Quantitative Investment and Risk Management: Where Does it Go from Here?

Panel Discussion Highlights from the 2013 Applied Finance Conference

Moderator: Kevin Jialin Sun
Panelists: Andrew Chin, Michael Edleson, and Javier Estrada

Session Background

■In early August 2007, almost every single quantitative hedge fund was in a panic selling mode, leading to tremendous losses. This big meltdown foreshadowed the global financial crisis and changed the quantitative investment industry for good. Over the past few years, investors have distanced themselves from quant models, and large money flown out. The industry was forced to do some serious soul searching, during which process the relationship between risks and returns emerged as one of the most important topics. In this panel discussion, two industry veterans and one well-known professor shared their views on how to juggle between risks and returns. They also discussed how quantitative strategies can be used so that the industry can provide better services to clients including individual retirement plans, pension funds and endowments.

Specifically, the panelists talked about three distinct but related topics in the field of risk management. First, are well-documented alpha strategies becoming beta strategies? How to provide true alphas and beta exposures to clients based on their specific needs? Second, what causes the "wrong-way risk," where downside risks increase when overall markets decline? Third, should additional risk factors such as the loss of purchasing power and shortfalls in terminal wealth be added in retirement planning? The understanding of these topics is a necessary step toward providing good asset management solutions to clients. The panelists, with their expertise in the field, provided us with overall answers to these questions.

About the Panelists

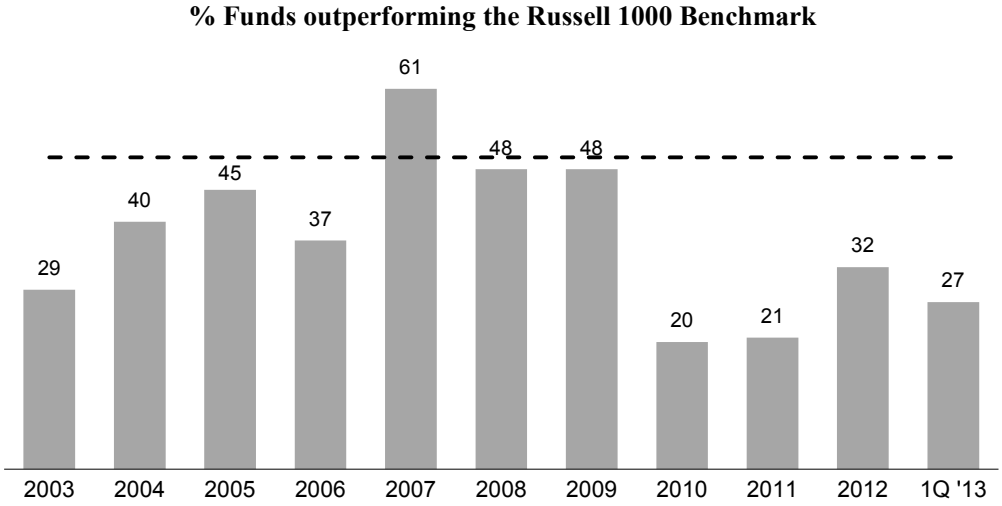
Mr. Andrew Chin is the Chief Risk Officer and Head of Quantitative Research for AllianceBernstein. As a Chief Risk Officer, he oversees all aspects of risk management to ensure that risks being taken are well understood and appropriately managed. He has held various quantitative research roles in New York and London since joining the firm in 1997. In 2004, Mr. Chin became a senior portfolio manager for Style Blend Equities and was named director of Quantitative Research for Value Equities in 2005. Mr. Chin holds a BA in math and computer science and an MBA in finance from Cornell University.

Dr. Mike Edleson is the Chief Risk Officer of the University of Chicago's endowment. He joined the University's Office of Investment in 2010. From 2003 to 2010, Dr. Edleson ran risk management globally for four divisions of Morgan Stanley as a managing director, including equities and MSSB (brokerage). Previously, he worked as chief economist and senior vice president of NASDAQ and NASD. Dr. Edleson was a finance professor at Harvard Business School for over six years, following four years on the faculty at West Point; he was an Army engineer officer and served nearly 30 years in uniform, active and reserve. Dr. Edleson earned a BS, summa cum laude, from West Point, an MS and PhD in economics from MIT.

Professor Javier Estrada is a professor of finance at IESE

Mr. Andrew Chin is the Chief Risk Officer and Head of Quantitative Research for AllianceBernstein in New York, NY. Dr. Mike Edleson is the Chief Risk Officer of the University of Chicago's endowment. Professor Javier Estrada is a Professor of finance at IESE Business School in Barcelona, Spain. Professor Kevin Jialin Sun is an Assistant Professor of accounting at St. John's University in New York, NY.

Figure 1. Active Management Has Been Under Pressure Recently



Source: Bank of America Merrill

Business School in Barcelona. Professor Estrada has done extensive research in the areas of portfolio management, investment strategies, and risk with a special focus on downside risk. His articles have appeared in the *Journal of Portfolio Management*, the *Journal of Investing*, the *Journal of Asset Management*, the *Journal of Wealth Management*, and the *Journal of Applied Corporate Finance*, among other journals. Prof. Estrada holds an MS in Finance and a PhD in Economics from the University of Illinois at Urbana-Champaign (USA) and a BA in Economics from the National University of La Plata (Buenos Aires, Argentina).

The moderator, Professor Kevin Jialin Sun, is an assistant professor of accounting at the St. John's University. Before joining St. John's University, he held quantitative research and portfolio management positions at various hedge funds and asset management firms, including a Vice President and Senior Quantitative Analyst position at AllianceBernstein. His articles have appeared at the Journal of Accounting, Auditing, and Finance, Research in Accounting in Emerging Economies, and the European Accounting Review. Dr. Sun was an assistant professor at the University of Hawaii at Manoa from 2005 to 2008. He earned a PhD in accounting from the University of Colorado at Boulder.

Andrew Chin: Leveraging Smart Beta Strategies

The Global Financial Crisis (GFC) brought an onslaught of changes to the asset management business. Since the crisis, investors of all stripes have been forced to re-assess their asset return assumptions and risk management paradigms. With bond yields at historically low levels, investors are looking for new sources of return and income. In addition, traditional asset allocation strategies failed to deliver on their diversification promises during the crisis, and as a result, the search is on for techniques and tools that can protect better during market meltdowns.

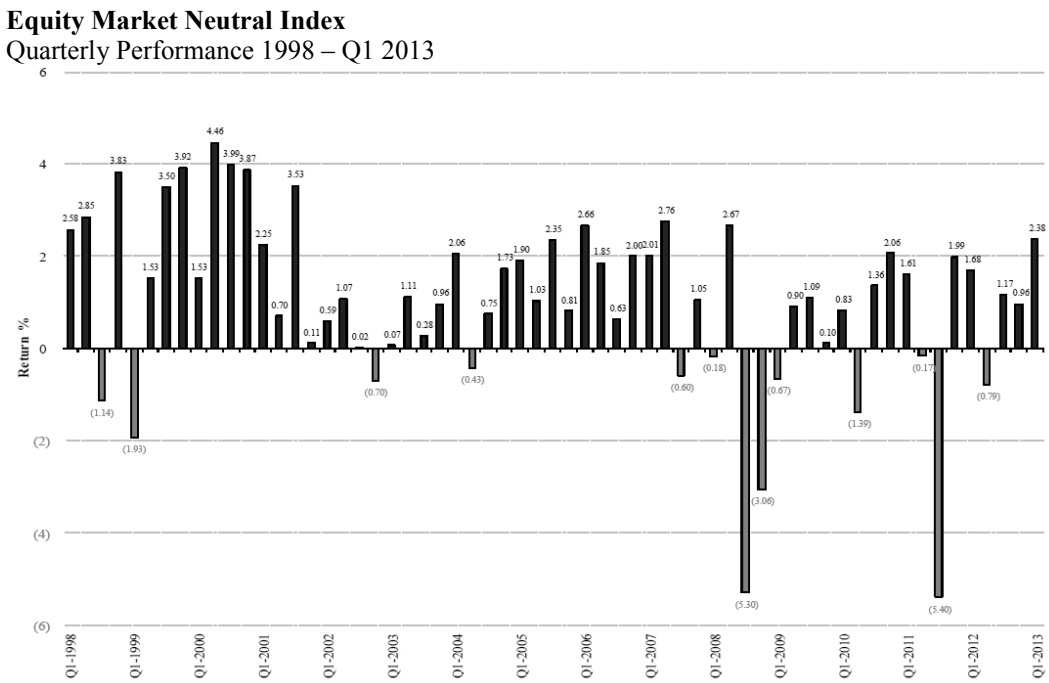
New trends have also emerged. Active managers have struggled as correlations between stocks have stayed stubbornly high. These common movements amongst stocks have made it more difficult for asset managers to outperform their benchmarks. On top of this, investor concerns have changed – with the big drawdowns in 2008, investors are increasingly finding it more difficult to meet their long-term goals, whether those goals are retirement income or funding status.

All is not lost though. With change comes opportunity and this time, it's no different. Emerging from the ashes of the GFC are opportunities to create and deliver more innovative products for our clients. Smart beta strategies present one such opportunity. My talk will provide a framework for how investors can leverage smart beta strategies to improve their investment outcomes as well as address the practical hurdles in implementing these strategies.

Recent Trends

Active managers are struggling today, even more so than conventional wisdom might suggest. There's a litany of academic research which suggest that the median mutual fund underperforms its benchmark after fees. More recent evidence suggests the results have been even worse. Since the GFC, according to research by Bank of America Merrill Lynch, less than one-third of equity funds have actually outperformed the broad market after fees (Figure 1). Many reasons have been given for this decline in relative returns,

Figure 2. "Alphas" Have Proven to be Elusive Recently



Source: HFR Global Hedge Fund Industry Report, First Quarter 2013

Figure 3. Client Needs are Changing

Concerns	Areas of Focus
• Funding Status • Elevated Risk / Drawdowns • Low Rates / Returns • Costs • Transparency in Investment Process	• Asset Allocation • Risk Management • Income-oriented Strategies • True High Alpha • Smart Betas

or "alphas" – high correlations between stocks and the macro-dominated investing landscape have made it harder for stock pickers to demonstrate their skills. The implied assumption is that as the financial market return to "normal," active management will roar back but it's unclear when that day will come.

Weak returns are not confined to the long-only mutual fund world. Hedge funds have also struggled to produce positive returns since the GFC. Figure 2 shows the quarterly performance of HFR's Equity Market Neutral Index and highlights how the number and magnitude of drawdowns have increased for these types of strategies since 2007. Other hedge fund strategies have experienced similar fates.

On top of these active management headwinds, investor needs are changing. Figure 3 lists some of the major concerns from investors and highlights some of the areas that are getting more focus because of those concerns. Each of these topics is worthy of more research and can fill up journals, so my talk will focus largely on asset allocation and smart betas.

Asset allocation has always been an important topic, but the twist today is that the conversation is not necessarily about the traditional asset classes or the diversification techniques that are commonly used. Instead, the discussions

Figure 4. New Building Blocks

	Traditional Betas	Smart Betas	Alphas
Potential Source of Value-Add	Equity beta	■ Behavioral biases ■ Anomalies ■ Structural biases	"True" skill
Examples			

revolve around new building blocks and new techniques for portfolio construction.

New Building Blocks

To achieve diversification, portfolios are normally constructed using building blocks that represent distinct and orthogonal risks to the portfolio. Traditionally, these distinct risks were expressed using criteria like style (Core, Growth and Value), capitalization (Large, Mid, and Small), and geography (typically US, International and Emerging Markets). While these designations were convenient and easily understandable, they didn't necessarily segment risks appropriately because all of these assets were exposed to big drawdowns in global equity markets. This was borne out painfully during the GFC.

The recent crisis has made investors more aware of the risks in their portfolios, and some have disaggregated risk along factors and styles. These factors represent risks in a more granular form and as a result, lend themselves to be good building blocks in diversified portfolios.

Separately, smart beta strategies are in vogue. Pension funds all around the world are re-thinking what risks they want exposure to as well as the most efficient ways to access those exposures. The emergence of smart beta strategies provides these asset owners with more flexibility in portfolio design and risk management. Figure 4 lists some of the new building blocks that investors now have access to. Traditional building blocks using the equity beta are still available, but smart beta building blocks may dramatically alter how investors view and take risk in their portfolios.

Smart beta offerings are systematic strategies that provide exposure to risk premiums. These types of strategies have also been called "alternative," "exotic," or "better" betas but in aggregate, they simply represent a repackaging of risk premiums. There are many examples of this – traditional ones like value, size and momentum have been in existence for decades, and more esoteric ones like implied versus realized volatilities or correlations have just recently come into favor. These strategies are typically delivered in a cost-effective way and potentially give investors better risk-adjusted returns versus the broad market. The popularity of these strategies has put more pressure on active managers to differentiate between "alpha" and "beta." Active managers can no longer rely on strategies that solely exploit the systematic exposure to various well-known factors. They must produce true alpha above and beyond what naïve factor strategies can deliver.

These changes can have a positive effect on the asset management industry because those managers with true skill in creating alpha will be rewarded for their prowess. These managers will reap the high fees that come along with skill. At the same time, those managers who were shopping smart beta as a substitute for alpha will see their competitive advantages erode.

In aggregate, these new building blocks spanning traditional beta, smart betas and alphas represent distinct risks that should be modeled in portfolio construction.

Figure 5. Assembling Building Blocks

Smart Beta Portfolio Construction

1. Identify smart betas
2. Construct smart betas
3. Allocate strategically
4. Shift tactically

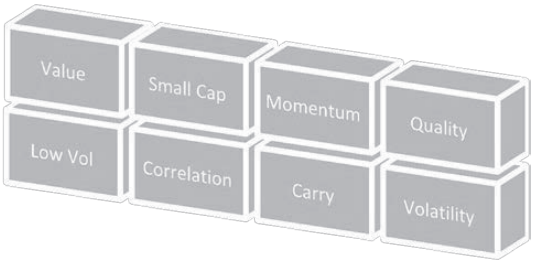


Figure 6. Smart Beta Portfolio Construction

Identify Smart Betas	Construct Smart Betas	Allocate Strategically	Shift Tactically
■ Which anomalies and behavioral biases to include? ■ Which ones are exploitable? ■ Consider available vehicles, transactions costs and liquidity	Selection ■ Investment Universe ■ Keep unintended exposures? ■ Optimize to get pure smart betas? Weighting Scheme ■ Equal ■ Cap ■ Attribute ■ Risk	■ Diversify through empirical and regime studies ■ Stress-test under various scenarios ■ Larger emphasis on risk characteristics?	■ Clarity on objectives ■ Is there skill? ■ Top-down vs. bottom-up implementation ■ Don't overwhelm strategic allocation

Eventually, these ideas must be put together into one cohesive framework so portfolio construction using smart betas is an important consideration.

Smart Beta Portfolio Construction

Our industry has seen a lot of research around asset allocation with traditional building blocks but until very recently, there hasn't been significant research in utilizing smart beta building blocks. Figure 5 illustrates the main steps in constructing a portfolio of smart betas. They are (1) Identifying the smart betas, (2) Constructing the smart betas, (3) Determining the strategic allocation, and (4) Tactically shifting around the strategic allocation. The next section discusses each of these issues in turn. Figure 6 provides a high-level summary.

The basic investment beliefs of investors determine the types of smart beta strategies to include in the portfolio. Aside from the usual Fama-French and momentum factors, other well-known factors can be found in quality, sentiment and growth themes (among others). It's conceivable that different investors will have different views on the set of risk premiums to include.

Another important consideration is which factors are exploitable. Issues such as liquidity, transactions costs, and investment vehicles may erode the potential risk premium

being exploited. Smart betas which utilize small cap and emerging market securities are more susceptible to these issues.

Once the smart beta ideas have been identified, the next step is to construct strategies to harvest the risk premiums. This process relies on two critical decisions: selection and weighting.

The selection process centers on the universe of stocks to apply the smart beta strategy. For example, should the Value smart beta strategy be implemented using US, Japanese, or Global stocks? The treatment of unintended exposures is another key consideration. For example, running a Value smart beta strategy after the GFC would likely have included significant exposures to factors like beta or volatility. Another example is that the Low Volatility smart beta may be over-exposed to sectors like Consumer Staples, Healthcare and Utilities because these are typically the most stable areas of the market. As a result, an investor needs to decide whether to retain these un-intended exposures in the smart beta strategy.

There are various weighting schemes for the securities in a smart beta strategy. Cap-weighted and equal-weighted are the most common but other weighting schemes are gaining traction. Attribute-weighting using the characteristics of a firm, like revenues, book value or income have become more popular in recent years. Finally, weighting schemes using risk forecasts like risk parity and maximum diversification have garnered interest recently because of the potential for higher risk-adjusted returns. To fully capture the risk premium implied by a smart beta strategy, an investor needs to determine the optimal weighting for the underlying securities.

The strategic asset allocation for the smart beta strategies will likely determine a big portion of the overall portfolio's return. Assuming they are chosen well, different smart beta strategies will likely perform differently over time. Indeed, there is likely little benefit to including a variety of smart beta strategies that are highly correlated. Nevertheless, simply diversifying along long-term correlations is not enough. Stress-testing strategies over different economic regimes would provide a better sense of the diversification effects during difficult periods. On top of this, an investor may choose to overweight or underweight certain smart beta strategies if he has credible long-term expected returns and a robust covariance matrix of these smart betas. Or, if an investor believes there is too much estimation error in predicting returns, a risk-parity approach may be appropriate.

It is even more difficult to tactically rotate amongst smart betas. Assuming an investor has skills in executing such a strategy, there should be clear objectives and the risk budget should be pre-determined for the overlay strategy so that the tactical moves do not overwhelm the strategic allocation.

Summary

In summary, the industry has changed dramatically since the Global Financial Crisis. With active managers struggling and interest rates at historical lows, investors are searching for returns everywhere. Indeed, these trends have led to more creativity and innovation in the asset management industry in terms of risk management and asset allocation.

Smart beta is one trend that presents opportunities for both asset owners and asset managers. These strategies promise to alter investment outcomes for investors – potentially improving after-fee returns and mitigating drawdown risks during market turmoil. Asset owners potentially have a more efficient way to access risk premiums, and asset managers may have new areas of growth in developing stand-alone smart beta strategies as well as overlay strategies to rotate amongst smart betas.

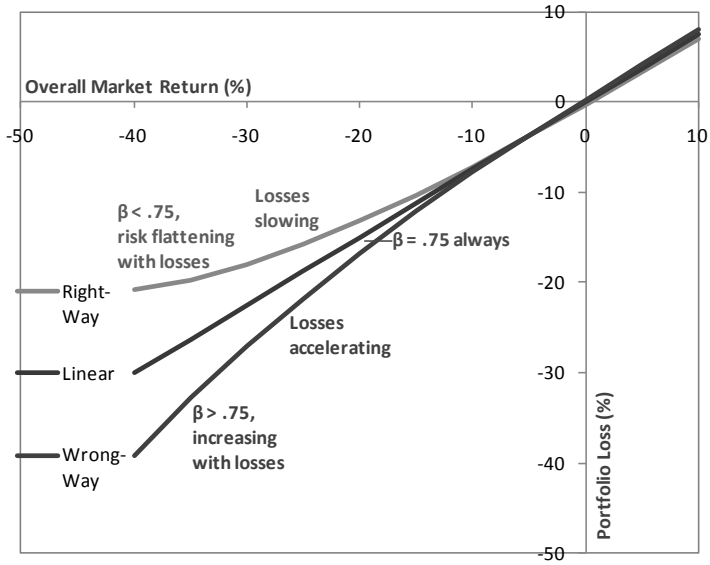
At the same time, smart beta presents risks too. These strategies represent new building blocks in portfolio construction so asset owners need to think through how these strategies fit into their portfolios. There are a variety of diversification questions that will need to be addressed depending on the smart beta strategies chosen for the portfolio. In addition, in this new world, there are risks to active managers – to show true skill, they potentially have to deliver returns which are above and beyond the returns of smart beta strategies.

Michael Edleson: Wrong-way Risk

Why do so many investment managers pursue wrong-way risk? Why do some people bend over to pick up pennies? I lumbered past a penny the other day, and, as an economics proto-geek, spent the rest of the walk home wondering if that was rational. What's the cost? Besides time, there isn't much cost most of the time.[1] But sometimes, I might finish this bit of Chicago sidewalk yoga with a slight muscle pull, some nasty germs from the ground, a slight pain in my back, the fellow citizen behind me crashing into me while watching YouTube, or worse. Maybe 1% of the time—at my age, certainly more than 0.1%, there will be *some* downside. The cost of this could range from a few bucks' nuisance value, to much, much more in some cases. The expected cost is about 4-5 cents for me, maybe more. But worse, the downside is quite fat-tailed, while the upside is pretty much limited to $0.01, less taxes. I see others bending over to pick up a penny, but it takes at least a dime to get this old man to do the dive.

[1] Would you pick up 1,000 pennies laid a pace apart, which might take you about an hour? Probably not, but a common behavioral finance 'fallacy of the small' will cause many to misestimate this 'wage' ratio and bend over for 1 penny because 'it's only a few seconds.'

Figure 7. Investment Return Profiles



In investing, though, humans engage in penny-picking far more often than we like to admit. I call this, as non-pejoratively as possible, *wrong-way risk*. An illustration is useful here. Figure 7 poses three investment return profiles, graphed against the market's return. In the middle, in a nice straight line, the way we all learned finance, is the profile of an investment with a beta to the market of 0.75.[2] A profile you'd probably prefer, though, is shown at the top. It's convex, or positive gamma, or positive 2nd-derivative—whatever you call it, your downside risk diminishes as the market return declines (your beta exposure gets lower as the market sinks). This is right-way risk; of course, as anyone who's dealt with options can tell you, this will usually cost you something. But, like a dime, anytime I can find this for free, I pick it up. The bottom return profile has the unfortunate characteristic of accelerating risk to the downside, giving you the most market beta exposure when you least want it. This is a negatively-convex, or wrong-way risk exposure.

Many investors, and practically all endowments and foundations, have wrong-way risk exposure. Before I explain how this comes about, let's take a moment to consider why we might care. After all, if returns were normal and financial market relationships were stable, having some extra exposure to the deep downside might not concern an investor, who might consider it as easily diversifiable as it is unlikely.

Imagine how an investor might view the portfolio problem in a textbook world. He knows the σ or standard deviation, which tells him how (un)likely large losses are in a normal/lognormal setting. He knows each asset's correlation structure and linear β (beta) to the market, so he knows about interactions and expected returns. He thus faces a robust efficient frontier with a well-known and stable covariance matrix. He knows just how much risk-reducing benefit he can expect from diversification, and can construct an efficient portfolio with known probabilities, that is in line with his appetite for loss. It's as easy as matrix multiplication.

In a parallel investment universe, called the real world, another investor struggles with the same problem. She also knows the σ, but runs into two problems using it. First, returns are fat-tailed in her world, so her chance of major loss is much higher, and harder to anticipate. Second, volatility isn't fixed, but instead spikes when she least wants it (as markets decline). In really bad times, it spikes a lot.[3] Next, her assets' correlations and β's also shift dramatically upward in a market rout, so she ends up more exposed to downside risk than she had planned, in each individual asset—and their interactions do not go as planned either. She thinks the stable covariance matrix will yield her a portfolio that is efficient and benefits from diversification; but, the covariance behaves doubly badly, as both its volatility and correlation components spike when she most wants stability. Thus, the diversification she counted on, along with the corresponding low portfolio risk, gets largely driven away in down markets, where it is needed the most. Her portfolio losses turn out much higher than expected.

Even without fat tails, this investor's portfolio will end up with far more risk than she thought, in markets when she *most* cares about risk. If you compound all this with fat-tailed returns, the problem of magnified risk in down markets is

[2] 0.75 is the beta that we target here at our university endowment.

[3] The VIX (volatility index) index more than quadrupled at the beginning of the Financial Crisis.

magnified yet again, by much larger probabilities of extreme conditions. If, on top of these 'market dynamics' problems, this investor *also* chooses to construct a portfolio with wrong-way risk exposure, the loss potential becomes much, much worse. You then have three essentially non-linear risk drivers interacting in a highly-toxic investment brew to exacerbate the probability and magnitude of loss. The spiky correlations, vols and betas, and disappearing diversification are compounded by much higher loss probabilities (fat tails), which are compounded further by the portfolio's accelerating risk exposure to downside moves (wrong-way risk). If the risk decision is informed by supposedly stable, linear risk metrics, as it often is, then the adverse portfolio outcome is almost sure to be at serious odds with the investor's risk appetite in this situation.

So how do investors, like endowments, foundations, pension funds and perhaps even you, end up taking on wrong-way risk exposure? Part of it is product-based. High-yield credit is a good example—it has a moderate beta, which is really a blend of its non-linear risk exposure. In a bullish regime, it acts bond-like with very low exposure to equity markets; while in a bearish regime, it acts equity-like with a quite high beta. The bondholder is paid a return premium for taking this wrong-way risk. Most 'carry trades' and hedge fund strategies, and many other products (such as options, if sold), have this characteristic of negative convexity, or high exposure to unlikely large losses, paid for with the promise of getting a somewhat higher return most of the time.[4] Part of it is behavioral. Even if we're not preternaturally optimistic, we may believe we can effectively control risk when markets turn on us, or we're fooled into a false sense of security by the insufficient risk metrics described above. So we'll grab for that extra return, even at the expense of leveraging our exposure to loss in the left tail. One can certainly think of ways that the agency problem in investing may contribute to this as well.

Perhaps the largest contributor to wrong-way risk exposure for pensions, endowments and foundations is illiquid or private investments.[5] The unpredictable flows from private investments should integrate in a balanced way with endowment payouts and evolving portfolio values in normal times. But in a severe down market, important aspects of these liquidity relationships break down in damaging ways. When the market turns down, your public investments shrink in value, but your private capital commitments (required future investment flows) remain as high as before, leaving your overall fund increasingly too heavily weighted in privates. This takes your risk exposure up as the market declines (negative convexity), and can hurt your endowment or organization in a variety of other tangible ways. Excessive variability of flows may cause operational failures, widening bid-ask spreads with forced asset fire-sales, forced debt issuance at high rates or blown debt ratings, and a lack of investment and organizational flexibility. At the investment level, the managers you've hired are in turn hit hard by heavy outflows, driving returns even lower with forced sales, lost opportunities, and nearly destroying GP alignment. In the Crisis we learned that leverage, fat-tailed losses, and illiquidity can interact in quite non-linear and nasty ways, wiping out some private funds such that they could not participate in the recovery. Not surprisingly, there's a strong relationship between a fund's illiquid proportion and the negative convexity in its return stream.

Aside from private investments, there are a couple of simple technical considerations that drive endowments and others into taking wrong-way risk: rebalancing, and fees. First, most asset owners will regularly rebalance to maintain strategic policy target weights. So they will tend to sell equities on the rise, and buy them on the fall. I love "Buy low, Sell high" as much as the next guy, but let's examine the risk implications. Relative to an unperturbed portfolio, the impact of this natural, mechanical rebalancing is clear—it results in lower risk (stocks sold) in high markets, and higher risk (stocks bought) in down markets. This 'strategy' is getting paid, sure; but for taking on a wrong-way risk profile. The dynamic strategy described here is similar to how one would dynamically replicate a short, or sold, put option—buy into declines to increase downside exposure, and conversely sell back (to reduce exposure) into increases—which produces negative convexity.

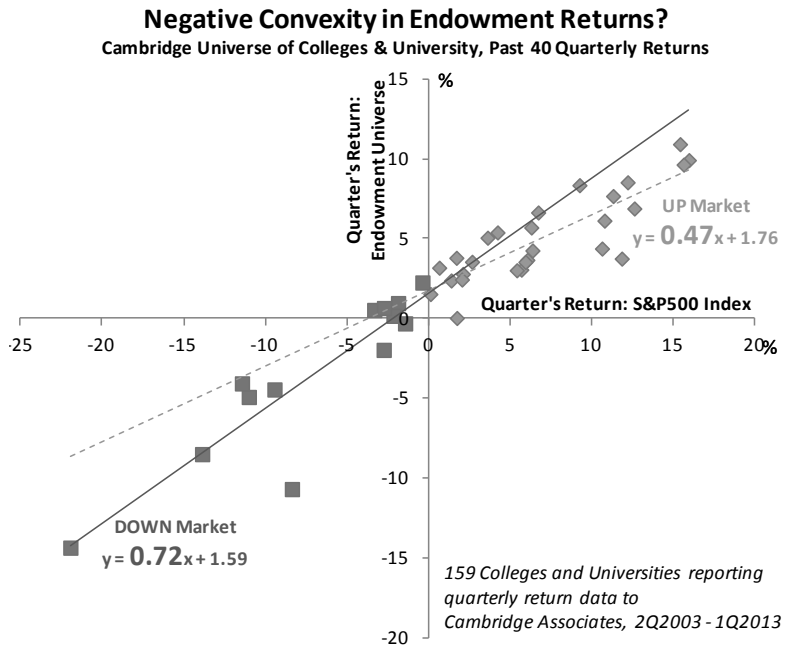
Second, the funds that asset owners hire typically have fee structures that directly create kinks in returns, or negative convexity. Essentially all private funds, nearly all hedge funds, and even some equity managers have 'carry' or incentive fees. In the common example of a 2/20 fund, the manager is paid 20% of fund investment gains, leaving the investor to reap 80% of the gains but bear 100% of the losses. Even without any of the points discussed above, you would expect most endowments, foundations, and pensions to exhibit noticeable negative convexity just from their kinked fee structures alone.

Taken together, these five causes of wrong-way risk should be evident in returns, leaving the asset owner a kinked or curved return profile that exhibits more risk exposure to down markets, and less risk exposure to up markets. A look at the data bears this out in Figure 8.

[4] An interesting paper by Jurek and Stafford (2011) finds that hedge funds' aggregate returns can be closely replicated by a portfolio of short options plus a long stock index overlay, less a sizable deduction that roughly mimics fees.

[5] These are generally private equity, real estate, or natural resource investments in long-term private structures, where the investor does not control the investment inflows and outflows; and, are often fairly high on the risk spectrum and/or levered. They make up about half the investment portfolio for the largest endowments.

Figure 8. Negative Convexity in Endowment Returns?



Using Cambridge Associates data on 159 US colleges and universities that report quarterly endowment returns in Figure 8, the figure scatterplots the 40 quarterly returns (ending 1Q 2013) for that universe vs. the S&P. The linear beta (not shown) is 0.60, but a quadratic regression shows the series to not be linear (a negative 2nd-order coefficient). A more intuitive view is shown here by breaking the sample down into UP and DOWN market quarters, then calculating the beta of each as shown. In UP markets, the beta of returns drops to 0.47, but in DOWN markets, the exposure increases to 0.72, or *more than 50% higher* than the UP market exposure. And to the extent that my use of the data is flawed, the differential exposure should be even higher than measured here.[6] This is not a phenomenon that I hear a lot of talk or concern about in the investment industry, though. Perhaps we don't notice it until it's too late to do anything about it, or possibly we are not generally trained to pick up non-linearities.

Note also, that it seems that investors get paid for taking wrong-way risk. Investors should be careful not to confuse this payment with 'alpha,' even though it might appear to be excess return at first glance. If you sell an option, you will collect a premium, but you have certainly not created any value, nor provided any excess return. If you had a straight stock portfolio and sold options on about 1/3 of it, you wouldn't have done anything to add value, but you would have 'kinked' your investment return profile, and pocketed a substantial amount in premium (producing something that looks a bit like the graph above). Compared to an unmolested or linear portfolio, it will appear that you have a higher return on average, but this just comes from the option premium and from the different shape of your return profile. Using normal techniques, this might appear to be 'alpha,' but it is clearly not. It's just your nominal fee for taking on a wrong-way exposure that other investors are happy to pay you to bear for them—you've written an insurance policy, for a market price. For large investment pools (and for many hedge funds), some of what they think of as 'alpha' is really just the price of wrong-way risk.

Wrong-way risk may not be a bad thing at all, if you are paid enough to take it, and if you can bear it. I won't try to make a case as to who ought to bear this risk, as that is another article altogether. I know that some folks are young and agile enough to pick coins up off the ground, just as I know that I am not—wrong way risk is, like many other risks, more suited for some investors than others. But it makes sense to know what risks you are taking, and to take them on willingly and for compensation, and *not* accidently. If you sit at the wrong-way risk table, you're going to get

[6] The analysis shown overlooks at least two important factors. First, several of the largest endowments (almost half of the top 20), with the highest proportion of illiquid or private investments, do not report quarterly and thus are missing from this sample. When examining the available data on the large, private endowments, their returns are more negative convex. Second, most of the schools in this quarterly-reporting universe include private fund values and returns that are lagged one quarter (as these report financials nearly a quarter late). This throws off the contemporaneous correlation, not only reducing the measured beta, but also hiding some of the negative convexity associated with those private investments. When this is corrected (which is not easy but can be done for a limited sample), both the betas and the beta differential between UP and DOWN increase.

fed…but it's not a free lunch.

At our University, we've carefully measured our risk profile as part of a long-term risk analysis and assessment alongside our investment strategy—both are integrated with the University's business goals and risk drivers, and ultimately serve the academic mission of the University.[7] We noted and discussed the shape and downside exposure of our organic risk profile (which was similar to most other large endowments), and have maintained those negatively-convex investments where they provide fair compensation or better. But in concert with the risk appetite of the University, wrong-way risk is mitigated by laying much of it off in the marketplace. This allows us to pursue attractive investment opportunities with unusual return profiles, re-craft the profile shape with efficient-cost overlays, and then consider the cost of the fully-risk-priced investment as part of the investment decision. The resulting net risk profile is much more linear; easier to manage, understand and communicate; and less likely to provide outsized surprises to our governance body and our University. We leave a few pennies on the sidewalk that way, but in the end we feel better and walk taller.

Javier Estrada: Risk Assessment

My talk focuses on two issues, both of them related to risk *assessment*. The first part of the presentation (section 1) dwells on the relationship between risk and the holding period, and the second (section 2) on two definitions of risk and how they affect the assessment of investment strategies.

Needless to say, when discussing issues related to risk it is essential to keep two things in mind. First, the holding period is critical when assessing both the risk of an individual asset and the relative risk of assets. And second, risk can be defined in many different ways (including volatility, beta, downside volatility, downside beta, factors such as size and value, shortfall probability, shortfall magnitude, and value at risk, to name but a few) and it is nearly impossible to argue that one measure is correct and all the others are wrong.

Risk Assessment: The Holding Period

Most investors agree that stocks are riskier than bonds in the short term; this is indeed the case largely regardless of the definition of risk considered. To illustrate, consider Figure 9, adapted from Estrada (2013a), which is based on a sample of 19 countries and the world market over the 1900-2009 period.[8] Risk is measured in four different ways, with two general measures of uncertainty (volatility and the spread between the highest and the lowest annual return over the sample period) and two measures of downside risk (downside volatility and the lowest annual return over the sample period). As the figure clearly shows, regardless of the measure of risk considered, stocks are riskier than bonds.

Across all 19 countries, stocks are on average almost twice as volatile as bonds (23.4% versus 12.4%) and they have spreads almost twice as large (154.0% versus 87.7%). When risk is measured in either way, in no country of the 19 considered stocks are less risky than bonds. Furthermore, on average across all 19 countries, stocks have more downside volatility than bonds (11.5% versus 7.8%) and higher worst annual losses (−54.3% versus −39.3%). In no country of the 19 considered stocks have lower downside volatility than bonds, and in only three countries stocks have a higher worst annual loss than bonds.

When the focus shifts to the long term, however, the statement that stocks are riskier than bonds becomes far more questionable. In fact, under some definitions of risk, including that of Warren Buffett, the opposite is the case. Buffett (2012) argues that risk should not be measured by how much assets fluctuate but by the probability that they destroy purchasing power over the intended holding period. In other words, Buffett argues that risk should be measured by the probability that the return of an asset does not beat the rate of inflation, or, similarly, by the probability that an asset delivers a negative real return.

Estrada (2013a) considers Buffett's view of long-term risk and complements it with another, the probability that stocks underperform bonds. More precisely, he considers the probability that stocks and bonds destroy purchasing power, $P(R<0)$, and the probability that stocks underperform bonds, $P(S<B)$, in both cases over holding periods of 20 and 30 years. Both probabilities are approximated with their historical frequencies; that is, the number of 20-year and 30-year holding periods in which stocks and bonds delivered negative real returns (or that stocks underperformed bonds) divided by the total number of 20-year and 30-year holding periods in the sample. The results for the same countries and sample period considered in Figure 9 are summarized in Figure 10.

Over 20-year holding periods, the average $P(R<0)$ for stocks (12.6%) is over three times lower than that for bonds (43.9%), and in fact lower for stocks than for bonds in every

[7] During 2010-2012, the Investment Office built its investment strategy and risk framework around TEAM, or Total Enterprise Asset Management. In short, investment return is not viewed in isolation, but subjugated to the overall University's achievement of its long-term goals, and considered alongside all the rest of the University's business risks. As an organization we are not willing to pursue risks to such an extent that would put our eminence in danger, thus an uncontrolled acceleration of risk in a deep downside scenario is outside our risk appetite, so we mitigate that.

[8] Figure 9 reports results only for the US, the average across the 19 countries in the sample, and the world market. Estrada (2013a) reports results for each of the 19 countries considered, which are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, South Africa, Spain, Sweden, Switzerland, the UK, and the US.

Figure 9. Risk in the Short Term

This table shows, for the series of annual returns, the standard deviation (SD), spread (SPD), volatility below 0% (SSD), and lowest return (MIN) for all 19 stock and bond markets in the Dimson-Marsh-Staunton (DMS) database over the 1900-2009 period. Returns for all countries are annual, real (adjusted by local inflation), in local currency, and account for capital gains/losses and cash flows (dividends or coupons). Returns for the world market are in dollars and adjusted by US inflation. All figures are in percentage.

	SD		SPD		SSD		MIN	
	Stocks	Bonds	Stocks	Bonds	Stocks	Bonds	Stocks	Bonds
USA	20.3	10.1	94.5	54.5	10.6	5.3	−38.0	−19.4
Avg 19 countries	23.4	12.4	154.0	87.7	11.5	7.8	−54.3	−39.3
World market	17.7	10.3	110.5	58.7	9.4	5.6	−40.4	−27.1

Figure 10. Risk in the Long Term

This table shows the proportion of holding periods in which stock and bond markets delivered negative real returns, P(R<0), and the proportion of holding periods in which stocks underperformed bonds, P(S<B), over 20 and 30 years. The data is the same as in Figure 9. All figures in %.

	P(*R*<0)				P(*S*<*B*)	
	20 Years		30 Years		20	30
	Stocks	Bonds	Stocks	Bonds	Years	Years
USA	0.0	42.9	0.0	27.2	3.3	0.0
Avg 19 countries	12.6	43.9	6.1	38.6	15.2	8.2
World market	2.2	39.6	0.0	28.4	7.7	2.5

country in the sample with the sole exception of Switzerland. Over 30-year holding periods, the average P(*R*<0) for stocks (6.1%) is over six times lower than that for bonds (38.6%), and in fact lower for stocks than for bonds in every country but Switzerland (in which they are equal).

Assessing risk with the probability that stocks deliver less purchasing power than bonds (the last two columns of Figure 10) further strengthens the view that in the long term stocks are less risky than bonds. Over 20-year holding periods, the average P(*R*<*S*) is only 15.2%, and in no country of the 19 considered this probability is higher than 30%. Over 30-year holding periods, the average P(*R*<*S*) is only 8.2%; in no country this probability is higher than 25%; and in almost one third of the countries (six) this probability is 0%.

In short, then, the data suggest that although in the short term stocks are clearly riskier than bonds, in the long term 1) stocks are very unlikely to destroy purchasing power; 2) stocks are far more unlikely to destroy purchasing power than bonds; and 3) stocks are very unlikely to deliver less purchasing power than bonds.

Risk Assessment: Volatility and Shortfall

Lifecycle strategies are by far the most typical way of saving for retirement. These strategies feature asset allocations that become more conservative over time, periodically reducing the allocation to more volatile assets (like stocks) and increasing the allocation to less volatile assets (like bonds and cash). A glidepath is the relationship between an investor's asset allocation and his age (or number of years to retirement).

Consider an investor with a working life of 40 years and making 40 annual contributions to his retirement fund. Each year he contributes an inflation-adjusted lump sum of $1,000 and rebalances his portfolio at the same time, for a cumulative contribution of $40,000 in real terms. And consider again the same 19 countries over the same sample period (1900-2009) discussed in the previous section. Then, for each country and region, 71 overlapping 40-year working lifetimes can be considered, the first over 1900-1939 and the last over 1970-2009. The focus of the analysis is on the series that collects the terminal wealth (the capital accumulated at retirement) across the 71 working lifetimes for each country and strategy considered.

Furthermore, consider five lifecycle strategies. The first starts fully invested in stocks and ends up fully invested in bonds; that is, it starts with a 100-0, and ends with a 0-100 stock-bond allocation. The other four lifecycle strategies are similar. They begin with 90-10, 80-20, 70-30, and 60-40, and respectively end with 10-90, 20-80, 30-70, and 40-60 stock-bond allocations. In all cases, the asset allocation between the beginning and the end of each 40-year working lifetime changes annually and linearly over time.

Finally, consider five contrarian strategies; that is, mirrors of the lifecycle strategies that start and end with opposite allocations to stocks and bonds. To illustrate, the lifecycle strategy that starts fully invested in stocks and ends fully invested in bonds is evaluated against a mirror strategy that starts fully invested in bonds and ends fully invested in stocks; the strategy that starts with a 90-10 (and ends

Figure 11. Risk – Volatility and Shortfall

This figure shows summary statistics, including the mean, median, standard deviation (SD), lowest value (Min), and average of the lowest decile (AvgD1) and quartile (AvgQ1), for the ten strategies described in the text. All figures are averages across the 19 stock and bond markets in the Dimson-Marsh-Staunton (DMS) database. All figures in thousands of dollars.

	100-0	0-100	90-10	10-90	80-20	20-80	70-30	30-70	60-40	40-60
Mean	96.1	123.0	99.0	120.5	101.8	117.9	104.6	115.3	107.3	112.7
Median	74.6	104.2	76.9	102.0	79.8	99.4	83.1	95.9	86.1	92.6
SD	58.2	71.2	58.5	68.2	58.9	65.7	59.3	63.7	60.0	62.1
Min	30.8	33.6	32.1	34.2	33.0	34.7	33.7	34.9	34.2	34.9
AvgD1	35.3	43.5	37.1	43.7	38.5	43.6	39.8	43.2	40.9	42.7
AvgQ1	41.9	56.2	44.7	56.3	47.2	56.1	49.5	55.4	51.4	54.4

with a 10-90) stock-bond allocation is evaluated against a mirror strategy that starts with a 10-90 (and ends with a 90-10) stock-bond allocation; and so forth. Importantly, note that all contrarian strategies have a common characteristic, namely, that they are less aggressive earlier, when investors are younger and savings are lower, and more aggressive later, when investors are older and savings are higher; hence, they feature glidepaths *opposite* to those featured by lifecycle strategies.

Estrada (2013b) considers this issue in detail using the same sample of 19 countries, over the same 1900-2009 sample period, considered in the previous section. The results for ten of the 15 strategies he considers are reported in Figure 11, which shows averages across all 19 countries in the sample.

Note, first, that without exception the lifecycle strategies deliver lower mean and median terminal wealth than their respective contrarian strategies. More important for our purposes, note that if risk is measured with volatility (SD), all lifecycle strategies are less risky than their mirrors. And yet, is volatility the right way to assess risk when saving for retirement? Is it not the case that investors really (or also) care about how much capital they will have at the end of their working lifetime?

If so, consider alternative measures of risk that focus on 'bad' scenarios. Consider the worst-case scenario (Min) first. In all cases, lifecycle strategies deliver lower terminal wealth than their respective mirror strategies. Shifting the focus away from the worst-case scenario to the worst 10% of scenarios (AvgD1) yields the same conclusion. Focusing on the worst 25% of scenarios (AvgQ1) yields again the same conclusion. In other words, if the focus is on terminal wealth, lifecycle strategies underperform contrarian strategies.

Importantly, note that putting together the fact that contrarian strategies are more volatile than lifecycle strategies, and the fact that contrarian strategies have more limited downside potential than lifecycle strategies, leads to an inescapable conclusion: The higher volatility of contrarian strategies is largely *upside* risk; that is, uncertainty about *how much better*, not how much worse, an investor is expected to fare with these strategies.

Are lifecycle strategies riskier or less risky than contrarian strategies then? It depends on how risk is assessed. If risk is assessed with volatility, lifecycle strategies are less risky; if risk is assessed with terminal wealth in 'bad' scenarios, lifecycle strategies are riskier.

Conclusions

When assessing the risk and return of assets, there is usually nothing to disagree upon in terms of return; as far as risk is concerned, however, the disagreements can be many and varied. An asset can be riskier than another in the short term, and yet less risky in the long term. A strategy may be riskier than another when risk assessed in one way, and less risky when risk is assessed in a different way.

There has been much progress in finance in the last few decades, and yet wide disagreements remain on how to assess risk. An investor's opinion on the risk of an asset may be very different from that of another investor, and yet it is often hard to argue that one is right and the other is wrong. Perhaps sooner or later we will agree to disagree, or simply agree that risk is in the eye of the beholder.■

References

Buffett, W., 2012, "Why Stocks Beat Gold and Bonds," *Fortune*, February 9, http://finance.fortune.cnn.com/2012/02/09/warren-buffett-berkshire-shareholder-letter/.

Estrada, J., 2013a, "Are Stocks Riskier than Bonds? Not If You Assess Risk Like Warren Buffett," *Journal of Asset Management* 14 (No. 2), 73-78.

Estrada, J., 2013b, "The Glidepath Illusion: An International Perspective," IESE Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2217406.

Jurek, J.W. and Erik Stafford, 2011, "The Cost of Capital for Alternative Investments," Harvard Business School Working Paper.

Schmid, M. and Q. Nguyen, 2013, "A Total Enterprise Approach to Endowment Management," *The NMS Exchange*, January 2012, 1-15.