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The Ten Fundamentals of Pension Fund Risk Management

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In January of 2012, I was called as an expert witness during litigation involving the San Diego County Employees Retirement Association. My testimony addressed various technical aspects of the investment policies, and the degree to which various risk reports provided to the SDCERA board did or did not conform to the requirements of their policies. In preparation for the litigation, I reviewed the investment policy statements of a large number of both public and corporate defined benefit pension plans.

The overall conclusion of that review was that the risk management policies of most pension funds are woefully inadequate in their conceptual representation of pension risk, leading to an inevitable failure in the execution of the risk management process. Here is our list of key issues that pension fund boards and management should consider in formulating risk management policies:

Risk is About the Future, Not the Past

The most troubling aspect of many pension fund investment policy statements was that they required that the risk of the fund be assessed retrospectively by calculating the statistical parameters of past realized returns. For example, in many plans the only quantitative measure of risk was the “historic tracking error of the fund against the policy benchmark over a sample period of N months.” From a conceptual perspective, this kind of view of risk is deeply troubling. *Risk is about understanding the range of potential negative outcomes in an uncertain future. There is nothing uncertain about the past.* Trying to run to a pension fund on this basis is like driving a car looking in the rear view mirror.

The other problem with this approach is that even if the fund does exceed policies on a historic basis, what do you do about it? The past is past and what is done is done. If ex-post volatility limits were violated it may be that this was the result of excessive risk taking by the fund strategies, or as the result of unusually volatile market conditions. If transient market conditions are the root cause, it might be reasonably believed that conditions have returned to normal so that no strategic action is required to bring future risks into conformity with policies. Even worse, consider the situation where historic risk realizations have been within policy limits. Is this a sufficient basis on which to assume future risks will continue to be within the prescribed limits? Could a homeowner reasonably assert that because their house was not on fire on average over the last sixty months, it is safe to sit in the living room although flames are visible in the kitchen?

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Risk assessment must be an explicitly forward-looking exercise while many investment policy statements *are written based on the unspoken and heroic assumption that the future will be like the past*. In today's complex and volatile financial markets the lack of validity of this assumption is self-evident.

You Can't Ignore the Best of What We Know

The risk assessment process for a pension fund is all about the future. This means that the only portfolio that is relevant to risk assessment is the portfolio we hold today. What the risk level was of the portfolio we held on average over the past few years is of little or no consequence. Risk assessment should come from formal risk systems that combine forward-looking assessments of market conditions and the best available information on what specific assets will make up our portfolio going forward. In almost all cases our current portfolio is the best estimator of the composition of our portfolio for the foreseeable future.

What is the Time Horizon for Risk?

Once we've gotten to the level that risk assessment is a forward looking exercise, we must be painfully aware of certain industry conventions. It is the custom of the financial services industry to talk about statistical risk measures such as portfolio volatility in annual units. For example, we might say the "volatility of a fund is 8%." But what does this actually mean? Are we saying that we are making a forecast of 8% *annual volatility* from today to one year from today, or are we making a forecast of the *annualized value of volatility* that is expected over a shorter horizon such as the next week, or the next month? As pension funds are typically very long term investors, ex-ante risk assessments that focus on very short horizons are often less meaningful. On the other hand, pensions and endowments often allocate a portion of their assets to some very volatile investments such as leveraged hedge funds that are capable of going bankrupt in an extreme market event. For these assets, risk assessment is less an issue of investment policy and more an issue of monitoring the solvency of the fund. Few if any pension fund investment statements explicitly address the forward time horizon of risk assessment.

100% of Our Portfolio Has Risk Even If We Can't See It

It is routinely true that the investment policy statements for pension funds simply ignore the risk of illiquid alternative investments such as private equity, venture capital and real estate as simply unknowable, and it is therefore appropriate to ignore them for risk assessment purposes. We would argue that the recent Global Financial Crisis, which was centered in real estate-related securities, is illustrative of the folly of this idea. If a pension fund owns a shopping mall or other illiquid asset as an investment, the true economic value of that asset is changing on a daily basis even if we cannot observe it. To the extent that appraisals are used to estimate the value of non-marketable assets, many studies have shown that the statistical properties of the estimated returns are biased. When appraisal values are used, returns become strongly serially correlated and the usual assumption about observations in a statistical sample being independent events is violated. When serial correlation is high,

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conventional calculations of things like annualized standard deviation of returns as a volatility measure is no longer appropriate. It is quite typical that when calculation adjustments are made to account for serial correlation, the risk values for illiquid assets double or triple relative to common beliefs. While there is a wide range of methods available to assess risk of alternative investments, the guiding principal must be that *risk assessments for a pension fund should incorporate 100% of the fund assets including illiquid alternatives.*

Hedge Funds, Derivatives and Risk Transience in Time

Since the beginning of financial markets, the simple concept of “nothing ventured, nothing gained” has been in place. Put more elaborately, there has always been a general concept that return and risk go hand in hand in a fashion that is contemporaneous in time. To get a chance for more returns in a given time period, you have to assume more risk during that same time period. With the widespread expansion of organized derivatives markets since the early 1970s, investors have had the opportunity to move the balance of risk and return across time. Many hedge funds and even traditional asset managers use derivatives or related strategies that can trade risk this month for return next month, or return this year for risk next year. Given the performance related fees common to hedge funds, there are strong economic incentives for hedge funds to produce return today for risk tomorrow. This is particularly true of funds that do not provide position transparency to their investors. While such strategies are sometimes successful for long periods, the ex-ante return distributions of such funds have a high degree of negative skew, which should be accounted for in risk assessments and allocation policies using the Cornish-Fisher expansion or other appropriate statistical adjustments.

Another key to controlling this risk is to create risk assessments using notional rather than market values of derivative investments. For example, consider a \$10 Million traditional US equity account managed by an external asset manager where for some reason the asset manager goes long \$50 million of S&P 500 index futures contracts. Consider the risk exposure of the fund one second after the futures trade is complete. The stock market risk exposure of the fund has increased by a factor of five. If stock index prices have not changed, the market value of the futures position is still zero as neither any profit or loss has yet been experienced.

A market value close to zero will make the futures position seem inconsequential when it actually massively increases the risk of the portfolio. As stated above, *risk assessments for a pension fund should incorporate 100% of the fund assets including illiquid alternatives (and that goes for hedge funds and derivatives too).*

The Special Risks of Active Management

Many pension investment policy statements focus a lot of attention on the issue of the potential for active managers to underperform their benchmarks. Unfortunately, fund sponsors incorrectly use “tracking error” as the measure of active risk. Tracking error is defined as the standard deviation of the active (benchmark relative) returns. Like any standard deviation it represents dispersion of the observations around the mean. For an index fund this is fine, since we know with certainty that the expected mean will be zero. The central paradox of active



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management is that *every active manager and every investor who hires an active manager must believe that the mean of their benchmark relative returns will be positive. Unfortunately, it is axiomatically true that roughly half of active managers must produce below average returns* (a negative active mean). Simply put, for someone to be above average, someone else must be below average. Unless we make the heroic assumption that a fund has a 100% success rate in hiring superior managers, assessing the risk of active managers requires a broader measure that incorporates both the dispersion of returns around their mean, and the potential for the mean to be negative over the future. For more information procedures to estimate active risk, please see our presentation at: <http://www.northinfo.com/documents/399.pdf>.

Pension Funds Pay Benefits with Cash not Investment Assets: Liquidity Matters

During the recent Global Financial Crisis there were several well publicized examples of large pension and endowment funds having to go out and borrow money in order to fund benefit payments and “cash calls” into additional alternative investment assets. There are two tractable ways to adjust traditional portfolio risk metrics (volatility, tracking error, VaR) to reflect liquidity concerns. One way is to get the investor to state a liquidity policy as described in Acerbi and Scandolo (2008), as “we want to be able to liquidate P% of our portfolio in T trading days.” Once our policy is stated we can calculate the cost of a hypothetical liquidation and then build the associated transaction costs into the portfolio risk estimates. *A profound result of this kind of analysis is that portfolio risk is a function, not only of portfolio weights but also of the dollar value of the portfolio, as the larger the positions are the greater the expected costs of liquidation will be.* This means that a \$1 Billion portfolio is riskier than a \$1 Million portfolio even if the security composition and weights are identical. This is different way of considering the “capacity” of a strategy as described in Vangelisti (2006).

A simple rule of thumb approach to liquidity risk that pension funds can follow is often required by insurance regulators for life insurance and annuity companies. For example, regulations may require that the entity maintain a “liquidity account” of cash and short-term government bonds that is equal to the expected benefit payments for the next three years.

Pension Funds Don't Pay Benefits with Benchmark Relative Money

As previously noted, many pension fund investment policy statements focus their risk management concerns on tracking error against a policy benchmark, with little regard for the absolute risk inherent in the formation of the policy benchmark itself. We speculate that most policies are written this way because it is easy to place blame on an external asset manager who performs poorly, while it rather more difficult hold anyone in particular as responsible for a market crash in an asset class to which we have allocated funds.

Unfortunately, this custom is counterproductive in that the almost all of absolute risk of loss in a typical pension fund arises from the market risks of the asset classes, not from the potential of specific hired managers to underperform benchmarks. Pension plans do not pay retiree benefits with benchmark relative money. For corporate

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pension plans that are subject to accounting rule FASB 87, the overall risks of the pension fund should be considered in a liability relative fashion, where the benchmark is not the internal policy benchmark but rather is a customized bond index that replicates the cash flow structure of the pension obligations. For public plans that are not subject to FASB 87, considering liability relative volatility is less imperative, but is still a very useful measure of the true funding risk of the plan.

The Risks of Underfunding and Financial Guarantees

Almost every pension scheme has an explicit guarantee of funding from the sponsoring organization. If the plan becomes underfunded by virtue of poor investment results, the sponsoring entity must increase cash contributions in future years to make up the shortfall. This is far from an academic issue as the cumulative underfunding of public pension funds in the US alone has been estimated in academic studies at ranging from \$1 Trillion to \$2.5 Trillion.

One conceptual way to view this situation is to assume that a pension plan is always fully funded, and that any present or future underfunding is made up by an implicit asset which is economically similar to a perpetual call option on a bond (i.e. a periodic series of cash flows) from the sponsoring entity. Under this framework, both the asset allocation and risk profile of a significantly underfunded pension scheme is radically different from the conventional perspective, as a large portion of the fund is now effectively concentrated in a bond-like security of a single issuer. We have not yet found a pension plan whose investment policy on risk management recognizes the buildup of issuer specific risk in the event of underfunding. Consider the case of a public pension plan that is 30% underfunded. How prudent would we consider it to be to invest 30% of that large pension plan into one bond of a single issuer?

You Can't Just Measure Risk, You Have to Manage It!

One old adage regarding the management of financial risk says simply that investors "should not put more money at risk than they can afford to lose." One way to address this issue is to consider the distinction between periodic risk and "first-passage" risks as defined in Kritzman and Rich (2002). Consider a pension fund with \$100 Million in assets that is concerned with the probability that their assets will be worth less than \$80 Million at some future date. One way to think of the problem is to ask the probability that the fund will be worth less than \$80 million at some specific date such as five years from now. Another way to think of the problem might be to ask the probability that the fund will be worth less than \$80 million *at any one moment between now and five years from now*. Obviously, the latter probability is always greater since there must be a greater than zero chance that the fund would fall below \$80 million for a moment in time and yet still finish the five year period above \$80 million. While pension fund policies often consider the former question in making asset allocation policies, the latter question is rather more algebraically challenging and hence is often ignored despite the fact that it is often the more relevant formulation of the problem. To the extent that the fund policies specify a minimum funding level, we can formulate risk limitations such that the first passage probability of violating the funding floor is at an acceptably low level.



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A further formalization of this idea is provided in the Discretionary Wealth Hypothesis of Wilcox (2003). Defined benefit pension plans have long thought in terms of assets, the present value of liabilities, and surplus. The Wilcox approach provides an even more elegant technique for managing risk. Wilcox derives that the optimal risk aversion, the Levy-Markowitz (1979) mean-variance risk aversion value λ for an investor is equal to one-half times the ratio of total assets divided by net worth (surplus). The important outcome of this process is that allowing time variation in λ maximizes the expected median of future surplus, rather than the mean of the surplus distribution. The effect is a dynamic asset allocation process, somewhat similar to a strategy of portfolio insurance. You are increasing aggressiveness when you can afford to do so and taking a more conservative posture when you must as a matter of prudence. Note that these changes only impact your risk aversion level. Actual changes in portfolio composition also must reflect changes in capital market expectations and expected trading costs.

We note that the operation of the Wilcox process is dependent on the existence of a funding surplus of some size in the plan. To the extent that most plans are actively discouraged by tax regulations of most countries from having a funding surplus, this may be problematic. However, this issue can be addressed by considering the economic values of sponsor funding guarantees as being large enough to bring the plan into a desired level of implicit surplus. Such an analysis is often a useful exercise in understanding the true financial extent of sponsor guarantees.

It is important to highlight that dynamic asset allocation strategies do introduce path dependence into terminal wealth values. Under the approach presented here, if investors experience a period of positive returns followed by a period of negative returns, the resulting wealth generally will be different than if the sequence had been negative returns followed by positive returns. This form of dynamic allocation may be pro-cyclical in that investors normally will switch from high-risk assets (stocks) to low-risk assets (bonds, cash) when the stock market declines. Such induced selling of stocks may increase the volatility of equity markets if carried out by large institutions. However, the introduction of path dependence is nothing new to the real world. We all live our lives by waiting to cross a street when a car is coming, carrying an umbrella when it's raining, or buying a little extra when a favorite food is unexpectedly on sale at the market. *At each moment of time, we must walk from where we stand.*