 2000 will likely live to 100.[3]

Despite the clear evidence of rising longevity statistics, the possibility of outliving retirement assets still feels remote to many participants. Because of that, the severe impact that outliving assets can have on later retirement years doesn't get enough serious attention until it's about to happen—when there are few, if any, options to offset that risk.

Earlier planning for longevity risk might cause participants to save more, but they frequently underestimate how long they may live and overestimate how high a withdrawal rate they can afford. Our recent DC plan-participant survey found that nearly one quarter of respondents believe that they could withdraw a whopping 10% or more annually from their DC plan savings without depleting their assets before they die. Four in 10 of our respondents believe that they could withdraw 7% or more annually.[4]

Not New Risks But Bigger Risks

None of these four risks are new. In fact, we examined them extensively in research we published a decade ago.[5] The issue today is that these risks are all rising, putting retirement security out of reach for most workers.

As a starting point, we looked at how well today's traditional target-date design would have met the spending needs of a participant retiring at age 65 in 1973—the last time participants faced a market environment where all four key risks were heightened.

We started with a hypothetical stand-in for an industry average glide path: the average of the top three target-date fund providers' allocations. We then used historical indices to calculate market performance. And we combined that with the assumption that employee retirement spending would be 50% of their final year's salary. Assuming that the participant had $500,000 (in today's dollars) at retirement in 1973, he or she would have run out of money by age 76, only 11 years after retirement (Exhibit 10).

So the four key risks would have eroded a participant's savings in the hypothetical average target-date strategy. Equities—the key driver of portfolio returns—failed to deliver on their long-term promise. Second, market risk was a major contributor to shortfall probabilities because of large market plunges in retirement that left the portfolio unable to recover sufficiently. Third, inflation

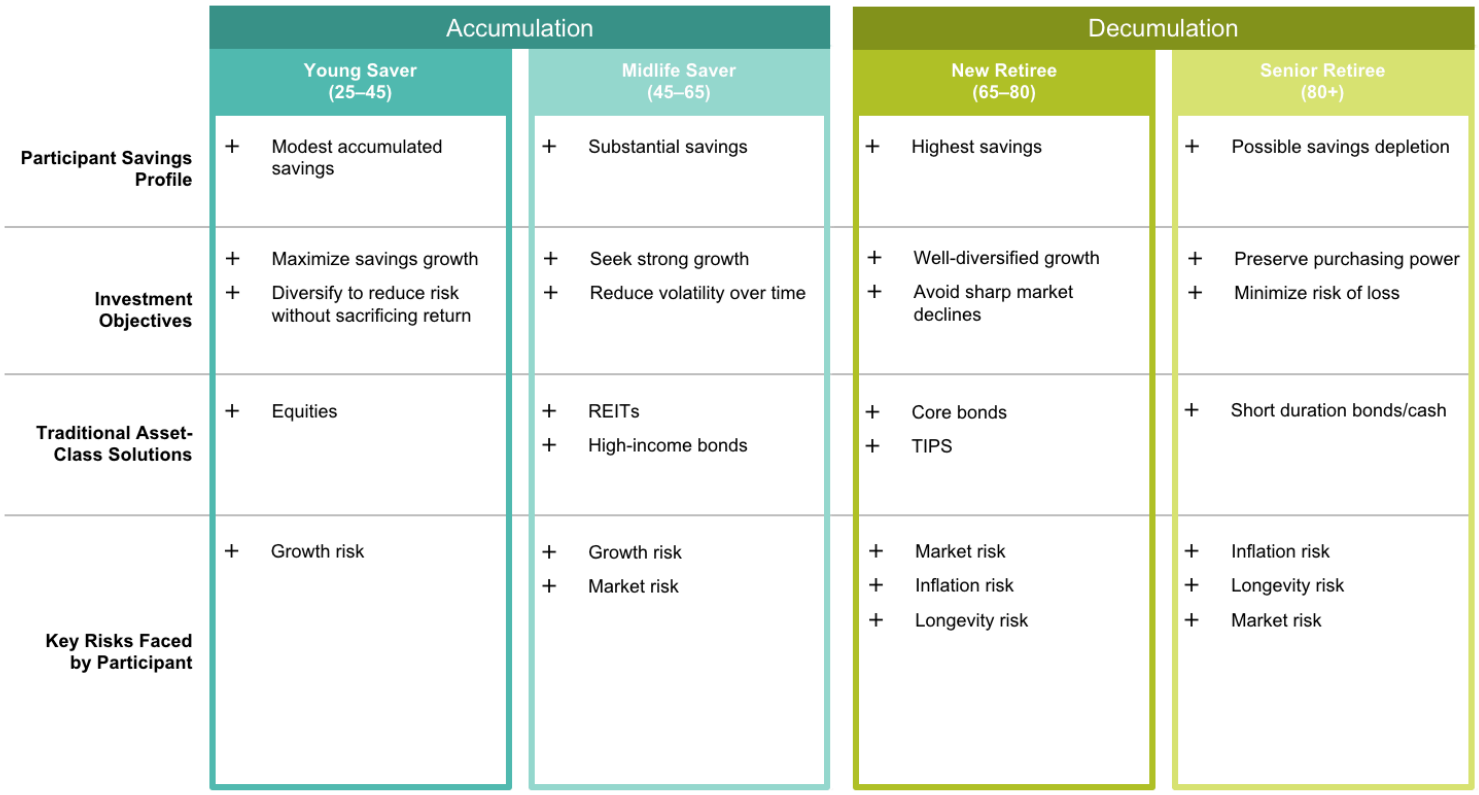


Exhibit 11: Core Glide Path Philosophy

rose at an above-average rate during retirement, and the traditional portfolio doesn't have enough inflation protection.

Lastly, anyone who lived past age 76 would have run out of savings in retirement—or been forced to drastically reduce spending. With half of the retirees expected to live past 90, this is a cautionary tale for anyone forming a retirement plan that tries to be successful only for the average life expectancy. And traditional retirement plans don't have direct longevity protections.

Many New Tools for Managing the Four Risks

We don't think that plan sponsors and participants need to accept these rather depressing outcomes. In our original research, we highlighted how the four key retirement risks trump the traditional investment-risk metrics, which largely focused on portfolio volatility. These traditional measures don't capture the true dangers that participants face at different life stages. Ultimately, we estimated that a broader array of traditional asset-class exposures and good portfolio implementation could better guard against retirement risks (Exhibit 11).

Over the years, we've evolved our blueprint as new investment strategies and vehicles have become available. Some of today's tools are already familiar to institutional investors and are increasingly gaining use more broadly across the investment community (Exhibit 12, next page). But to date, these tools haven't made their way into general use for target-date funds.

Some strategies, such as commodities and market-neutral funds,[6] have been around for decades. Others, such as long-short credit[7] and unconstrained bonds, have only recently come on the scene. New or old, nontraditional diversifying asset classes can help create portfolios that are better able to capitalize on market opportunities and combat the four major risks. Those characteristics explain why the expanded menu of risk-management tools is growing—and the innovation will continue. For example, Treasury Inflation-Protected Securities (TIPS) were a somewhat provocative asset class when they were included in target-date funds 10 years ago, partly because they appeared only in the late 1990s.

But which new tools are worth using in target-date funds, and which are too cumbersome or costly?

We provide DC plan sponsors and participants with a framework that analyzes key risks, evaluates the role of traditional and nontraditional diversifiers in combating them, and builds an enhanced glide path solution that we believe will improve retirement outcomes (Exhibit 13, next page).

Advancing Target-Date Diversification

Our new blueprint includes both equities and "equity diversifiers" to manage the growth risk that young savers face in the early part of the glide path. Equities still command the lion's share of the allocation because they remain the most reliable engine for investment growth. But we believe that prudent diversification is possible without sacrificing returns. The role of equity diversifiers is to access other strategies that demonstrate strong growth potential but that have a more modest correlation to equity markets. So while it's important to diversify the equity allocation

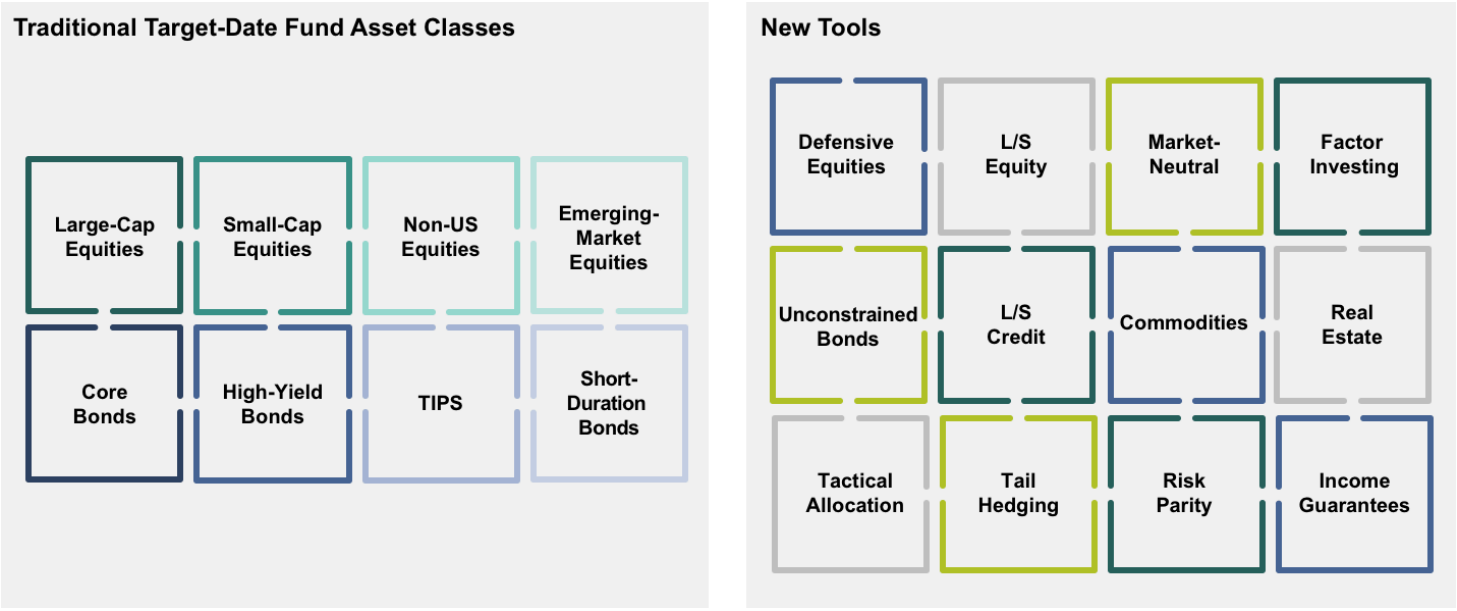


Exhibit 12: Using Traditional Asset Classes and New Tools to Help Manage Risk

	Growth Risk	Inflation Risk	Market Risk	Longevity Risk
How It Happens	+ Equities fail to deliver long-term growth	+ Inflation raises spending needs and leads to poor stock/bond returns	+ Large drawdowns near retirement permanently deplete capital	+ People are living longer and outliving their savings
Strategies to Reduce Risk	+ Strong returns with modest correlation to equity market	+ Strong growth in periods of rising inflation	+ Reduced sensitivity to market and interest-rate risk	+ Provide a reliable stream of income throughout retirement
Diversification Solutions	**Equity Diversifiers** + L/S Equity + Risk Parity	**Inflation Diversifiers** + Real Estate + Commodities + TIPS	**Equity Risk Management** + Defensive Equities + Dynamic Allocation **Fixed-Income Diversifiers** + Market Neutral + Unconstrained Bond + L/S Credit	**Guaranteed Income Component**

Dynamic Asset Allocation
Multi-Manager Design

Exhibit 13: Advancing Target-Date Diversification to Mute Heightened Risks That Participants Face Today
Diversification does not guarantee a profit or eliminate risk.

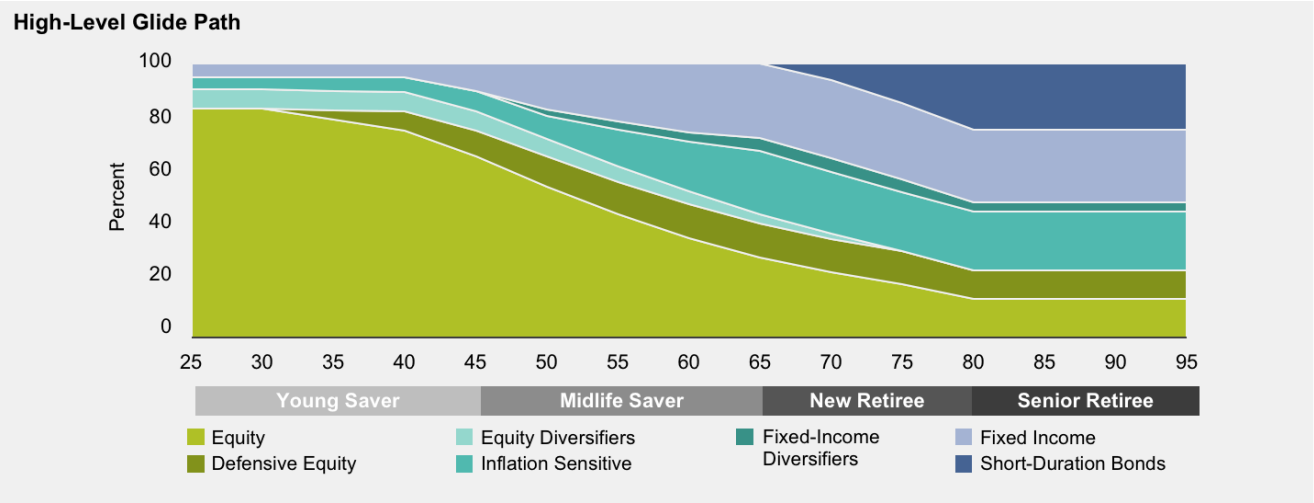


Exhibit 14: A New Blueprint for Tomorrow's Target-Date Fund
For illustrative purposes only

Equities	Growth	+ US, non-US developed & emerging market + Large-, small- and mid-cap + Defensive + Style-factor-oriented
Equity Diversifiers	Growth with low correlation to equity market	+ Long/short equity + Risk parity
Inflation-Sensitive	Strong performance during periods of rising inflation	+ Real estate + Commodities + Real bonds (TIPS)
Fixed-Income Diversifiers	Stable return with little interest-rate or market sensitivity	+ Unconstrained bonds + Market neutral
Fixed Income	Stability and income	+ Core + High income + Long duration + Short duration + US, global, currency-hedged

Exhibit 15: Bridging Traditional and Nontraditional Asset-Class Exposures in Efforts to Improve Results

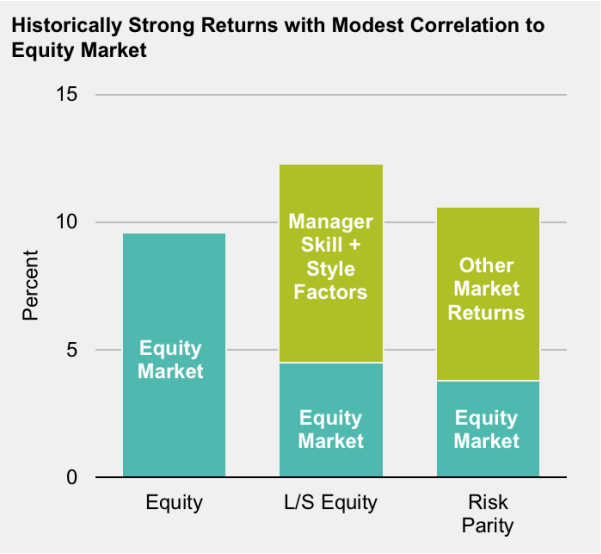
by geography, capitalization and style, effective diversification doesn't stop there (Exhibit 14 and Exhibit 15).

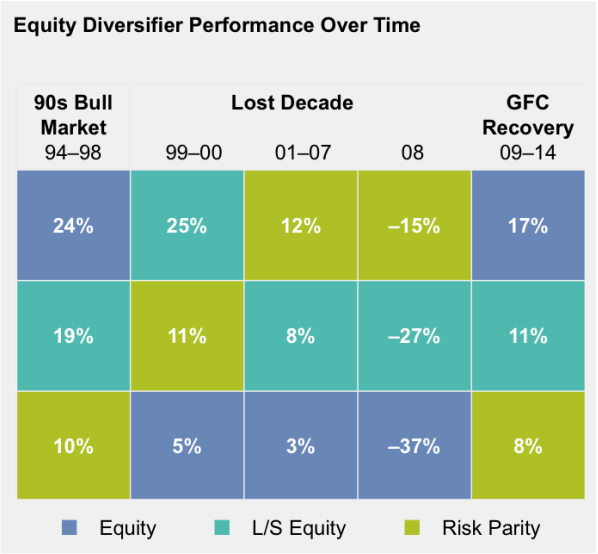
A number of good candidates exist to take it further—long-short equity strategies, for example. They reduce equity exposure by taking long positions in stocks that may rise and hedging the portfolio with short positions in stocks that appear set to underperform. They're designed to profit as much from a manager's security-selection skill as from broad market performance. Risk-parity strategies also diversify away equity exposure, allocating portfolio risk across a very broad collection of asset classes like commodities, corporate bonds and government bonds, as well as stocks.

Later in the glide path, participants need more inflation protection. This element calls for strategies that generate strong growth in periods of rising inflation, such as real estate, commodities and inflation-protected bonds. We believe that these "inflation-sensitive diversifiers" are underused in most target-date offerings today, but they would be helpful additions in the middle to later stages of the glide path.

Reducing market risk becomes crucial as participants glide toward retirement, since large market losses can no longer be recouped through future income and savings. We think that lower-volatility "defensive equities" can be employed more extensively to manage stock market drawdowns.

In the retirement years, the glide path should diversify interest-rate risk. One way to do that is reducing the duration of the bond portfolio—but that will likely sacrifice income. "Fixed-income diversifiers" should be included, too, as a way of reducing the risk of rising interest rates without sacrificing the return that investors would give up with a large cash position.





For the period January 31, 1990-December 31, 2014

*US equities are based on S&P 500; total equity hedge is based on HFRI Equity Hedge (Total) Index; risk parity is based on Salient Risk Parity Index returns. Down market is defined as a month where return is less than zero. Down-market return is calculated by taking the average of the returns of down-market months.

Exhibit 16: Long-Short Equity and Risk Parity Help Create More Consistent Returns While Muting Growth Risk
Source: Hedge Fund Research, Salient Partners and S&P

For senior retirees, there are ways to hedge against longevity risk that can be directly incorporated into a target-date design (see "Transforming Target-Date Results with Lifetime Guarantees," page 57). But the critical issue is to make sure that the glide path manages the portfolio's growth risk through retirement, not simply to retirement. That way, participants can keep enough growth assets in their portfolios to satisfy spending needs well beyond the average life expectancy.

And as we'll describe, a dynamic allocation and multi-manager process of diversifying risk should be considered across the entire glide path, as a way to manage changes in market risks and allow participants to gain "best-of-breed" access to managers across the asset spectrum.

Equity Diversification Seeks to Deliver Consistent Growth

In evaluating various equity-diversifying strategies (Exhibit 15, previous page), we're looking for the ones with strong return potential but less correlation to the equity market—and we're evaluating the best way to incorporate them into the glide path. The objective isn't to give up growth but to find strategies that grow at different paces and at different times in an economic cycle.

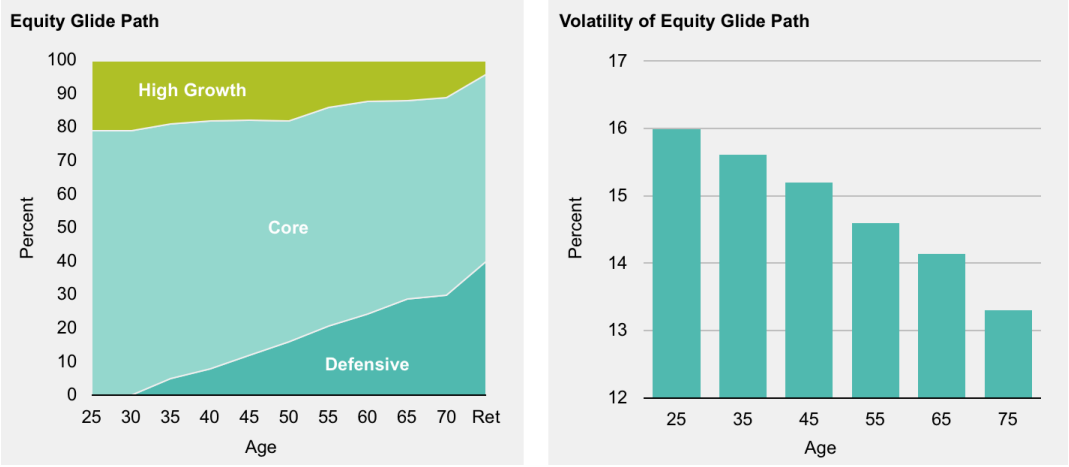
We looked at average annual returns over the last 25 years for long-only equities, long-short equities and risk-parity strategies. Returns for the three categories have been essentially comparable over the long term—but they've generated their returns from different sources (Exhibit 16).

Long-short equity generates more than half its returns from factors outside the benchmark movements of the equity market. What's important in long-short equity strategies is manager skill (think "alpha diversification"). That means selecting securities, exposing the strategy to different factors that offer attractive returns within the market and tactically adjusting across factors to increase returns. Those factors could be value or growth styles, quality, profitability or momentum strategies.

Risk-parity strategies generate diversification not by selecting individual securities but by diversifying across broad asset markets (think "beta diversification"). They don't rely on equity market returns alone. They diversify their exposure across interest rates, commodities, credit and other asset classes. And they use some leverage to deliver a more consistent return pattern, structuring this part of the portfolio so that there's an equal risk contribution from multiple asset classes.

There's a clear benefit in using both long-short equities and risk-parity strategies, which typically surfaces during sharp market plunges such as in 2008. But it's even more worthwhile during lengthy periods of underperformance from equities—the traditional growth engine for portfolios. That was the case for the 10-year period from 1999 through 2008: equities delivered an average annualized return of –1.4%, while long-short equity and risk parity actually delivered stable, more consistent return patterns of 6.9% and 9.0%, respectively.

The fundamental reason for diversification holds true here: no one asset class or strategy outperforms all the time. Those divergent returns for long-short equities and risk-parity strategies won't happen over all periods. If we diversify away from equities when they're the best-performing asset class, the other strategies will lag. That was the case during the bull market of the late 1990s—and that has also happened since the end of the recent financial crisis. But better diversification—in this case, incorporating equity diversifiers—helps create a more consistent level of growth over



As of December 31, 2014
Volatility is based on historical simulated monthly returns of the equity sleeve from January 1999 to December 2014. The allocation is based on the equity portion of AB Multi-Manager Select Retirement Funds. Performance of underlying strategies is represented by monthly returns of asset-class benchmarks: US large-cap is by Russell 1000 Index; US small- and mid-cap by Russell 2500 Index; international developed by MSCI EAFE Index; emerging market by MSCI Emerging Market Index; defensive by MSCI World Minimum Volatility Index. The simulated portfolio is rebalanced monthly without fee or transaction cost.

Exhibit 17: Defensive Equity Strategies Have Reduced Sensitivity to Market Risk in Retirement
Source: MSCI, Russell Investments and AB

the long term. And we believe that adding equity diversifiers won't sacrifice long-term portfolio growth; it will actually enhance it.

Defensive Equities to Moderate Market Risk

Besides diversifying the equity portion of a portfolio to find more consistent growth, we can also diversify to help reduce market risk, especially near or in retirement. We can use different types of equity strategies—ones with higher or lower volatility and performance patterns—to different degrees along the glide path (Exhibit 17).

Early on, participants' risk tolerance is very high, and most of their financial assets reside in their future income. They can take on much more market risk in those early years because they have more time to absorb a short-term market plunge—and they have fewer portfolio assets to be impacted by those downturns.

This risk profile allows us to include larger weightings in higher-risk, higher-growth strategies such as emerging markets and small-cap equities. We can also include "frontier" emerging markets that have even higher potential (and risk) than the more established, traditional emerging markets. And it's not just the geographical and capitalization makeup that might vary. The equity component should have specific allocations to actively managed long-term strategic styles such as value and growth investing, which may require longer time horizons to realize their alpha potential.

As participants move toward retirement, the equity part of the glide path should adjust to include more defensive strategies that cushion against downside scenarios and typically fall less than the overall market in periods of stress. These strategies may include low-volatility within each of the glide path's three major asset categories—equities, diversifiers and fixed income—our research guides the calibration of the various underlying components, essentially constructing glide paths within the overall target-date framework. Equities and strategies focused on companies with higher-quality cash flows and dividends. Essentially, we can think of this evolution of equity exposure as a glide path within the glide path.

With a graduated approach to adjusting from aggressive to more moderate equity strategies, we can rein in the volatility of the glide path's equity component. This tempering of exposure to potential volatility means that every dollar that a participant has in equities becomes less volatile in later years (Exhibit 17). It provides a bit more downside protection during short-term market drops, which is important during retirement. It will likely give up a small amount of upside growth, but we think that's a trade that participants are willing to make—especially during the period right before they retire.

Inflation Diversifiers: The Delicate Balance

Rising inflation poses a big investment problem: The benefits of traditional stock/bond diversification can break down, which could expose participants to larger-than-expected downside risks. With enough time during the accumulation phase, a portfolio can absorb the shocks of inflation. But inflation risk becomes acutely important for participants near or in retirement. That's when the portfolio really needs tools to offset the impact of a traditional portfolio's decline in value just as spending needs rise due to an inflationary environment.

Several asset classes shine when inflation is rising, but traditional stocks and bonds aren't among them. TIPS will absorb the upward movement of inflation, and they're very important in protecting a bond portfolio against inflation. But they don't actually provide any further upside to guard against poor stock performance during inflationary periods.

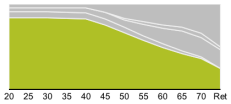
However, various real assets—such as REITs, commodity stocks and commodity futures—respond quite positively when inflation is rising, or even when expectations for future inflation rise. Also, given their higher inflation beta (how much performance tends to move for every 1% change in the CPI), they can offer inflation-risk protection to the growth portion of the portfolio

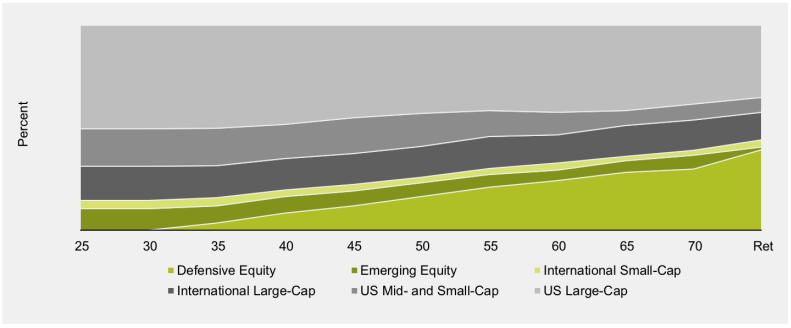
Glide Paths within the Glide Path

Within each of the glide path's three major asset categories—equities, diversifiers and fixed income—our research guides the calibration of the various underlying components, essentially constructing glide paths within the overall target-date framework.

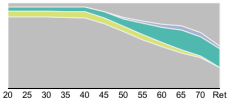
A Closer Look at:

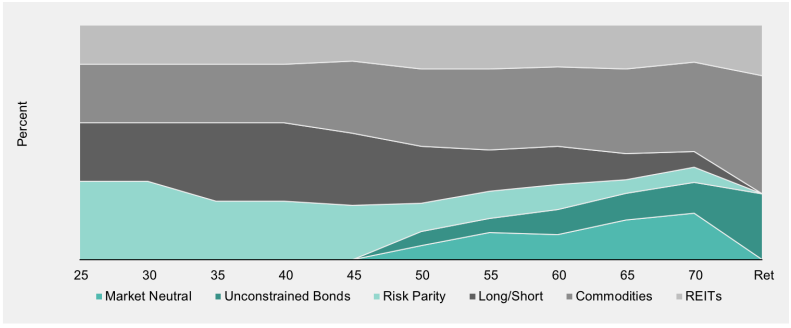
Equities



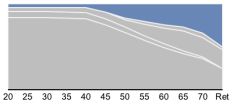


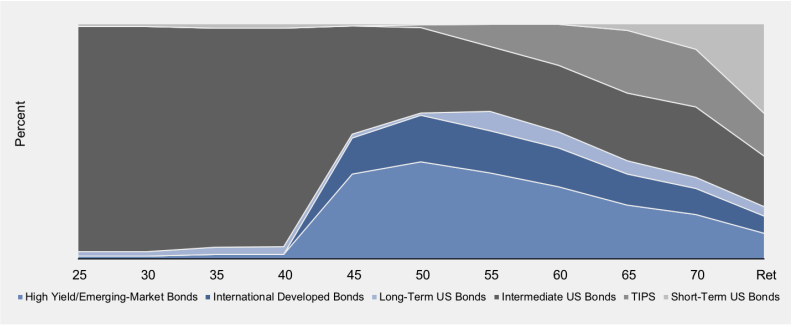
Diversifiers





Fixed Income





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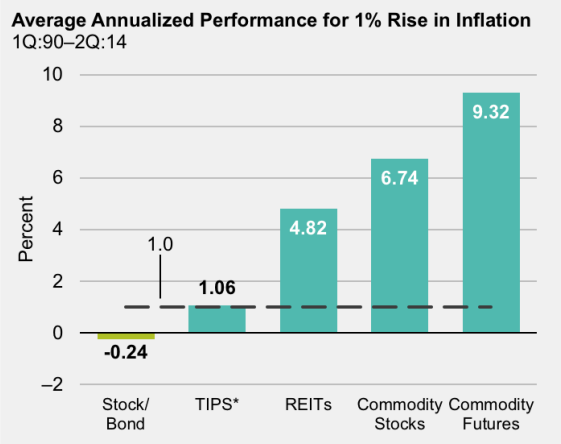
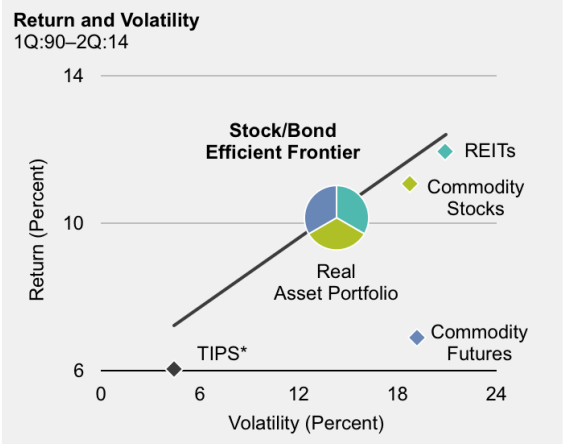
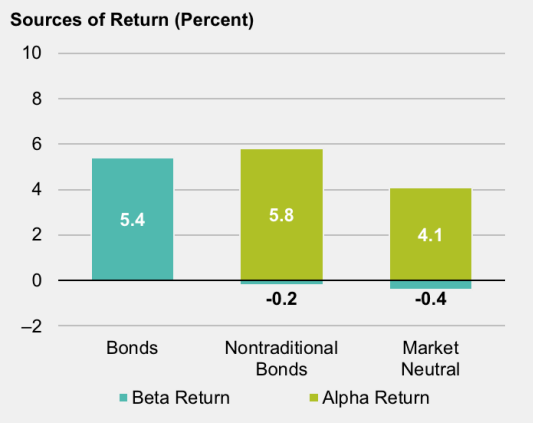
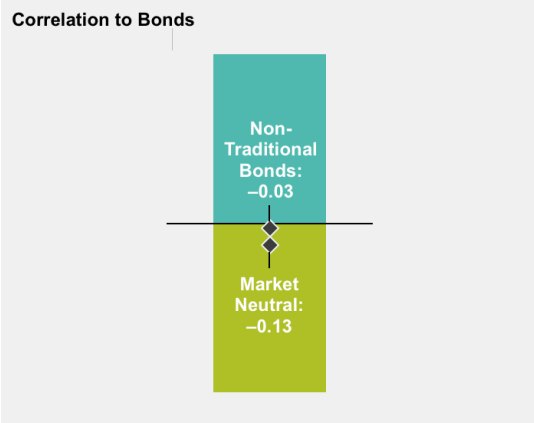




Through June 30, 2014
Past performance does not guarantee future results.
*TIPS data from 1Q:98

Exhibit 18: A Mix of Inflation-Sensitive Assets Has Potential to Offset Inflation Shocks in a Cost-Effective Way
Source: BCOM, Bloomberg, Federal Reserve Bank of Philadelphia, FTSE EPRA/NAREIT, GSCI, S&P and S&P Dow Jones





For the period January 31, 2000–December 31, 2014
*Down market is defined as a month where return is negative.

Exhibit 19: Fixed-Income Diversifiers Help Reduce Interest-Rate Risk for Retirees
Source: Bonds are Bloomberg Barclays US Treasuries; nontraditional bonds are mean return of Morningstar nontraditional bond universe; market-neutral is HFRI EH: Equity Market Neutral Index.

(Exhibit 18, previous page). We can think of these asset classes as a form of insurance that pays off when inflation and/or inflation expectations rise. That's because these assets either cause the inflation (like certain commodities) or they're quickly able to pass through rises in inflation by hiking rent prices (like real estate).

Exposure to inflation-sensitive assets sounds good and worthwhile to many people. As a result, inflation protection can be priced at a premium to traditional stocks and bonds. For example, when we place REITs, commodity stocks, commodity futures and TIPS on the stock/bond efficient frontier for risk and return, they each fall below it—some quite far below (Exhibit 18, previous page). So investors have to sacrifice some return or take on substantially more volatility in exchange for the inflation protection that any one of these asset classes provides on its own.

But we can minimize some of that return sacrifice by blending various real assets together. Commodity stocks, commodity futures and real estate have low correlations to one another, and they respond differently depending on the inflationary regime. So they're well suited to one another for diversification purposes. When we combine them, we can deliver a significant "inflation beta" while still maintaining an efficient risk-adjusted return.

Seeking to Reduce Interest-Rate Sensitivity of Bonds

Another key risk that can be reduced with an expanded tool set is interest-rate risk, which increases in a glide path as investors move into their retirement years. We see several ways to include greater diversification to the glide path's bond allocation to achieve that goal.

1. **High-Income Strategies**, like high-yield and emerging-market bonds, are effective diversifiers for participants in the midlife stage because these strategies offer higher returns than traditional bonds. They also have less interest-rate sensitivity than a core bond allocation.
2. **Global Bond Strategies** hedged to the US dollar can diversify interest-rate risk across many geographies and lessen the impact of a sharp rise in US interest rates.
3. **Low-Duration Strategies** added later in life help reduce interest-rate sensitivity and volatility, but they do so at a cost to long-term returns.
4. **Fixed-Income Diversifiers** are another underused alternative. These active strategies are designed to generate stable returns without being sensitive to the interest-rate environment, as their returns are driven predominantly by manager skill rather than broad market exposure—an appealing trait as we enter a period that's likely to see rising rates. Nontraditional bonds and market-neutral strategies are two examples (Exhibit 19).

Nontraditional bonds, focusing on absolute returns, tend to be more unconstrained than traditional bond funds. Some nontraditional bond strategies use various ways to manage interest-rate sensitivity. They may include high-yield bonds, securitized loans, foreign sovereign bonds and corporate debt. Equity market-neutral strategies generally take long and short equity positions and attempt to hedge out all market exposure. These funds work to provide small but steady returns in all market conditions.

These two categories—nontraditional bonds and market-neutral equities—generate returns from alternative approaches to the markets. They're uncorrelated to the typical long-only bond market and provide important diversification during periods of rising interest rates. Exhibit 19 shows that the correlation of these strategies to US Treasury bonds (or interest-rate risk) has been virtually zero for the past 15 years.

Before incorporating these strategies into a target-date glide path, it's important to determine when and where they best fit as an allocation. We believe that they work best as a substitute for some part of fixed-income exposure late in the glide path. But the "who" is just as important as the "when" and "where." These are active strategies that don't depend on market movement (beta) as much as they depend on individual manager skill (alpha). So they need careful manager selection—a filtering process for sifting through

the universe of managers with widely variable approaches and strategies and making sure that the return source will last.

Risk Management Across the Glide Path

Using the broader set of asset-class and strategy tools helps the strategic allocation do a better job of managing retirement risks. But prudent glide path management also requires the use of two other risk-management strategies: dynamic asset allocation and multiple managers across the glide path.

Dynamic asset allocation. The best target-date structures should incorporate a certain amount of flexibility; like trees and tall buildings, target-date funds need to bend with the wind. That's because even the most thoughtful views on asset-class risk and return will need to be constantly revisited as market conditions change.

For example, there can be a significant disconnect between the volatility of a glide path that's expected, based on the overall stock/ bond mix, and the volatility that's realized in extraordinarily volatile market environments. We've witnessed multiple periods of elevated risk, but it would have been particularly evident to someone who was approaching retirement in 2008, when realized volatility was double the long-run expectations (Exhibit 20). Volatility this high can produce a large portfolio drawdown right before a participant is about to retire and start withdrawing cash—it can permanently damage their capital and feeling of retirement security.

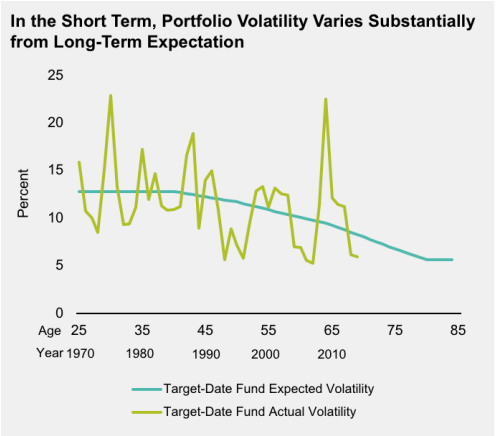
Dynamic asset allocation provides the ability to monitor and adjust the glide path, responding to meaningful changes in market conditions. If there's a big increase in market volatility or a sharp change in the correlation characteristics of different diversifying asset classes, adjustments to the glide path may be able to mute the effect of those risks, providing significant benefits to participants.

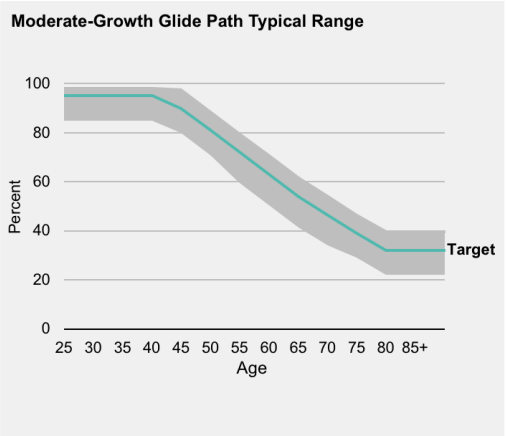
We think that this type of strategy should focus primarily on risk moderation—not alpha generation. So the band (or range of flexibility) within which the overall equity allocation can be adjusted during extreme market conditions should typically be tilted toward the downside (Exhibit 20). Target-date funds may be long-horizon strategies, but they're more likely to function better if they include some capacity for flexible adjustments and aren't simply set on autopilot. When market conditions change, the investment manager can adapt the glide path to reduce the risk to participants. The flexibility of additional volatility management is especially worthwhile just before retirement—a critical savings period for a participant's portfolio to generate income throughout retirement.

Multi-manager approach. Implementing the glide path through a multi-manager structure is another prudent risk-management strategy. This approach is actually common across most of the investment-management industry—but not yet in the target-date fund arena. Single-manager structures may compromise plan sponsors' fiduciary prudence and have an adverse economic impact on participants. After all, it's highly unlikely that any one investment-management firm can be best-of-class in all asset classes.

We calculated the performance of multi-manager portfolios by using funds from multiple combinations of three managers and compared these with the performance of individual managers' funds. We looked at all possible three-manager combinations that had performance figures available from 2004 through 2014. Our research shows that using multi-manager funds has historically produced more stable returns with improved median alpha compared with single-manager actively managed funds.

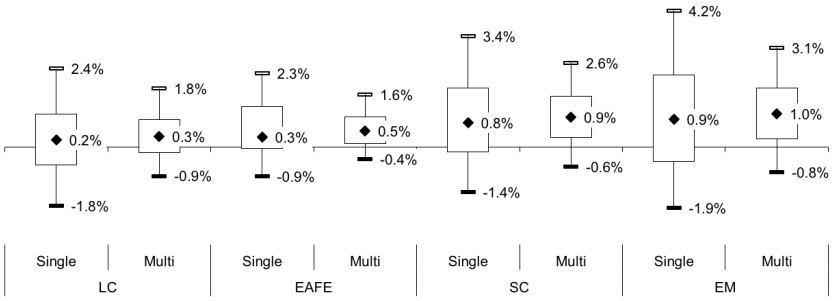
For example, in four major equity categories—US large-cap, international (Europe, Australasia and Far East, or EAFE), US small-cap and emerging-market equities—the median returns for multi-manager portfolios in each category do better than the single-manager median result (Exhibit 21, next page). Also, the range of returns for the multi-manager results is tighter, which could provide greater consistency—and contain loss potential better.





Through December 31, 2014
*Individuals cannot invest directly in an index. Index volatility is not representative of the volatility of any AB product or fund. Target-date fund average volatility based on not representative of any AB target-date product.

Exhibit 20: Short-Term Risk Can be Mitigated with a Dynamic Approach
Source: Bank of America Merrill Lynch, Bloomberg Barclays, FTSE, MSCI, Russell Investments and AB



*Single takes the percentile of all funds in each category. Multi takes the percentile of all possible combinations of three funds within each category. Annual excess returns from 2004–2014. Benchmark for Core US Large-Cap Equity is S&P 500 Index; Core US Small-Cap Equity is Russell 2000 Index; Core EAFE Equity is MSCI EAFE; Core Emerging Market Equity is MSCI Emerging Market. Subtracted an estimate of 63 basis points for survivorship bias based on academic papers

Exhibit 21: A Multi-Manager Allocation Has Historically Produced More Stable Returns and Improved Median Alpha Versus a Single-Manager Allocation
Percentage average annualized out performance versus benchmark, 2004-2014
Source: eVestment, MSCI and Russell Investment

Currently, single-manager, proprietary target-date funds still dominate the market. But the status quo may soon change, now that the DOL has encouraged plan sponsors to consider customized and nonproprietary offerings.

Transforming Target-Date Results with Lifetime Guarantees

Typically, DC plans focus on accumulating assets, not translating them into income during retirement. As a result, very few plan participants have a clear idea of how much retirement income their accounts are likely to provide—or how long they will provide it. Many participants are also unaware of how much more they'd need to contribute to achieve the retirement income they want.

The glide path enhancements described in this research can help improve asset accumulation and moderate economic and market risks faced by participants in retirement. But glide path improvements alone can't provide participants with complete certainty that they won't run out of money in retirement. Investors are still at the mercy of the market's trajectory—as well as their own life expectancy.

The only way to provide income certainty is to incorporate secure income provided through insurance products—a relatively new frontier for DC plans, and target-date funds in particular. Without income certainty, many retirees will either run out of money or be forced to curtail their spending.

For an income solution to have wide appeal among DC plan participants, an ideal secure income solution should incorporate the following desirable characteristics:

+ **Income certainty:** Most participants want a steady income stream in retirement, with a retirement withdrawal amount that will never go down, even if the market does.[8]

+ **Access to the retirement account:** Participants rarely purchase a traditional annuity at retirement because they're afraid to make an irrevocable decision. They want access to their assets at any time for any reason, without penalty.

+ **Ability to capture market upside:** While the focus is on a steady income, retirement can be a long period, of 30 or more years. The ability to capture the upside of growth in the market can potentially grow the account value as well as increase the income.

+ **Known fee and benefit rate:** The benefit rate and any applicable fee should be known ahead of time and not change with the market environment.

+ **Bequest to beneficiaries:** After the participant's death, any remaining assets in the account should go to the participant's beneficiaries without penalty—not to an insurance company.

+ **Multiple insurers:** Being backed by multiple top-rated life-insurance companies provides competition in obtaining the best rates and sustainability of the solution.

+ **Personalization:** Participants have diverse life goals, and their investment strategy should have some flexibility to accommodate those differences. The secure income feature should allow participants to choose when they want to retire and how much secure income they need.

This combined wish list of secure income features can serve as the template for a suitable solution. Our recent participant survey found strong appeal for such a solution among participants. Surprisingly, we also found that 74% of non-plan participants said that they would be interested in such an investment and that it would enhance their desire to take part in their employer's DC plan. For plan sponsors committed to increasing plan-participation levels, this is noteworthy.

But for such a solution to be successful, plans need to effortlessly connect participants to it. In other words, it needs to be the default investment for the DC plan.

Some large DC plans have already adopted secure income target-date fund solutions. Cost-effective scalability, however, still has a way to go for midsize and smaller plans. Innovations for DC plans typically occur at the large end of the plan-size spectrum, and we believe that it's only a matter of time before secure income target-date solutions become available to most plans.

Tomorrow's Target-Date Fund...Today

The quest for retirement confidence and income security seems to recede further into the distance with each year. But better target-date fund design can make a big difference for the increasing number of workers who rely on this prominent DC solution.

ONE SOLUTION FOR LIFETIME INCOME:
UNITED TECHNOLOGIES CORPORATION

In 2012, United Technologies Corporation (UTC) became the first large US DC plan to partner with AB on a secure lifetime income default option within its DC plan. Lifetime Income Strategy (LIS) combines the simplicity of a target-date fund with the security of lifetime income, guaranteed by multiple insurance companies.[9] It's also an individualized, next-generation target-date solution because each participant's portfolio is based on his or her birth date, and he or she has the opportunity to indicate the portion of the account to be converted into guaranteed income. LIS is designed to protect participants from the risk of outliving their money and the impact of market volatility on retirement income—while providing the opportunity for growth.

First Steps: UTC had closed its DB plan, and company leaders decided that their DC plan should function more like a pension plan. In a series of meetings with the benefits group, treasury, investments and legal, they drafted three principles that informed the entire design process: keep it simple, flexible and cost-effective. The overarching objective: Do more than give workers the opportunity to save and invest for retirement. Help them be confident that they'll have adequate income in retirement.

That constituted a shift in framing—away from simply the savings and investments framework to incorporating steady retirement income as an explicit objective. For UTC, the importance of retirement income was manifold: security and certainty for participants; and the ability to attract and retain top talent for the company.

To keep it simple for employees, UTC's fiduciaries made LIS the plan default.

Choosing an Insurance Structure: The key issue that UTC had to resolve was the structure or vehicle that it would use for the guarantee. The company leaders compared many potential alternatives—from annuities to systematic withdrawal plans. They weighed the pros and cons, such as level of income and liquidity (or lack thereof). The plan could get the highest income out of an immediate fixed annuity and the greatest flexibility from systematic withdrawal plans. But it was the guaranteed lifetime withdrawal benefit (GLWB) that proved most appealing in addressing each aspect and option that UTC thought was critical to include.[10]

For example, liquidity was a must. They considered the possibility that a participant or an employee might lock into an immediate annuity one day, and go to a doctor the next day and get bad news. Employees in that situation would "lose the mortality lottery." UTC didn't want to provide such a limited solution.

UTC wanted a fixed price up front on the benefits that it purchased. That means that as a participant's assets get folded into the portfolio's secure income allocation, the pricing and income rate for that portion is fixed at the time of that purchase. Ultimately, the value of the overall insured component's benefits can change in the future, but anything that has already been purchased is fixed at that time.

In terms of fees, UTC looked at market rates for very similar benefits in the retail market. It also looked at what alternatives cost in the institutional market. In terms of UTC's three basic principles, the GLWB solution managed to address simplicity and flexibility, while keeping cost dramatically lower than what was available in virtually any other form.

Multiple Insurers: One critical—and unique—ingredient of the LIS was not being beholden to any one particular insurance company. Having multiple insurers on the LIS platform was attractive from at least two different perspectives: competition (and therefore pricing power) and sustainability (minimizing insurer and capacity risks). A structure was implemented where, on a regular basis, participating insurance companies compete for capacity within the program, and UTC's LIS platform buys from them based on competitive bids. Importantly, this all happens under the hood, to keep things simple for participants.

Default Necessity: UTC's plan sponsors recognized that even if they made annuities available to people through the DC plan, participants simply don't choose to buy them. By making lifetime income the default, UTC communicated to employees that it had spent a lot of time, care and effort to come up with what the company leaders saw as the best solution. It also communicated that they believe that it's the right solution for the vast majority of their employees and participants. But UTC has also included the freedom and control that people need to opt out if they decide that LIS isn't for them.

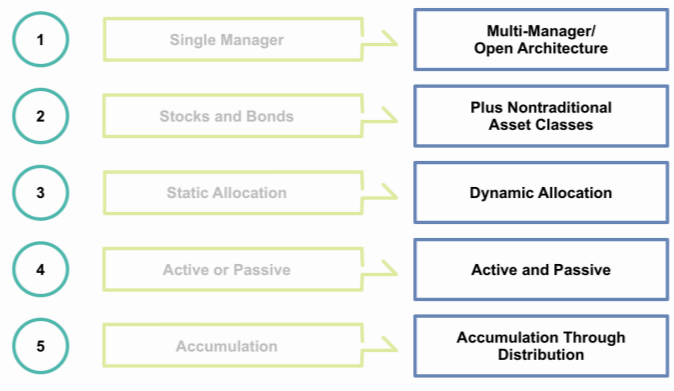


Exhibit 22: Best Practices Evolve, and so Should Your Target-Date Fund
The Evolution of Target-Date Design

We believe that tomorrow's target-date fund should incorporate a broader collection of different strategies than they do now. Our first blueprint identified a broader set of retirement risks that an array of traditional asset classes needed to guard against. This new glide path takes another important step forward: It identifies the critical outcomes needed at various life stages and how combinations of traditional and nontraditional strategies can work in tandem to improve retirement security—particularly important in today's environment, as expected returns for traditional asset classes are depressed versus historical norms. In our view, target-date funds that incorporate a broader set of asset classes with a multi-manager architecture can reduce risk and build more retirement income. They do it by enhancing diversification and the effectiveness of risk management for participants at different stages in their lifecycle.

The final frontier for target-date design—for the real retirement objective of DC plan participants—is incorporating a lifetime income guarantee.

Improving Outcomes

The enhancements we've discussed in our updated target-date strategy make meaningful improvements toward the goal of attaining sufficient income replacement in retirement through at least age 90. As we noted earlier, traditional target-date funds would have run out of money just 11 years after retirement for participants retiring in 1973, when the four key risks were heightened. But we don't have to look too far back in our history to find another period where low growth and market risk ravaged participants' savings.

Consider a participant who turned 55 years old in January 2000. That was the start of what can be considered "the lost decade"—stocks, represented by the S&P 500, actually delivered a negative return: –0.95% between 2000 and 2009. Just when their portfolios could have benefited most from robust returns, these participants experienced low growth and high risk to their sequence of returns—large market crashes twice over the decade just prior to retirement.

Over this short period of a decade, let's compare the outcomes of the traditional target-date fund and one that uses only our enhanced asset-allocation design (without any insurance component or guarantees). Starting with $500,000 at age 55 in January 2000 and using the same assumptions that we did before for contributions, the new glide path would have resulted in 13% higher savings when participants turned 65 in 2009.

There's a lack of historical index data prior to 1990 for all the asset classes we've discussed, so we used similar 10-year periods from 1990 to 2014 to calculate glide path performance for participants who were 55 at the start of the 10-year period. The new glide path would have done better than the traditional glide path about 80% of the time. We repeated a similar exercise for participants who had just retired (age 65) at the start of each of the 10 years, and the new glide path demonstrated better results in the vast majority of the periods. So we believe that this type of broad asset-class diversification could deliver a major improvement in retirement savings results.

Incorporating the use of dynamic strategies to mitigate short-term market risk and the use of multi-manager portfolios for diversification would, we believe, further improve these outcomes. We expect that adding these features would likely yield additional tangible benefits for DC plan participants.

A Viable Framework for the Future of Retirement

Target-date assets are a critically large pool of assets, one that will only increase in importance for the future of many workers, many companies and the economic well-being of the country. But as we noted earlier, the target-date industry lags behind the rest of the investment-management world.

Traditional, first-generation target-date solutions still dominate DC plans. These solutions typically use single managers, traditional stock and bond asset classes, and allocations that tend to be static. Usually, these early solutions stick to entirely active or entirely passive investing approaches, rather than mixing the best of both for the different asset classes where active or passive makes the most sense. Traditional target-date funds also focus nearly exclusively on the accumulation phase of the glide path—lacking any thoughtful solution for what happens during the 30 or more years without a paycheck that many participants will encounter.

We believe that target-date providers and DC plan sponsors need to push toward multi-manager, open-architecture mandates that incorporate a broader collection of diversifying assets, that can dynamically adjust the glide path when market conditions change, that can take the best of active and passive approaches, and that embrace better solutions for the distribution phase—not just accumulation (Exhibit 22).

KEY ACTION POINTS FOR TARGET-DATE FUND SELECTION

FIDUCIARY CONSIDERATIONS

+ Document how the current target-date fund/QDIA was selected
+ Ensure that all the DOL's "Tips for ERISA Plan Fiduciaries" were followed as part of the initial selection and ongoing monitoring of the target-date fund
+ Revisit the target-date fund selection decision and ongoing monitoring process if unable to document that all the tips are satisfied

INVESTMENT CONSIDERATIONS

+ Ensure that the asset allocation is sufficiently diversified to mitigate key participant risks
+ Assess whether the manager employs a multi-manager process
  + If so, determine if an independent fiduciary is responsible for manager selection

Endnotes

1. The DOL defined QDIAs as default investments that "include a mix of asset classes consistent with capital preservation or long-term capital appreciation or a blend of both."

In 2007, the DOL specifically noted three types of diversified options: a target-date retirement fund product or model portfolio; a target-risk fund or model portfolio (such as a balanced fund); or an investment-management service that allocates a participant's assets among the plan's alternatives based on the participant's age, target retirement date or life expectancy.

2. "Inside the Minds of Plan Sponsors," AB, 2014

3. Alina Tugend, "Fears, and Opportunities, on the Road to Retirement," *The New York Times*, June 3, 2011

4. "Inside the Minds of Plan Participants," AB, 2014

5. "Target-Date Retirement Funds: A Blueprint for Effective Portfolio Construction," AB, 2005

6. Market-neutral funds are strategies that take long and short positions with minimal market exposure.

7. Long-short credits are strategies that take long and short positions in credit securities in order to mitigate market risk and interest-rate risk.

8. Among current target-date users in our recent survey "Inside the Minds of Plan Participants" 74% find a target-date fund offering a guaranteed income stream appealing or extremely appealing. Further, 53% of nonusers and 69% of non-plan participants also found it appealing or extremely appealing. The survey was conducted in early 2014 and consisted of a demographically diverse sampling of more than 1,000 US workers either in a DC plan or eligible to participate in such a plan.

9. Guarantees are based on the financial strength and claims-paying ability of each insurance company.

10. Guaranteed Lifetime Withdrawal Benefit (GLWB) is a type of annuity that sets a withdrawal amount that will last throughout a participant's retirement, even if the market falls or the account's assets run out. The insurers will continue the withdrawal payments, if needed. Guarantees are based on the financial strength and claims-paying ability of each insurance company.

Disclosure

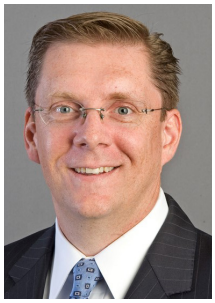
"Target date" in a fund's name refers to the approximate year when a plan participant expects to retire and begin withdrawing from his or her account. Target-date funds gradually adjust their asset allocation, lowering risk as a participant nears retirement. Investments in target-date funds are not guaranteed against loss of principal at any time, and account values can be more or less than the original amount invested—including at the time of the fund's target date. Also, investing in target-date funds does not guarantee sufficient income in retirement.

***Past performance does not guarantee future results.**

Authors' Bios

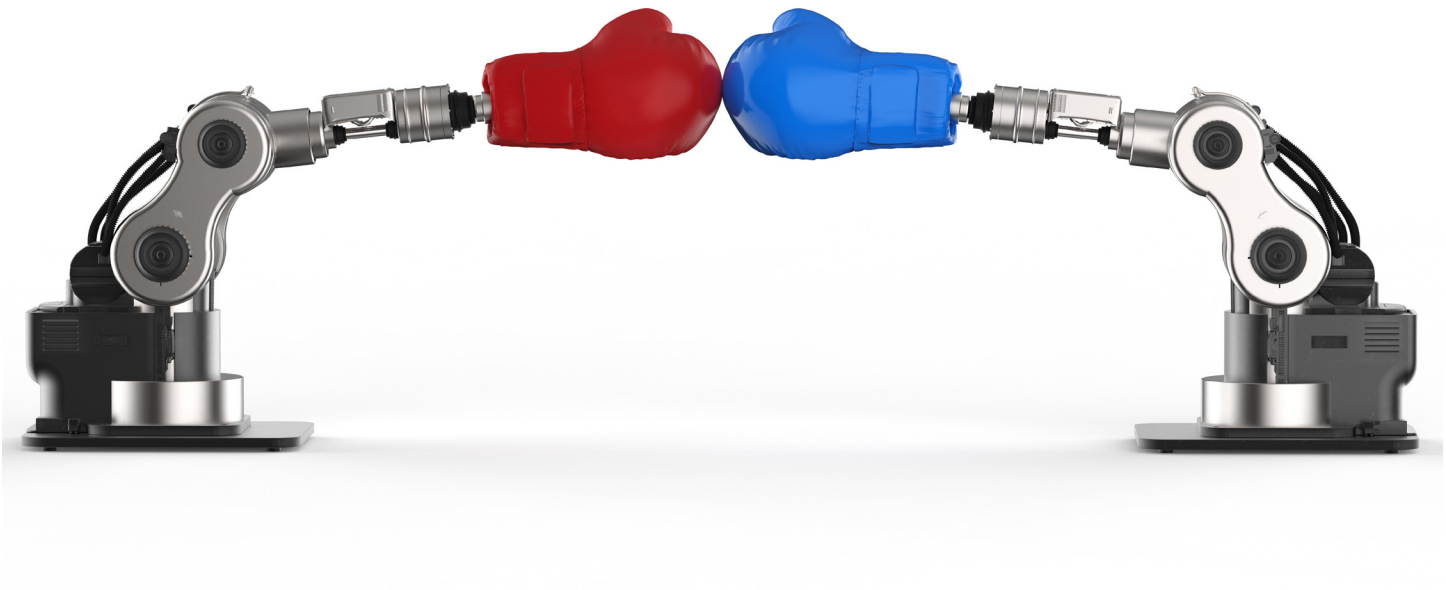
Daniel Loewy, *CFA*
AllianceBernstein (AB)

Daniel Loewy is Chief Investment Officer and Head of Multi-Asset Solutions at AB. He oversees the research and product design of the firm's multi-asset strategies, as well as their implementation. In addition, Loewy is Chief Investment Officer for Dynamic Asset Allocation, and is responsible for the development and investment decision making for that service. He is also a member of the Real Asset Investment Policy Group and the Target Date Investment Oversight team. Loewy previously led the Wealth Management Group's research on the major investment issues faced by our highest-net-worth clients, including asset allocation, alternative investments and tax management. Prior to that, he was a research analyst in the equity research department, where he followed the aerospace and defense and capital goods sectors. Additionally, Loewy has served as an associate portfolio manager for our value equity services. He holds a BS in industrial and labor relations from Cornell University and an MBA from Columbia University, and is a CFA charterholder.



Christopher Nikolich
AllianceBernstein (AB)

Christopher Nikolich joined AB in 1994 and is the Head of Glide Path Strategies (US) in the Multi-Asset Solutions business, leading research efforts relating to effective target-date fund construction. He is the author of Anti-Depression Advice for Retirees, among other defined contribution (DC)–related research. Nikolich also works closely with clients in the structuring of their customized target-date funds. He was previously a senior investment director within DC. From 2002 to 2008, Nikolich was a senior portfolio manager on the Blend Strategies team, where he worked closely with clients on the creation and implementation of multi-asset-class solutions. From 2004 to 2006, he was based in London, where he worked with clients in the UK and Europe. From 1996 to 2002, Nikolich was a portfolio manager in the Index Strategies Group, where he managed risk-controlled equity services. He holds a BA in finance from Rider University and an MBA in finance and international business from New York University, and is a member of the Board of Trustees of Rider University.



2017 Endowment vs. Public Pension Returns

Michael Karris
Endowbridge Capital

Does the Endowment Model still work?

Judging by large endowments' steady outperformance of a 70% global stock /30% U.S. bond index, the answer is YES. Versus a 60% S&P 500 / 40% US bond index, the answer is not as clear cut.

Even so, the Endowment Model still adds value for a long-term portfolio that uses alternative assets, especially venture capital. The lucrative illiquidity premium has generated superior returns for U.S. endowments versus U.S. public pensions, mainly during the 1990s internet bubble, and until the 2008 financial crisis.

However, the outperformance gap between 20 of the largest endowments and pensions has shrunk since 2008, partly as pensions have increased allocations to alternative assets as they seek the same investment success as endowments. Asset allocation has also helped pensions' recent good performance.

Besides capturing an illiquidity premium, the Endowment Model uses greater diversification, an equity bias, and riskier/uncorrelated assets (e.g., venture capital and emerging markets stocks, oil, and timber) versus a 70/30 portfolio.

However, many smaller investors struggle to run an endowment portfolio, proof that a one size strategy does not fit all investors. Thus, in the spirit of the Endowment Model, a well-designed index fund strategy could also earn superior risk-adjusted returns versus a balanced benchmark. By excluding alternative assets, small investors could avoid many of the drawbacks of the Endowment Model by:

- improving liquidity and transparency,
- reducing fees and complexity, and
- eliminating lock-up provisions and investment gates.

Or by focusing on beta to streamline the Endowment Model, investors could use an index fund strategy alongside top alternatives managers as a sensible modification to long-term investment policy.

The Endowment Model

In the investment world, many folks debate whether the Endowment Model still works.

The Endowment Model is based on the Yale Model, pioneered by Yale's David Swensen, Dean Takahashi and team since 1985. Using the infinite investment horizon of an endowment to its advantage, they diversify across riskier assets than a U.S. 60/40 mix. Yale still captures great value from the illiquidity premium of alternative assets (e.g., private equity like leveraged buyouts (LBOs) and venture capital (VC); real estate; and natural resources). They also use hedge funds for low correlated absolute returns; generally maintain an equity bias; and shun low expected return assets like fixed income.

Most U.S. endowments target a return of about 8%, or roughly 5% spending + inflation, but aim higher than breakeven to achieve real growth to protect against future unforeseen costs like tax threats from Congress. While many investors use the Endowment Model to try to match Yale's legendary results, it does not necessarily guarantee the same great success of the Yale Model.

Endowments Outperform Longer Term

Exhibit 1 depicts the disperse performance of 20 large U.S. endowments over 20 years ending FY 2017, versus a tighter performance range for 20 large U.S. public pensions (that report June 30 fiscal year returns). Returns are reported either gross or net of fees. Over 20 years, we see the Endowment Model has worked very well for top endowment teams. (See Appendix for a simplified version of Exhibit 1).

Many colleges have added great value versus a balanced benchmark like the 70% MSCI ACWI Stock / 30% Bloomberg Barclays U.S. Aggregate Bond. The greater dispersion of endowment track records underscores the importance of asset allocation, manager selection, and investment team skill.

In contrast, the lower dispersion of pension returns implies greater uniformity in strategy, perhaps due to their larger fund sizes. While large U.S. public pensions outperformed a 70/30 with similar risk, they lagged top endowments over the longer term.

Over the 20 years, public pensions were plagued by lower returns AND lower discount rates, which inflated the present value of liabilities. As a result, pensions' funding level ratios (assets/liabilities) fell disproportionately into underfunded status. In a 2017 NASRA report,[1] the average public pension had only 72.1% of the assets needed to meet liabilities, down from 100.8% in 2001.

The 20 large endowments shown in Exhibit 1 represent $263.2 billion of assets, or nearly half of $ 566.8 billion across 809 endowments, as reported in the 2017 NACUBO and Commonfund Study of Endowments (NCSE). Twenty of the largest U.S. public pensions (that report FY June 30 returns) are depicted by blue triangles in Exhibit 1, and represent $2.07 trillion of AUM, or about half of $4.33 trillion in public defined benefit (DB) plan assets per Federal Reserve 2017 data on NASRA.

How did endowments manage to greatly outperform public pensions over the 20 years?

Colleges: Heavy Users of Alternatives

First, endowments were early, heavy users of a wide range of illiquid, lucrative alternative assets. They ramped up use of alternatives during the 1980s-1990s. Venture capital especially drove impressive returns for the top endowments as they basked in the Internet Bubble glory days of the 1990s.[2]

As we know, endowments invest in perpetuity, allowing some to invest aggressively and tolerate illiquidity to maximize returns over generations of students (Read Stephen Mihm's "How College Endowments Learned to Love Risk").

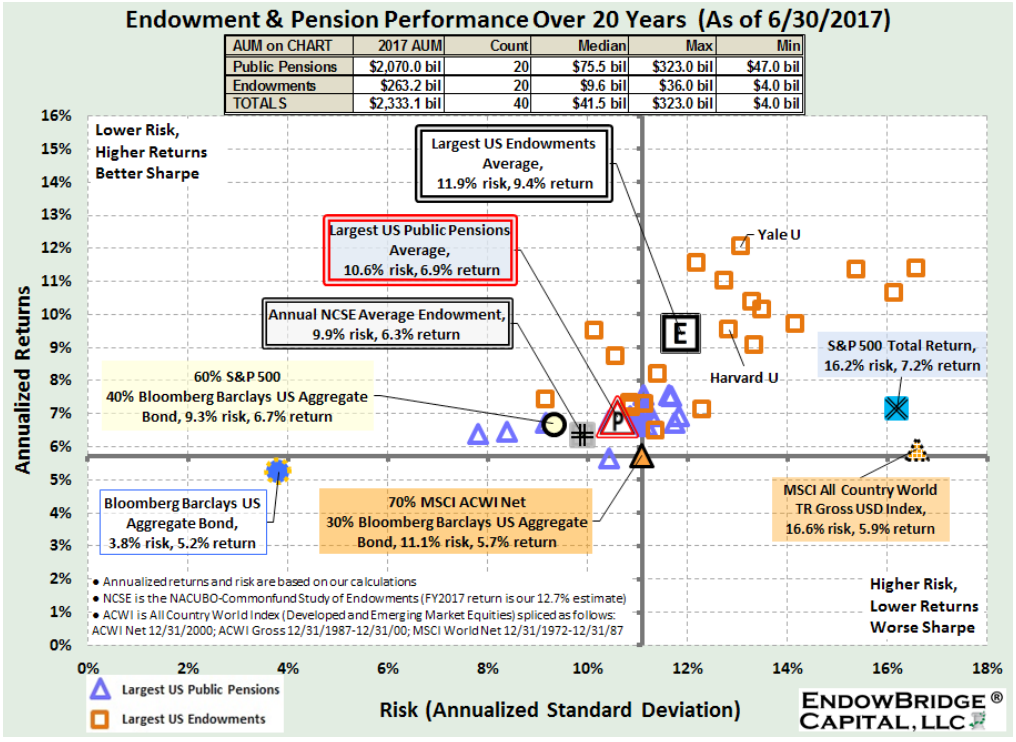


Exhibit 1
Sources: See Appendix

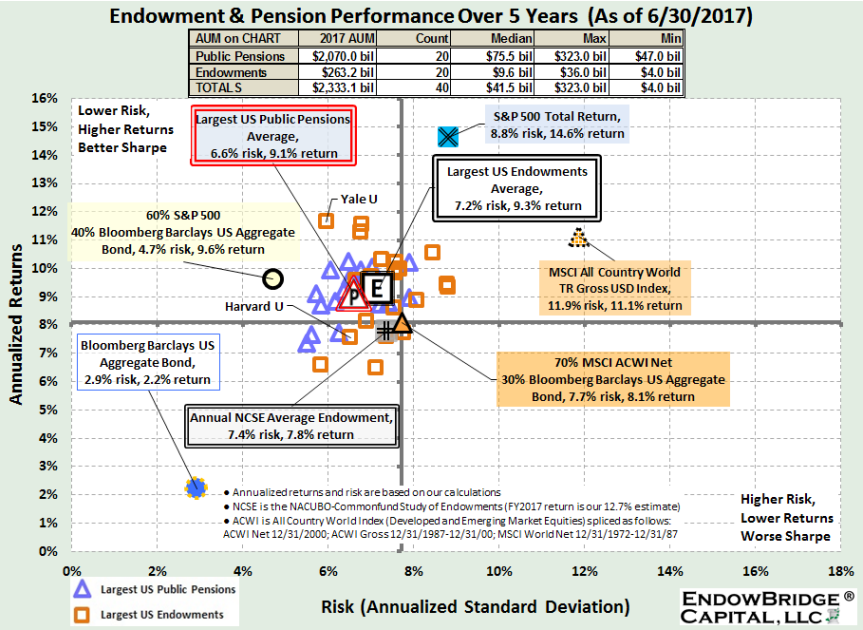


Exhibit 2
Sources: See Appendix

Colleges use endowment funds for student scholarships, endowed professorships, and as income for operating budgets and facilities.

Public employers are also perpetual entities, with pensions having a long horizon of liabilities resulting from a lifetime of payments promised to retirees. Yet, demographics (workforce age), plan design, vesting, and funded status influence the risk of a public pension's asset mix.

Unlike corporate pensions that use mark-to-market (MTM) accounting to value liabilities, public pensions currently use a higher target return to discount liabilities under the Governmental Accounting Standards Board (GASB). Historically, the average of public pension discount rates has been in a narrow range from 8.22% in 1992 to 7.57% in 2016.[3] However, individual discount rates used range from 5.5% to 9%. Notice the similarity of the 8% average target return of public pensions to the 8% return hurdle of endowments. In contrast, as reported by Pensions & Investments,[4] there is a lower 4.39% average discount rate for 100 of the largest U.S. corporate pension plans in 2016.

Historically, public pensions used fixed income as a more precise hedge for liabilities than stocks or alternatives. However, the trends of lower returns, lower bond yields, and a high similar target return have motivated public pensions to diversify with other assets just like endowments.

In contrast, because corporate DB plans use MTM discount rates, they rely more on *Liability Driven Investment* (LDI) strategies, such as the greater use of fixed income, especially long duration bonds, to reduce funded status volatility.

However, there have been recent changes in GASB standards that have increased transparency of government accounting for liabilities.[5] If public pensions were to ever adopt MTM accounting like corporate pensions, perhaps there could be a sea change in public plan asset allocation.

Pensions: Slower to Use Alternatives

Unlike endowments, public pensions only gradually shifted away from the 1950s bond dominant portfolios (96% in 1952),[6] after strict regulations limiting permissible investments were relaxed in the 1980s and 1990s. After suffering the Great Inflation of the 1970s, and the ensuing largest rise in yields in U.S. history, pensions began shifting to stocks in the 1980s and 1990s hoping to increase returns and diversify. Given their large size, they focused on liquid, larger cap stocks, and some alternatives like LBOs and real estate. Stocks grew from 23% of pension assets in 1982 to 67% in 1999.[7] As a result, public pension performance over this period began to resemble that of a 60/40 index.

Interestingly, corporate DB pension allocations to equities and bonds have changed in opposite directions versus public pensions since the Pension Protection Act of 2006. According to a Milliman study of 100 large corporate defined benefit pension plans,[8] average equity allocations decreased during 2016 to 36.1%, "the lowest equity allocation in the 17-year history of the Milliman PFS." In 2005, equities were over 60% of corporate DB assets. Meanwhile, fixed income grew from under 30% in 2005 to 44.1% of corporate DB plans in 2016 per the Milliman PFS.

Pensions: Hindered by Their Size?

Venture capital is an important source of returns for endowments. However, large pensions are likely hindered by their size from committing as much of their portfolios to VC as endowments, given the smaller size/riskier nature of the VC universe compared to large cap stocks. For instance, a Preqin report[9] cites $434 billion of unrealized value for VC as of June 2017, and $190 billion of dry powder. Another report[10] showed about 10% of U.S. public pensions commitments were to VC, with more allocated to buyout funds.

In contrast, the U.S. stock market capitalization totaled $27.4 trillion as of 2016 (source The World Bank). Thus, VC has made a bigger impact on relatively smaller endowment portfolios than on behemoth public pension plans.

Even so, other alternative assets are playing a much bigger role in modern pension portfolios, similar to those of endowments. By our findings (see Exhibit 5 on page 64), we calculate that the 20 public pensions had a 27.1% average allocation to alternatives

in FY 2016, rising from a 16.8% average for pensions in 2008. In contrast, the 20 large endowments had on average 60.5% in alternatives in FY 2016, versus 57.1% in FY 2008.

Since asset allocation is a big driver of returns, it broadly explains much of the performance differences between pensions and endowments.

More Regulated & Conservative

Lastly, unlike endowments, public pensions are more heavily regulated by the federal Internal Revenue Code and other state laws because they have a legal liability to pay employees' pension benefits. Underfunding can mandate state contributions and impact future taxes, or threaten benefit cuts to workers and retirees.

Per NASRA, U.S. public pensions serve 12.8 million active (working) members and 9.1 million annuitants. Problems with the health of public pensions, or even excessive manager fees, can cause major headaches for politicians and fund executives. Between the scrutiny of government agencies and their constituencies, public pension investing can be politically influenced, another reason why pensions tended to be historically more conservative than endowments.

Pensions Gain Over the Short-Term

The previous 20 year chart in Exhibit 1 does not tell the whole story. With pensions using more alternatives, returns are starting to resemble those of endowments, as can be better seen in the shorter five year chart of Exhibit 2.

Even though endowment returns recently ceded ground to public pensions, notice that Yale delivered strong returns. Exhibit 2 shows far less performance dispersion among endowments, which are more in line with pensions. Perhaps this suggests a levelling of the investment playing field between endowments and public pensions.

Also, note the good risk-adjusted returns of the 60% S&P 500 / 40% Bloomberg Barclays U.S. Bonds Aggregate index over the 5 years (upper left quadrant). The 60/40 beats both the pension and endowment averages with lower risk.

Rolling 3 Year Periods Clarify Trends

A single time period chart is only a snapshot in time. To see the forest for the trees, one should look at rolling periods for performance trends.

Before comparing endowments to pensions, Exhibit 3a compares the average rolling 3 year return of 20 large endowments to a 70% MSCI ACWI Stock /30% U.S. Aggregate Bond index. Over a 35 year period (6/30/1982-6/30/2017), endowments enjoyed an average annual excess return of +2.22%, with a risk lower by -0.85%.

While endowments have greatly outperformed the 70/30 from the 1990s until the 2008 financial crisis, the excess return narrowed since the crisis. Overall, Exhibit 3a proves that the Endowment Model still adds RELATIVE value above the 70/30, despite the gravitational pull of weak ABSOLUTE returns currently troubling ALL investors. For instance, while many investors earned healthy returns in FY 2017, the 10 year CAGR will be below 5% for some investors.

Note that the extent of the Model's success depends on the benchmark used, as is seen on the next page in Exhibit 3b. Since the crisis, large endowments have struggled versus the less diversified, U.S. centric 60% S&P 500 / 40% Bloomberg Barclays U.S. Aggregate Bond index. In fact, the bulk of outperformance in Exhibit 3b is limited to the late 1990s to mid-2000s.

Should we be concerned that the U.S. 60 /40 index has been harder for endowments to consistently outperform than the 70% MSCI ACWI Equities / 30% U.S. Aggregate Bond benchmark?

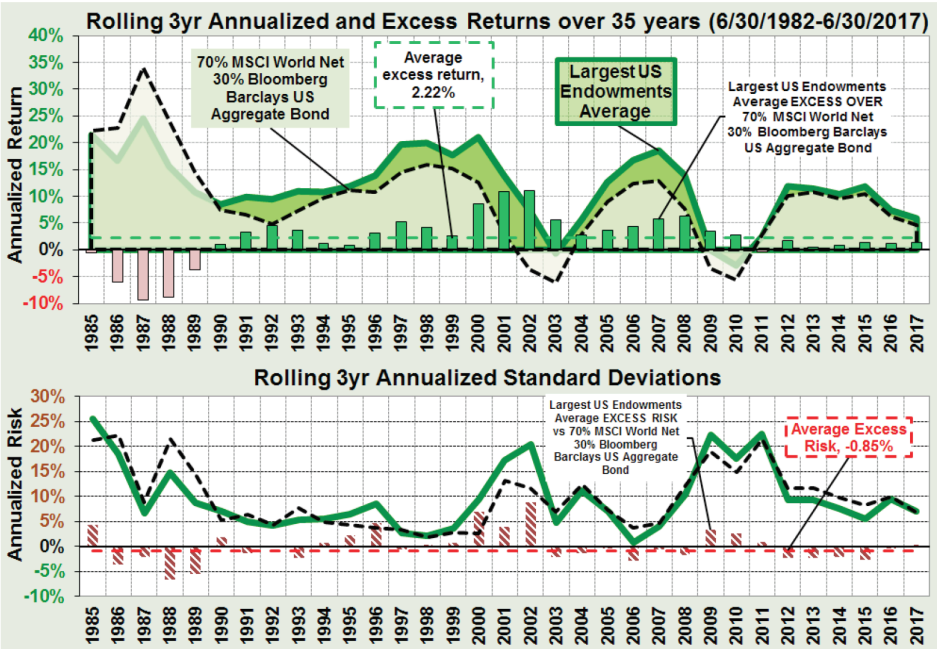


Exhibit 3a: Rolling 3 Year Performance: 20 Large U.S. Endowments vs. Global 70/30 Index

Sources: Data from MSCI All Country World Index, Bloomberg Barclays, and individual college financial and/or investment reports.MSCI ACWI Net since 12/31/2000 is spliced with ACWI Gross 12/31/1987-12/31/2000; MSCI World Net 12/31/1972-12/31/1987

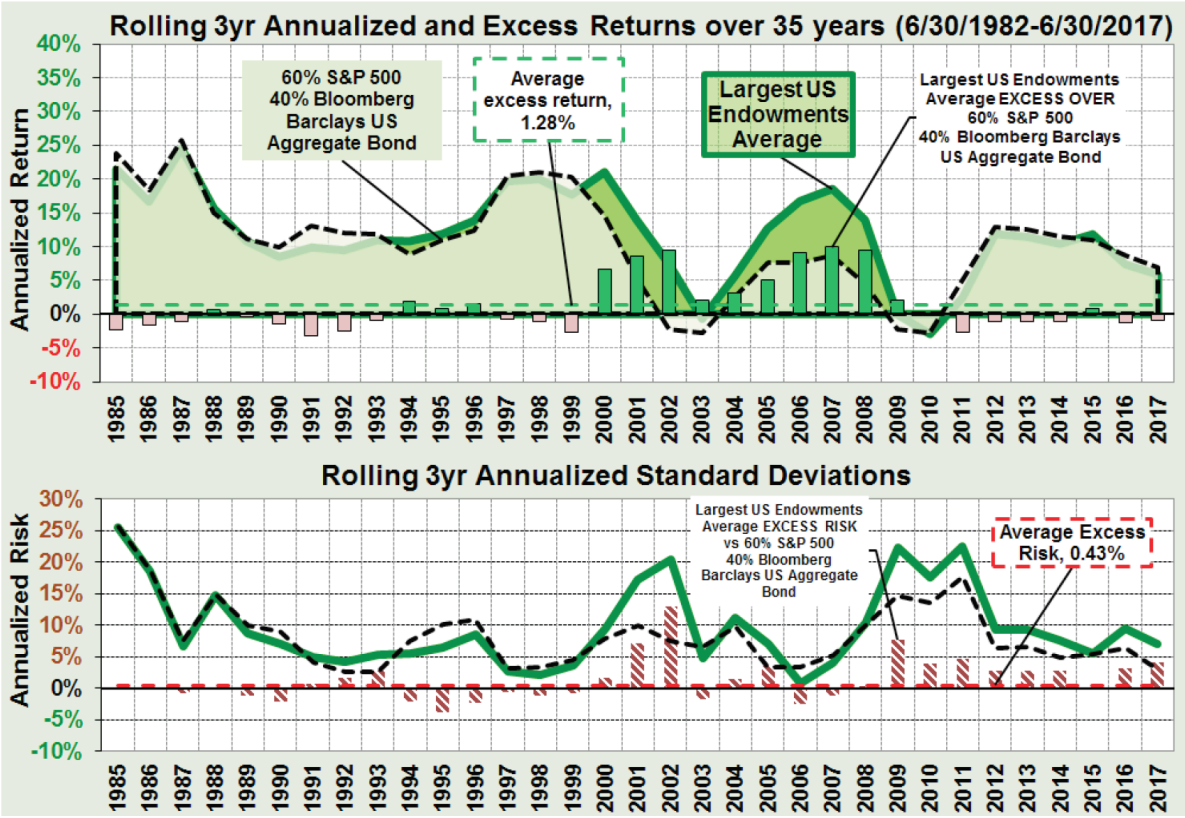


Exhibit 3b: Rolling 3 Year Performance: 20 Large U.S. Endowments vs. U.S. 60/40 Index
Sources: Data from Standard & Poors, Bloomberg Barclays, and individual college financial and/or investment reports.

In Defense of the Endowment Model

The U.S. centric 60/40 is not as well-diversified for most investors. It is essentially a bet on U.S. large cap public stocks / U.S. bonds. Thus, due to the cyclicality of global markets, this index could easily experience periods of underperformance. Thus, diversification is necessary to control risks and increase the chances of earning future outperformance. For instance, the rise in economic dominance of China and emerging markets (EM) countries could easily generate sustained outperformance of EM stocks.

Besides using geographical diversification, the Model uses alternatives to uniquely diversify and add value. For instance, some hedge funds deliver absolute returns to mitigate a bear market, while others, like managed futures, can protect against spikes in volatility. Buyout funds unlock hidden value via the restructuring of companies. Venture capital helps finance new innovative companies like Google, Amazon, and Facebook, and has the potential for high returns. Inflation-linked bonds, real estate, and commodities serve as an inflation hedge and offer low correlated real returns. Thus, diversifying beyond U.S. large cap stocks helps investors cope with global economic challenges.

Lastly, the endowment average masks the great outperformance of top teams versus the 60/40. Despite the recent struggle versus the U.S. 60/40, there is a healthy 1.28% of excess annual return versus it over 35 years, with only 0.43% higher annual risk. Any top college that had settled for the U.S. 60/40 over this period would have lost out. Clearly, the Endowment Model works very well for some colleges over long time periods, so we should not abandon it just yet.

Endowments vs Pensions: Rolling 3 Years

Finally, Exhibit 4 compares endowments to public pensions. Like the prior charts, it also shows considerable endowment outperformance versus public pensions from the early 1990s until the financial crisis. Yet, over the 8 year period from June 30, 2008 to the fiscal year ending FY 2016, large endowments have slightly underperformed with an average annualized return of 5.4%, versus an average 5.5% return for the 20 large pensions.

Have public pensions finally emulated the Endowment Model? It is unclear whether the lead once enjoyed by large endowments has narrowed due to stretched valuations from a flood of capital chasing crowded trades, causing the illiquidity premium to shrink. What is clear is that asset allocation roughly explains some of the outperformance of pensions since FY 2008.

We do not have year-by-year allocation and asset return data for each of the 8 years for this study's 40 institutions to do a proper performance attribution. Instead, if you will excuse us, here are general, back of the envelope calculations using return data from annual NCSE studies to add color.[11] The starting allocations listed below are as of FY 2008, yet there were considerable changes over the 8 years ending FY 2016 (see Exhibit 5). Thus, even though the conclusions below are general at best, the annualized excess

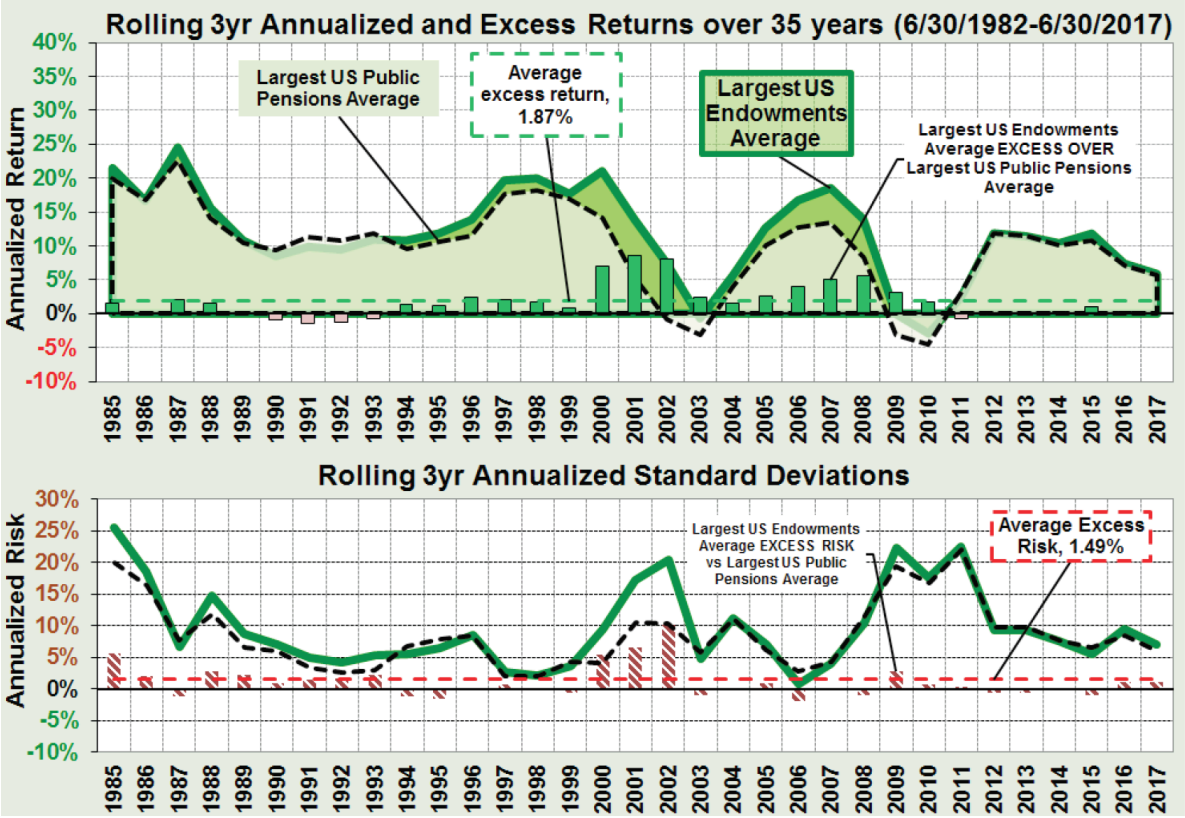


Exhibit 4: Rolling 3 Year Performance: 20 Large U.S. Endowments vs. 20 Large U.S. Public Pensions
Sources: Data from individual college and public pension financial and/or investment reports.

	FY 2008 Averages		FY 2016 Averages			
Asset	20 Large U.S. Public Pensions	20 Large U.S. Endowments	20 Large U.S. Public Pensions	Change vs 2008	20 Large U.S. Endowments	Change vs 2008
Traditional						
Fixed Income	27.7%	10.1%	24.6%	-3.1%	7.7%	-2.4%
Cash	1.4%	1.3%	1.9%	0.5%	2.3%	1.0%
U.S. Equities	34.5%	13.7%	26.4%	-8.1%	12.0%	-1.7%
Non-U.S. Equities	19.6%	17.8%	20.0%	0.4%	17.5%	-0.3%
Subtotal Traditional	83.2%	42.9%	72.9%	-10.3%	39.5%	-3.4%
Alternatives						
Hedged Strategies	1.4%	24.4%	5.2%	3.8%	23.0%	-1.4%
Real Estate	7.4%	9.6%	9.5%	2.1%	8.7%	-0.9%
Private Equity	7.0%	16.7%	9.8%	2.8%	21.3%	4.6%
Natural Resources	1.0%	6.4%	2.6%	1.6%	7.5%	1.1%
Subtotal Alternatives	16.8%	57.1%	27.1%	10.3%	60.5%	3.4%
Total	100.0%	100.0%	100.0%		100.0%	

Exhibit 5: Average Asset Allocations of 20 Large U.S. Public Pensions versus 20 Large U.S. Endowments
Sources: Data from individual college and public pension financial and/or investment reports.

0.1% return for public pensions is very roughly explained by the following:

- The 20 public pensions on average had much higher U.S. public stock FY 2008 exposures (34.5% vs. 13.7% for the 20 endowments), but were underweight better performing private equity (7.0% vs. 16.7%). Private equity had 9-11% annualized returns on average over the 8 years (using NCSE data for the $1+ billion endowments), and outperformed the Russell 3000's annualized 8.7%. Netted, U.S. equity and private equity exposures likely gave a very rough 0.3% overall advantage to the pensions.
- Pensions had higher FY 2008 exposures to bonds (27.7% vs. 10.1% for endowments) on average, which softened the blow from stocks, and helped pensions with the subsequent drop in yields. The Bloomberg Barclays Global Bond Aggregate had a 3.4% annualized 8 year return; the U.S. Aggregate had a 4.8% annualized return.
- However, pensions were typically underweight hedge funds (1.4% vs. 24.4% for endowments). Hedge funds had a 3.8% annualized return over 8 years for the NCSE $1+ billion endowments. The hedge fund underweight likely offset the benefit of the bond overweight above, costing pensions a rough net 0.1%, and reducing their net overall outperformance to 0.2%.
- Pensions on average had lower allocations to natural resources (roughly 1.0% vs. 6.4% for the endowments). Returns were roughly 1.6% annualized over the 8 years for the NCSE $1+ billion endowments. The underweight cost pensions about 0.1% of annualized return, and reduced net overall outperformance to 0.1%.
- Small allocation differences in other assets mostly cancelled each other out. Pensions had a slight underweight in real estate (7.4% vs. 9.6% for endowments) with 1.8% returns for NCSE $1+ billion endowments (low vs REITs due to a lag in reporting). However, pensions were slightly overweight non-U.S. equities (19.6% vs. 17.8% for the endowments), with about 2.0% annualized returns for the NCSE $1+ billion endowments.

Despite the differences in allocations, the trend for public pensions over the 8 years has been a decrease in U.S. stocks and bonds in favor of more foreign equity, real estate, private equity, and other alternatives. Thus, continued convergence of allocations may ensure similar future returns.

The Endowment Model Drawbacks

Overall, the Endowment Model continues to be a success for those with resources to effectively run it. Yet, smaller institutions tend to find the Model challenging to run due to shortcomings such as:

- the high cost to implement it
- high underlying fees, especially painful in a low return environment
- high complexity; poor transparency
- illiquidity (despite growth in secondary markets for alternatives)
- limited access to top alternatives funds
- burden of extensive fund manager due diligence (essential for diversification)
- fund manager transition challenges
- redemption gates and multi-year lock-ups

Some of these disadvantages are magnified during a financial crisis. High fees undermine long-term return goals, and rare fund manager blow-ups create headline risk, with an ensuing backlash from constituencies. Concerns over manager risk can result in over-diversification across fund managers and expensive beta. (Read my LinkedIn article December 9, 2016 "Endowment Diversification & the Beta Trap").

During the last crisis, illiquidity forced some colleges to issue bonds and/or sell assets at a discount to meet budgetary needs, and/or to meet private equity commitment calls.

As a result of these many challenges, smaller endowments on average tend to fall short of their return goals and jeopardize their missions, as can be seen in Exhibit 6.

The Endowment Model Alternative

Is there another way to achieve some of the superior returns of the Endowment Model, and avoid many of the drawbacks?

As we know, the Endowment Model evolved to improve upon a balanced index like the traditional U.S. centric 60/40. In the spirit of the more aggressive investment style of large endowments, we find that a well-designed index fund strategy that targets some of the underlying beta exposures of a typical endowment could add value versus a balanced benchmark.

Exhibit 7 shows a mean variance optimization (MVO) performance analysis of over 1 million random beta portfolios versus benchmarks over a 20 year period ending June 30, 2017. The beta portfolios consist of combinations of index funds we use in our strategy (using total returns, net of fees, and benefitting from dividend reinvestment).

Prior to inception of index funds that have a short history, model returns were created by taking the total return of an index, less a rough hypothetical fee, and splicing these model returns onto the actual return series for these index funds, making the results of this analysis highly hypothetical. Note that model returns are not actual returns.

The graph also displays the performance of 20 of the largest endowments and 20 of the largest U.S. public pensions over this period like in Exhibit 1.

The MVO plot can be broken into 3 areas: the gray region consists of 569,809 unreasonably diversified portfolios (55% of the total) which we define as those with one or more assets making up more than 25% of the portfolio. The dark green area shows 475,807 reasonably diversified portfolios (or 45%% of all beta portfolios) with each asset under a 25% weight. The third region is the efficient frontier on the upper edge of the plot, consisting of portfolios that maximize return for a given risk level. However, note these portfolios tend to be NOT sufficiently diversified.

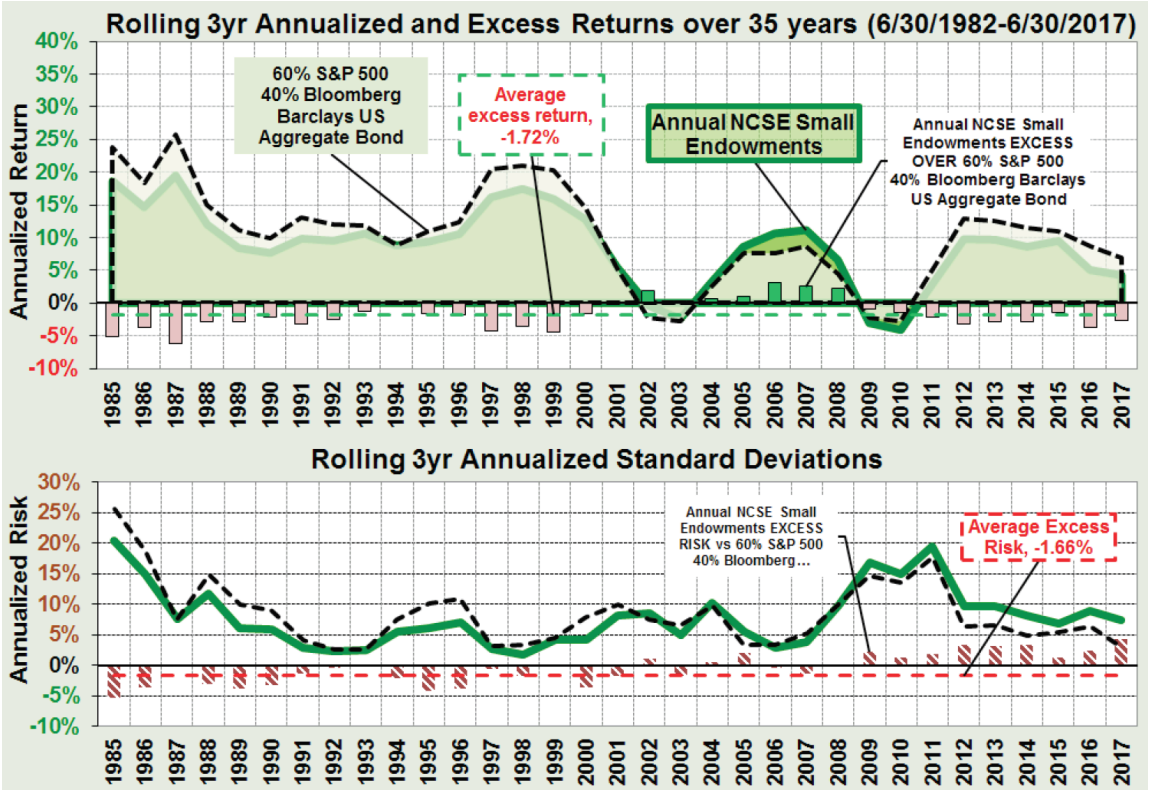


Exhibit 6: Rolling 3 Year Performance: Small Endowments vs. Global 70/30 Index
Sources: Data from MSCI All Country World Index, Bloomberg Barclays, and individual college financial and/or investment reports. MSCI ACWI Net since 12/31/2000 is spliced with ACWI Gross 12/31/1987-12/31/2000; MSCI World Net 12/31/1972-12/31/1987

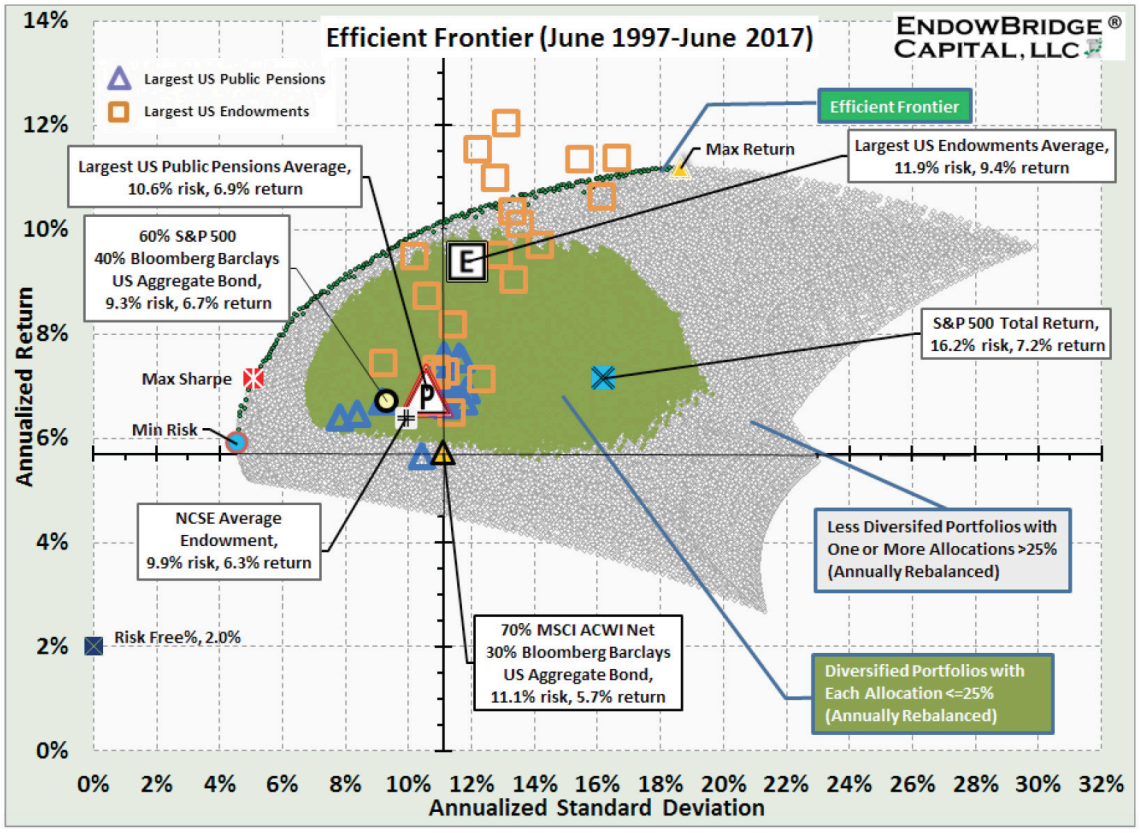


Exhibit 7: Mean Variance Analysis of Beta Index Portfolios vs. Benchmarks for the 20 Year Period Ending June 30, 2017
Sources: Data from MSCI, Bloomberg Barclays, Standard & Poors, NACUBO-Commonfund Study of Endowments, and individual college and public pension financial and/or investment reports. Some institutions only report returns that are GROSS of fees, others are net of fees.

Besides the limitations of using model returns, note there are limitations and caveats of using a MVO analysis, such as the high sensitivity to changes in inputs like risk and return assumptions. Also, Exhibit 7 shows historical results, whereas a more useful analysis would be to use future forecasted risks, covariances, and returns to optimize asset allocation. Again, there is also the potential for unreasonably concentrated portfolios to be output as optimal solutions on the efficient frontier. Lastly, the MVO does not take into account the illiquidity of investments. See my 2016 paper "Efficient Frontier Insights & The Endowment Model" for more details.

While past performance does not guarantee future success, note that there are 89,019 index fund portfolios (8.5% of the total) in the upper left quadrant of the dark green area that outperformed a 70/30 benchmark with lower risk.

Thus, it appears that an index fund strategy could have delivered superior returns and avoided the drawbacks of the Endowment Model by improving upon liquidity, transparency, and fees, while reducing complexity.

As a caveat, an index fund strategy likely would NOT benefit from superior assets like venture capital, especially during a period of irrational exuberance like the Internet Bubble. As Exhibit 7 shows, top endowments delivered returns well above the efficient frontier of beta index portfolios (note that a 10 year chart would tell a different story).

However, our research suggests that some small to mid-sized endowments might be better off with a low-cost index fund strategy. And our actual results of running the EndowBridge Legacy Strategy since June 30, 2013 also corroborates what others like Vanguard[12] and David Swensen[13] have also suggested about the suitability of using index funds for some investors. Others have also written about replicating endowment returns with index funds.[14] Lastly, even the $38.5 billion Nevada pension plan embraces index funds for a substantial portion of their portfolio. (Read my LinkedIn article on "The Allure of an Index Fund Strategy.")

Despite the limitations of the MVO analysis and using the past to predict the future, the main takeaway is that there could be many roads to investment success (and the Endowment Model is not a one size fits all strategy).

Conclusion

Public pensions have recently seen encouraging performance on par with some endowments, owing partly to convergence of allocations between endowment and pension portfolios. Public pensions are likely to continue to embrace riskier assets to improve their underfunded status. Yet, due to lingering portfolio differences between these two types of investors, differences in performance may persist.

The current era of low returns is challenging for all investors. Even top endowments have seen a drop in rolling multi-year returns. Low returns will make it harder for investors to achieve their missions, so creativity may be in order.

In the relentless pursuit of alpha, the investment industry relies upon innovation to deliver the potential for better returns. Portable alpha, 130/30 strategies, high frequency trading, and smart beta are on a long list of innovation, despite sometimes delivering mixed results.

Even the fabled Endowment Model continues to evolve as it tries to match Yale's remarkable success. Some investors struggle to implement the Endowment Model, and fall short of long-term investment goals. As reality check, investors should use a diversified balanced benchmark like the global 70/30 to ensure their efforts ultimately lead to long-term risk-adjusted success.

Institutional investors that consistently fall short of their investment goals should explore other ways to improve returns. Chasing riskier assets to seek higher returns is not always the answer.

Even though recent returns clearly show that the Endowment Model still works for many investors, the high fees of below average alternative assets managers can weigh heavily on performance, especially in a low return environment. Despite facing pressure to lower fees, top fund managers definitely earn their fees, so it is unfair to punish all fund managers equally. However, using some index funds to decrease over-diversification could reduce expensive beta and still leave room for top fund managers.

Lastly, there are many roads to investment success. Using a well-designed portfolio of low-fee index funds could also serve to streamline the Endowment Model. A beta-driven portfolio could give greater control over asset allocation and rebalancing, and bring benefits such as better liquidity and transparency. Even partially using an index fund strategy alongside the best existing alternative asset managers could be a sensible modification to a long-term investment policy.

Appendix

For a clearer, simplified picture of Exhibits 1 and 2, here are the charts WITHOUT the distraction of individual data points for the large endowments and public pensions that make up the averages:

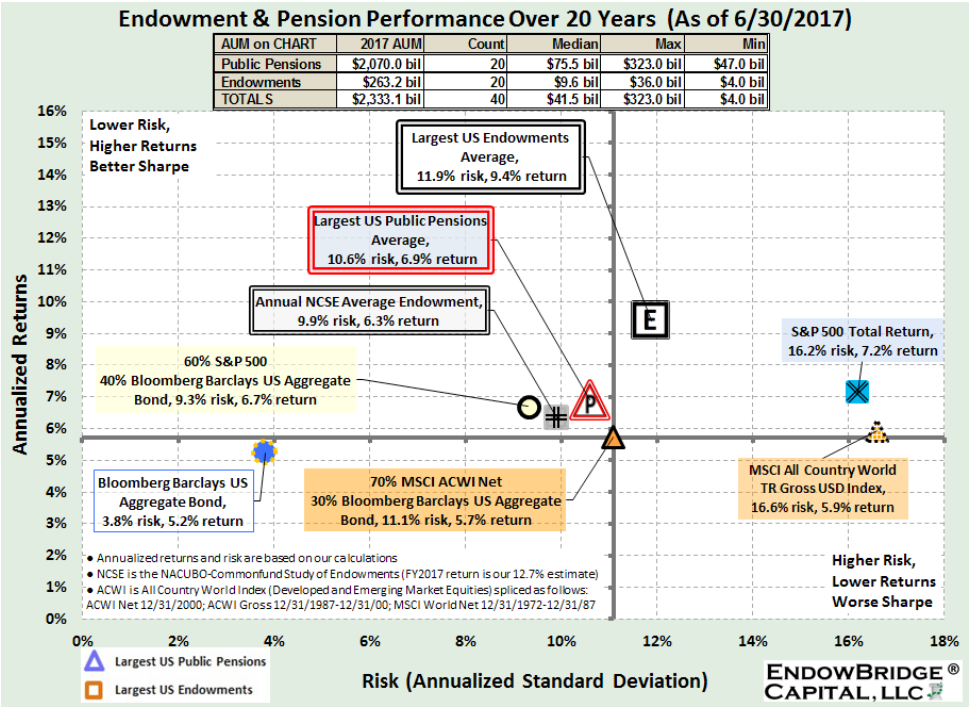


Exhibit 1s: Simplified Endowment and Public Pension Returns versus Annualized Risks for the 20 Year Period Ending June 30, 2017
Note how large endowments have higher returns and higher risk than public pensions and balanced benchmarks over the long-term.
Sources: Data from MSCI, Bloomberg Barclays, Standard & Poors, NACUBO-Commonfund Study of Endowments, and individual college and public pension financial and/or investment reports.

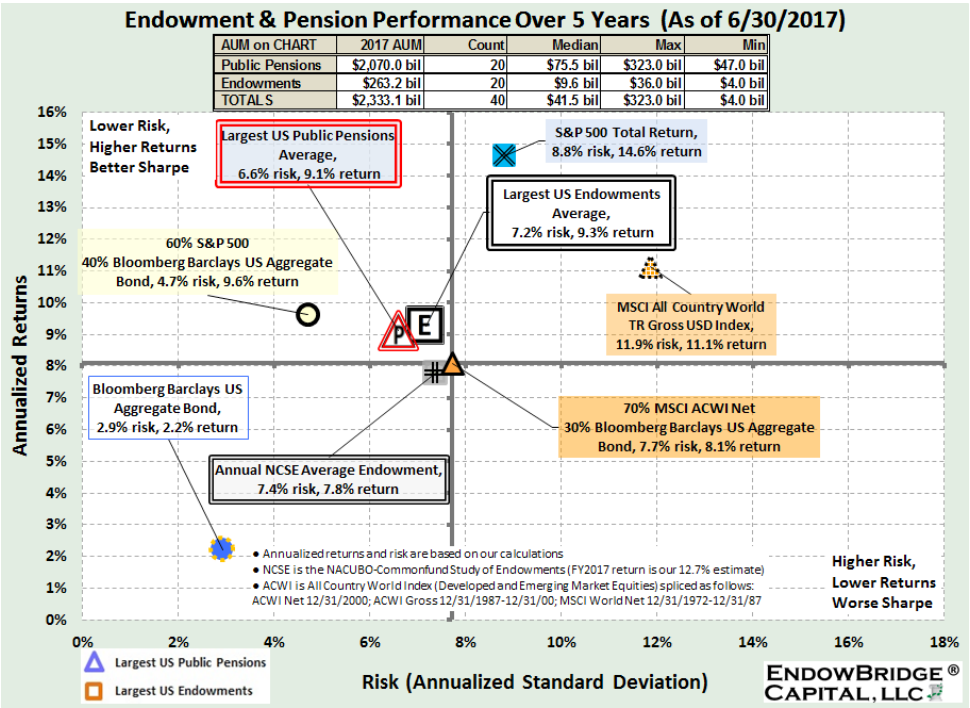


Exhibit 2s: Simplified Endowment and Public Pension Returns versus Annualized Risks for the 5 Year Period Ending June 30, 2017
Shorter-term, large endowments are more in-line with public pensions and balanced benchmarks.
Sources: Data from MSCI, Bloomberg Barclays, Standard & Poors, NACUBO-Commonfund Study of Endowments, and individual college and public pension financial and/or investment reports.

Endnotes

Special thanks to Dan Zibman and several others for their insightful contributions and invaluable feedback.

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2. Dan Primack, (2016) "No, Yale's VC Portfolio Didn't Nearly Double Every Year," *Fortune* April 14, 2016

3. Assumed returns (2017) "National Charts of Annual Return for State and Local Pensions, 1992-2016," Public Plans Data produced by the Center for Retirement Research at Boston College

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5. Craig Foltin, Dale Flesher, Gary Previts, Mary Stone (2017) "State and Local Government Pensions at the Crossroads, Updated Accounting Standards Highlight the Challenges" *CPA Journal*

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7. Mark A. Sarney, (2000) "State and Local Pension Plans Equity Holdings and Returns," *Social Security Bulletin*, Vol. 63, No. 2

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Author Bio

Michael Karris
EndowBridge Capital

Michael Karris founded EndowBridge® Capital in 2013 with a mission to help small to mid-sized endowments and foundations by improving their investment solutions while delivering superior risk-adjusted returns via a much simpler index fund strategy and vehicle.

Formerly, he was Director of Investments/Trading for Columbia University's endowment focusing on beta rebalancing, hedging overlay strategies, and transition management. He developed analytical tools for risk management and performance attribution.

Michael also worked at JP Morgan Asset Management in fixed income on the Long Duration and Stable Value teams, focusing on portfolio management and analytics for defined contribution & defined benefit pension plans.

Prior to this, he worked at BNP Paribas in Global Fixed Income Sales covering US fund managers, hedge funds, and private banking groups. He has extensive experience in capital markets, working with institutional investors across many asset classes since 1993.

Michael earned an M.B.A. from Northwestern University's Kellogg Graduate School of Management, and a B.S. in Electrical Engineering from the University of California, Los Angeles.

He is a registered investment adviser and holds a NASD Series 65 license (having previously held Series 7, 3, and 63 licenses).

Hye Young Jeong, *CAIA*

Hye Young has over 12 years of financial industry experience, of which 8 years have been devoted to asset management. Hye Young is currently in Client Services & Marketing role at Western Asset Management in Singapore, in charge of North/ South Asian institutional clients for all fixed income strategies which also include structured products. Prior to joining Western in 2016, she served as a Senior Client Service Officer for Mutual Fund Business at Baring Asset Management in Korea. She was responsible for overall management of relationship with distribution partners.

After her MBA, Hye Young took a challenge and became a credit analyst in Shinhan Bank Singapore branch, where she performed credit analysis to assign risk ratings. From 2007 to 2012, she held positions as a Relationship Manager and Infrastructure Fund Manager at Shinhan BNP Paribas Asset Management in Korea, where she developed relationship with clients for expansion of retail fund business and analyzed infrastructure projects for investment in fund. Hye Young started her financial industry career with JPMorgan Chase Bank in Korea.

Hye Young earned her MBA from Melbourne Business School in Australia and Bachelor of Business Administration from Ewha Womans University in Korea. She is a charterholder of Chartered Alternative Investment Analyst (CAIA) and associate member of American Institute of Certified Public Accountants (AICPA).

We recently distributed a Joint Task Analysis survey (JTA) which collected inputs from fellow CAIA members and investment professionals to determine the future course of the CAIA curriculum. In appreciation for participating in this survey, we sat-down with Hye Young Jeon and got an opportunity to better understand what led her down the path of Alternative Investments. Below is a transcription of the Q&A session we had.

What inspired you to go in to the financial field?

My personal interest in finance started when I was attending the university. While studying at Ewha Womans University in Korea, I simultaneously started to work towards the American Institute of Certified Public Accountants (AICPA) to strengthen my financial knowledge. Secondly; at that time the financial industry in South Korea was growing rapidly, so it was a great way for me to capture the opportunities that were going to become available.

What were your biggest challenges to get here?

I started my career with JP Morgan Chase Bank in South Korea, which required people with extensive experience and a high degree of financial knowledge. Entry level jobs have a chicken and egg problem. Big companies would like someone with experience at an entry level position, but you can't get the experience for the entry level role. However; since I had my AICPA it helped paved the way for me to start my career.

Where do you believe the industry is going? Where do you see the most room for growth, and how do you see yourself being a part of it?

Since the financial industry is rapidly changing, you really have to keep learning. I strongly believe, especially in this field that I would never be able to say I know it all. Given the many changes after the global financial crisis, I see a lot of the growth in compliance. I also see a growth for non-traditional or customized products for clients, hence the importance of continuing education.

What advice would you give your younger self on the first day of working in this industry?

Doing the job task well should always be the primary responsibility. However; if I could go back I believe I would emphasize with great importance networking. Looking back now I can see how networking would have broaden my contacts in the industry and would have been a definitive positive in my career.

Which countries do you believe provide the best opportunities now for a person who is entering the financial industry and why?

The financial industry in Asia has been growing rapidly, that helps developing Asian countries to create opportunities. And although I came to Singapore for personal reasons, so far, I enjoy working in Singapore. And I am seeing a lot of real estate and hedge fund companies expanding here. I also network and participate in our local CAIA chapter events here in Singapore. I would also explore working in the US and Europe, as I'm sure it will be very different from everything I have experienced.

Finally shifting gears to CAIA, what made you work towards the CAIA designation? How has CAIA furthered your career?

I started my career mainly working with structured products such as ABS, which initially gave me exposure into the world of alternative investments. Also, in my second job at BNP Paribas Asset Management in South Korea, I was an infrastructure manager. I was lucky to have exposure to the alternative investment field. From then on, I wanted to learn about other alternative investment assets, this is when I started to pursue the CAIA designation. In terms of education and preparing for my role it has helped tremendously. While I was getting my MBA in Melbourne I was simultaneously looking for a job. My approach for looking for a job was to first look for CAIA members in my community; which turned out to be a very warm and welcoming group. In fact, when I came to Singapore I continued to remain connected with the CAIA community and frequently attend the educational/networking events, which without a doubt has helped my career greatly.

The CAIA Endowment Investable Index

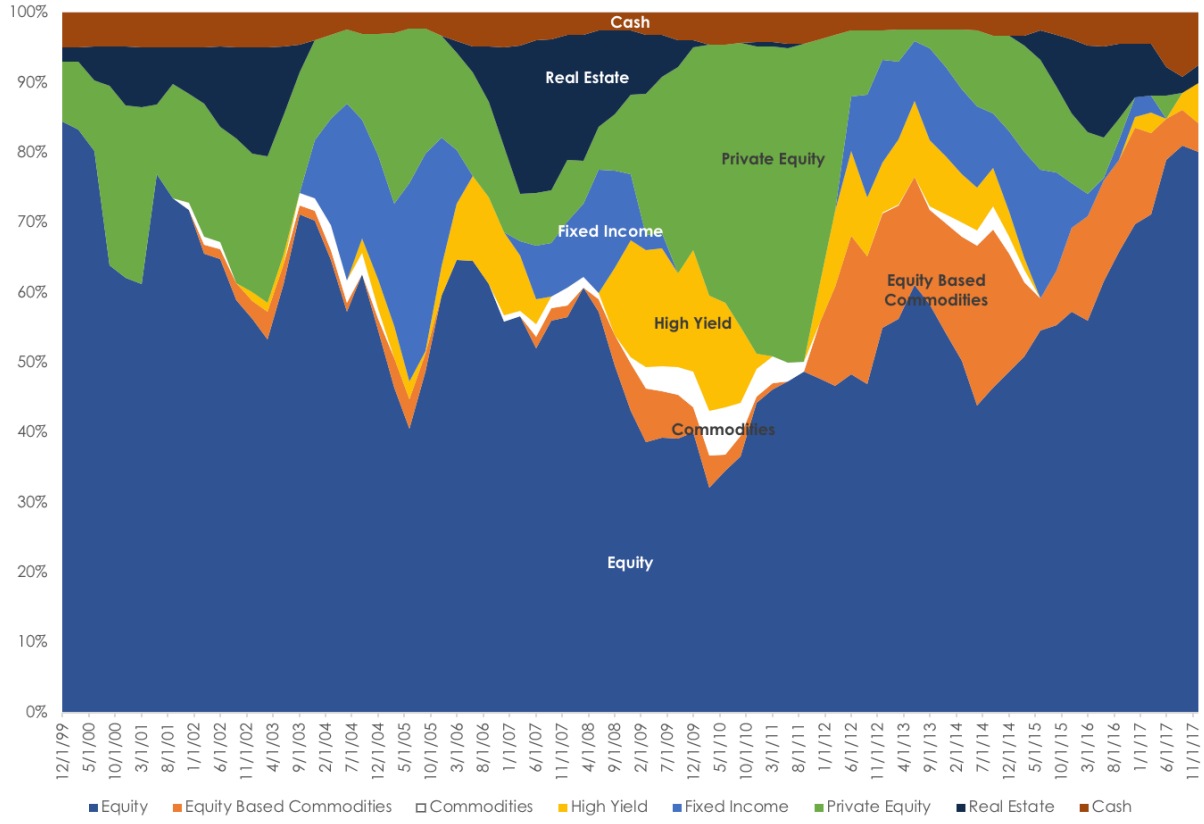
Hossein Kazemi

Kathryn Wilkens, *CAIA*
Pearl Quest

We present the historical weights, allocation as of month-end December 2017, and historical performance to the replication portfolio that was introduced in our AIAR publication Volume 6 Issue 1.

The below graph shows the exposures of the Multi-Asset ETF portfolio through time. It is important to note that the volatility displayed by these exposures does not imply that endowments alter their asset allocations as frequently as the Multi-Asset ETF portfolio. While an endowment may hold a fixed allocation to various asset classes, the underlying assets/manager may display time-varying exposures to different sources of risk. For instance, a hedge fund manager may decide to increase her fund's exposure to energy stocks while reducing the fund's exposure to healthcare stocks. Though the endowment's allocation to that manager has remained unchanged, its exposures to energy and healthcare sectors have changed. Also, if returns on two asset classes are highly correlated, then the algorithm will pick the one that is less volatile. For instance, if returns on venture capital and small cap stocks are highly correlated, then the program will pick the small cap index if it turns out to be less volatile.

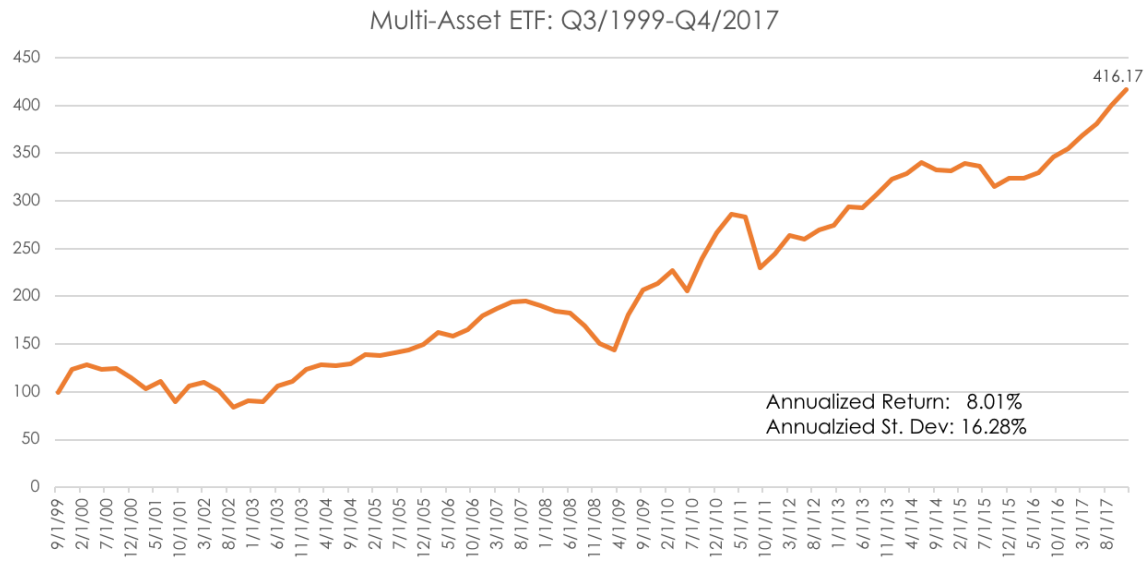
Endowment Index Weights



Allocation Suggested by Algorithm

RUSSELL 2000 ETF	MSCI World Free ETF	Vanguard FTSE Emerging Markets ETF	Materials Select Sector SPDR® ETF	Technology Select Sector SPDR® ETF	Consumer Staples Select Sector SPDR® ETF	Health Care Select Sector SPDR® ETF	BBgBarc US Corporate High Yield TR USD	SPDR® Dow Jones Global Real Estate ETF	Cash & Short-Term Treasuries
24.41%	26.15%	4.46%	4.03%	12.90%	1.27%	10.99%	5.81%	2.55%	7.45%

Historical Performance



Authors' Bios

Hossein Kazemi, *Ph.D., CFA*
CAIA Association
Isenberg School of Managment,
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Dr. Hossein Kazemi is the Senior Advisor to the CAIA Association's Program. Dr. Kazemi has been involved with the CAIA Association since its inception as a senior advisor and a managing director. In his current role, he helps with the development of the CAIA program's curriculum and directs the CAIA Association's academic partnership program. In addition, he serves as the editor of *Alternative Investment Analyst Review*, which is published by the Association. He has worked with universities and industry organizations to introduce them to the CAIA program. Dr. Kazemi is Michael and Cheryl Philipp Distinguished Professor of Finance at the Isenberg School of Management, the University of Massachusetts - Amherst. He is the Director of the Center for International Securities & Derivatives Markets, a nonprofit organization devoted to research in the area of alternative investments, a co-founder of the CAIA Association, and home to CISDM Hedge Fund/CTA Database and the *Journal of Alternative Investments*, the official research publication of the CAIA Association. He has over 25 years of experience in the financial industry and has served as consultant to major financial institutions. His research has been in the areas of valuations of equity and fixed income securities, asset allocation for traditional and alternative asset classes, and evaluation and replication of active management investment products. He has a Ph.D. in finance from the University of Michigan.

Kathryn Wilkens, *Ph.D., CAIA*
Pearl Quest LLC

Kathryn Wilkens is the president and founder of Pearl Quest LLC, a consulting company currently focused on tracking and replication products, and educational services in the alternative investments space. She is also an RIA with S Capital Wealth Advisors and assistant editor for the *Journal of Alternative Investments*.

About CAIA

Founded in 2002, the CAIA Association is the world leader and authority in alternative investment education. The CAIA Association is best known for the CAIA Charter (www.caia.org), an internationally-recognized credential granted upon successful completion of a rigorous two-level exam series, combined with relevant work experience. Earning the CAIA Charter is the gateway to becoming a Member of the CAIA Association, a global network of more than 9,000 alternative investment leaders located in 90+ countries who have demonstrated a deep and thorough understanding of alternative investing. The CAIA Association now supports 30 vibrant chapters located in financial centers around the world and sponsors more than 150 educational and networking events each year.

The List:
Alternative Indices

The performance table below is a collection of both traditional and alternative indices for the 1, 5 and 10-year period annualized through September 2017. Both the annualized volatility and draw-down figures are calculated using a 10 year quarterly return series.

Alternative investments have been growing markedly over the past few years, creating a multitude of opportunities for owners and allocators alike. As the number and type of alternative asset classes continue to proliferate, we believe they are playing a more unique role in assisting investors achieve their desired investment outcomes. As we expect this trend to continue, we found it necessary to structure a pure alternative assets portfolio to have visibility in this exciting marketplace.

We set out to strike a balance between available assets in proportion to their market value, and to reflect the average "alternative investor". We defined the investment opportunity to simply be the following three assets classes: Real Asset, Private Equity/Venture Capital and Hedge Funds. Real assets are comprised of real estate, commodities, timberland, farmland, infrastructure, bank loans and cat bonds; within real asset the weights were structured to reflect the market portfolio[1] within that universe. To arrive at our weight's, we researched various endowments and foundations, as well as surveys conducted by Willis Towers Watson and Russell Investments. Based on our research, alternative historical allocations have not had material deviation's and therefore we decided to implement a market weight of 1/3 across each of those asset classes. A few of the constituents are not investable, and some may be reported gross or net of fee.

	Ending Sept 2017				
	1 Yr	5 Yr	10 Yr	Ann. Vol	Draw-down
MSCI World Free	18.83%	11.62%	4.81%	17.72%	-48.59%
Barclays Global Agg	-3.70%	-0.54%	2.92%	7.83%	-10.20%
MSCI Emerging Markets	22.91%	4.36%	1.65%	23.81%	-53.18%
Barclays Global High Yield	9.28%	6.44%	7.95%	12.99%	-27.15%
HFRI Fund Weighted Composite	7.11%	4.71%	3.08%	7.49%	-19.03%
CISDM EW Hedge Fund	8.83%	5.76%	4.15%	8.15%	-19.16%
CISDM CTA EW	-1.38%	3.50%	5.55%	7.62%	-7.93%
CISDM Distressed Securities	8.01%	5.51%	4.71%	7.71%	-20.05%
CISDM Equity Long/Short	7.80%	6.77%	4.44%	7.32%	-14.53%
CA US Private Equity	16.79%	13.27%	9.59%	8.67%	-25.08%
CA US Venture Capital	8.00%	14.12%	8.92%	8.25%	-18.44%
LPX Mezzanine Listed Private Eqty	5.43%	7.99%	-0.62%	33.92%	-81.08%
FTSE NAREIT All Equity REITs	2.57%	9.97%	6.06%	25.20%	-62.95%
NCREIF Property	6.90%	10.35%	2.84%	5.82%	-23.88%
S&P Global Property	5.83%	8.15%	5.89%	22.82%	-62.98%
S&P Global Infrastructure	13.15%	9.35%	3.61%	17.44%	-48.72%
Bloomberg Commodities	-0.29%	-10.47%	-6.83%	20.40%	-65.91%
NCREIF Timberland	3.28%	7.13%	5.20%	4.59%	-5.69%
NCREIF Farmland	6.15%	12.71%	12.61%	5.08%	0.00%
Alternative Assets Portfolio	**8.29%**	**9.33%**	**6.30%**	**6.96%**	**-21.89%**
Global 60/40	**9.46%**	**6.76%**	**4.52%**	**11.16%**	**-29.29%**
60% Portfolio/40% Global 60/40	**9.02%**	**7.81%**	**5.28%**	**9.11%**	**-26.34%**

Source: CAIA, CISDM, HFRI, Cambridge Associates and Bloomberg.

1. Global Invested Capital Market by Hewitt EnnisKnupp, an Aon Company

Submission Guidelines

Article Submission: To submit your article for consideration to be published, please send the file to **AIAR@caia.org**.

File Format: Word Documents are preferred, with any images embedded as objects into the document prior to submission.

Abstract: On the page following the title page, please provide a brief summary or abstract of the article.

Exhibits: Please put tables and graphs on separate individual pages at the end of the paper. Do not integrate them with the text; do not call them Table 1 and Figure 1. Please refer to any tabular or graphical materials as Exhibits, and number them using Arabic numerals, consecutively in order of appearance in the text. We reserve the right to return to an author for reformatting any paper accepted for publication that does not conform to this style.

Exhibit Presentation: Please organize and present tables consistently throughout a paper, because we will print them the way they are presented to us. Exhibits may be created in color or black and white. Please make sure that all categories in an exhibit can be distinguished from each other. Align numbers correctly by decimal points; use the same number of decimal points for the same sorts of numbers; center headings, columns, and numbers correctly; use the exact same language in successive appearances; identify any bold-faced or italicized entries in exhibits; and provide any source notes necessary. Please be consistent with fonts, capitalization, and abbreviations in graphs throughout the paper, and label all axes and lines in graphs clearly and consistently. Please supply Excel files for all of the exhibits.

Equations: Please display equations on separate lines. They should be aligned with the paragraph indents, but not followed by any punctuation. Number equations consecutively throughout the paper, using Arabic numerals at the right-hand margin. Clarify, in handwriting, any operation signs or Greek letters, or any notation that may be unclear. Leave space around operation signs like plus and minus everywhere. We reserve the right to return for resubmitting any accepted article that prepares equations in any other way. Please provide mathematical equations in an editable format (e.g., Microsoft Word, using either Equation Editor or MathType).

Reference Citations: In the text, please refer to authors and works as: Smith (2000). Use parenthesis for the year, not brackets. The same is true for references within parentheses, such as: (see also Smith, 2000).

Endnotes: Please use endnotes, rather than footnotes. Endnotes should only contain material that is not essential to the understanding of an article. If it is essential, it belongs in the text. Bylines will be derived from biographical information, which must be indicated in a separate section; they will not appear as footnotes. Authors' bio information appearing in the article will be limited to titles, current affiliations, and locations. Do not include full reference details in endnotes; these belong in a separate references list; see next page. We will delete non-essential endnotes in the interest of minimizing distraction and enhancing clarity. We also reserve the right to return to an author any article accepted for publication that includes endnotes with embedded reference detail and no separate references list in exchange for preparation of a paper with the appropriate endnotes and a separate references list.

Submission Guidelines

References List: Please list only those articles cited, using a separate alphabetical references list at the end of the paper. We reserve the right to return any accepted article for preparation of a references list according to this style.

Copyright Agreement: CAIA Association's copyright agreement form giving us non-exclusive rights to publish the material in all media must be signed prior to publication. Only one author's signature is necessary.

Author Guidelines: The CAIA Association places strong emphasis on the literary quality of our article selections.

Please follow our guidelines in the interests of acceptability and uniformity, and to accelerate both the review and editorial process for publication. The review process normally takes 8-12 weeks. We will return to the author for revision any article, including an accepted article, that deviates in large part from these style instructions. Meanwhile, the editors reserve the right to make further changes for clarity and consistency.

All submitted manuscripts must be original work that has not been submitted for inclusion in another form such as a journal, magazine, website, or book chapter. Authors are restricted from submitting their manuscripts elsewhere until an editorial decision on their work has been made by the CAIA Association's AIAR Editors.

Copyright: At least one author of each article must sign the CAIA Association's copyright agreement form—giving us non-exclusive rights to publish the material in all media—prior to publication.

Upon acceptance of the article, no further changes are allowed, except with the permission of the editor. If the article has already been accepted by our production department, you must wait until you receive the formatted article PDF, at which time you can communicate via e-mail with marked changes.

About the CAIA Association

Founded in 2002, the Chartered Alternative Investment Analyst (CAIA) Association® is the international leader in alternative investment education and provider of the CAIA designation, the alternative industry benchmark. The Association grants the CAIA charter to industry practitioners upon the successful completion of a rigorous two-level qualifying exam. Additionally, it furthers the Association's educational mandate through the dissemination of research, webinars, and videos. CAIA supports three publications for members: AllAboutAlpha.com, The Journal of Alternative Investments, and the Alternative Investment Analyst Review. CAIA members connect globally via networking and educational events, as well as social media.

CAIA.org


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