From Sow's Ear to Silk Purse:

Transformation of the Arizona Public Safety Personnel Retirement System

by | **Marc R. Lieberman** and **Mark Lundin, Ph.D.**

Immediately before the tech bubble burst early in the new millennium, the assets of the Arizona Public Safety Personnel Retirement System (PSPRS) were largely managed in-house. With the concurrence of the system's board and a single outside consultant, staff had allocated 70% of the system's $5.6 billion portfolio to domestic stocks, many of which were concentrated in the technology sector.

When the market for these equities crashed, the system lost more than $1.6 billion in asset value over 24 months—far more than the system would have suffered had its portfolio been highly diversified.

Over the next 12 years, system executives and staff struggled mightily to learn from their mistakes and ensure such concentration never happened again. Today, the system has one of the best risk-adjusted portfolios in the nation. If the financial market downturn that so adversely affected the system in 2002 were to occur today, we estimate the system would lose 5.5% instead of the 21.1% loss it suffered from that event.

This is the story of how the system turned a sow's ear into a silk purse.

A large statewide public fund's effort to diversify its once very concentrated and enormously volatile portfolio resulted in it placing among the top 10% of the industry's risk-adjusted portfolios.

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TABLE 1

Worst-Case Scenarios—Lessons From the Past

Events	Today's Portfolio	PSPRS Trust Actual
Asian Crisis of 1997	**8.1%**	**5.7%**
Russian/Long-Term Capital Management Crises 1998	−5.4%	−5.5%
September 11, 2001 World Trade Center Attacks	−2.7%	−11.7%
Stock Market Crash 2002	−5.5%	−21.1%
August Crisis 2007	**3.3%**	**1.6%**
January Crisis 2008	−2.3%	−2.7%
Credit Crunch 2008 (August to November)	−9.3%	−23.1%
Credit Crisis 2009 (January to February)	−5.6%	−12.9%
Averages	**−2.4%**	**−8.7%**

Paramount Need: Diversification

The principal lesson learned from the tech crash of 2000-2002 was that the system needed to greatly diversify its assets. It might seem obvious today that it was problematic for the system to put most of its eggs in one basket (stocks and especially tech stocks), but before 2000 the traditional asset mix for pension funds was 70% domestic equities, 20% bonds and a bit of "alternative assets," typically real estate. The folly of this approach became apparent in the market crash.

The system embarked on an aggressive program to modernize its portfolio and build, to the extent possible, a group of asset classes that largely would be uncorrelated to the equity markets and generally would be uncorrelated with each other. To do that, it needed to take a number of important steps.

Step One: Appropriate Consultants

The system hired two sets of outside consultants to guide its path to diversification. The first was a general advisor to assist the system in constructing its portfolio, detailing the asset classes that would make up the portfolio and how those classes would be configured. The system eventually retained New England Pension Consultants (NEPC), which provided support in asset allocation and the changeover to external managers from internal management for most of the system's portfolio.

NEPC also recommended the system allocate sizable portions of its assets to highly diversified private equity, hedge fund, credit opportunity, risk-parity, absolute-return, global tactical asset allocation, secondary interests and foreign equity programs.

Step Two: Legislative Authorization

Although NEPC's advice was sound, the system was unable to implement its recommendations immediately. First, the system needed to obtain specific legislative authorization in order to invest in some of these asset classes. That objective was achieved in 2008.

Many government pension systems experience this roadblock to diversification. Overly restrictive "legal list" statutory limitations on what investments a system can hold are designed to "protect" the system but actually contribute to its losses and extreme volatility.

The system gained the opportunity to significantly lessen its market risk by diversifying asset class exposures, but only after those limitations were finally relaxed and the system was allowed to invest in assets not correlated to the equity and bond markets.

Step Three: Specialty Advisors

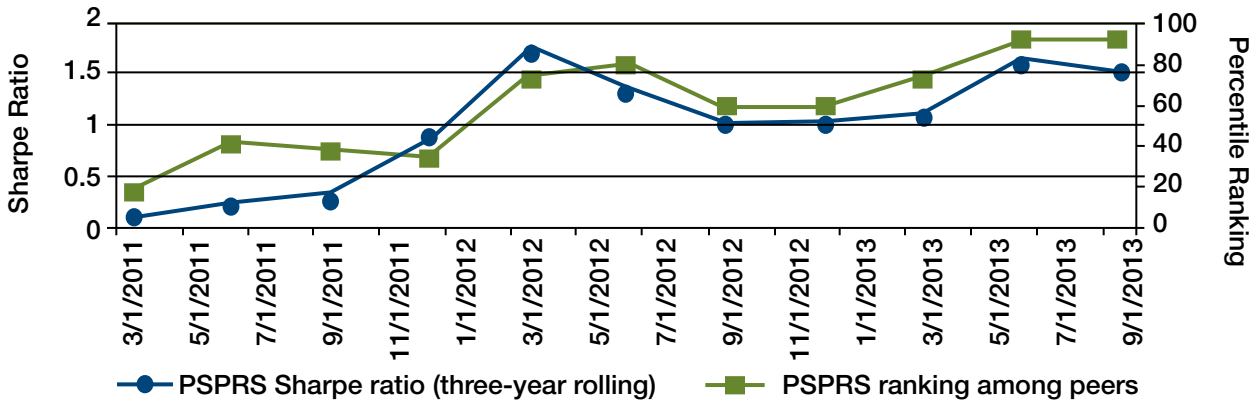
After securing legislative authorization to invest in alternative assets, the system retained outside consultants that could advise where it should invest its capital. The system chose StepStone Group and Albourne Partners to serve as its advisors for private equity and

takeaways >>

- The Arizona system hired two sets of outside consultants to guide its path to diversification—a general advisor to help construct a much more diversified investment portfolio and consultants that provided support in asset allocation.
- The system obtained legislative authorization in order to invest in asset classes not correlated to the equity and bond markets.
- Sizable portions of assets were allocated to private equity, hedge fund, credit opportunity, risk-parity, absolute-return, global tactical asset allocation, secondary interests and foreign equity programs.
- With collaboration of specialty advisors, the system built a portfolio that is in the top 10% of its peers on a risk-adjusted basis.
- The system hired a highly qualified and experienced investment department staff that developed comprehensive governance and investment policies.

FIGURE

Risk-Adjusted Return Trend



hedge fund investments. It chose ORG Portfolio Management to serve as its consultant with respect to real estate, and it selected NEPC to advise with respect to *credit opportunities* (investments providing opportunistic loans to a wide variety of borrowers who, due to the Great Recession, no longer enjoyed access to traditional financing lines).

With the collaboration of these advisors, the system has constructed a portfolio that delivers performance in the top 10% of its peers on a risk-adjusted basis. The portfolio is intentionally designed to lose far less than a conventional 60/40 stock/bond portfolio in the event of a market crash. It is also designed to perform much better than previous versions of the system's portfolio during past crises. Table I reflects the expected results of the system's current portfolio in the event that past market crashes and corrections were to occur today.

We estimate the system's portfolio on average is now three times less exposed than prior asset allocations to previously observed adverse market conditions.

Step Four: Adequate Staff and Governance

Retaining appropriate advisors wasn't enough to set the system on sound footing; it needed sufficient investment staff to process the advice of its consultants. The system also needed to implement comprehensive controls to ensure no one person was controlling the system's investments and to provide for many eyes to scrutinize all investment actions. And it needed to ensure its board continually was kept aware of the system's investment performance and involved in how assets were invested.

To those ends, the system put in place (through expansion) a highly qualified and experienced investment department staff that developed comprehensive governance and investment policies that are constantly being refined with the help of outside consultants.

The Results

The system now has one of the best risk-adjusted portfolios among U.S. public pension trusts, according to data from NEPC. While the system delivered "only" an 11.14% return for the fiscal year that ended June 30, 2013—compared to an equity bull market return of 21.46% as measured by the Russell 3000 index—the figure shows that a clear trend in both risk-adjusted return and ranking among peers has developed in the five years since 2008. Sharpe ratios (a means of measuring risk)[1] have been above 1 in the past five years (indicating low risk), with risk-adjusted performance moving steadily upward to the top decile among peers since 2010.

Even more startling is that the system's portfolio has more upside potential than downside risk. We can gauge this by first modeling the portfolio's dependence on major market factors and then probing the reaction of the investment portfolio to various degrees of movements of those factors. In the case of the Arizona system, we determined that movements in the MSCI North America stock index and U.S. three-year Treasury note explained a major fraction of portfolio returns in the past five years. Added on top of this dependence is a wide array of idiosyncratic risk we are unable to explain, but these first two major factors might be

TABLE II

Notable Drivers of Global PSPRS Trust

Market Factor Change	Portfolio Return	Market Factor Change	Portfolio Return
MSCI North America −10 std	−25.8%	U.S. 3-year T-Note −10 std	−7.8%
MSCI North America −6 std	−15.5%	U.S. 3-year T-Note −6 std	−2.9%
MSCI North America −5 std	−12.5%	U.S. 3-year T-Note −5 std	−1.7%
MSCI North America −3 std	−7.2%	U.S. 3-year T-Note −3 std	0.8%
MSCI North America −2 std	−4.5%	U.S. 3-year T-Note −2 std	2.1%
MSCI North America −1 std	−1.9%	U.S. 3-year T-Note −1 std	3.3%
MSCI North America +1 std	3.4%	U.S. 3-year T-Note +1 std	5.8%
MSCI North America +2 std	6.1%	U.S. 3-year T-Note +2 std	7.0%
MSCI North America +3 std	8.7%	U.S. 3-year T-Note +3 std	8.2%
MSCI North America +5 std	14.1%	U.S. 3-year T-Note +5 std	10.7%
MSCI North America +6 std	16.7%	U.S. 3-year T-Note +6 std	11.9%
MSCI North America +10 std	27.3%	U.S. 3-year T-Note +10 std	16.9%

TABLE III

Current Status

PSPRS Trust December 2013	Portfolio Weight	Historic Volatility* (12-month standard deviation)	Monthly Volatility (Forecast)	Monthly VAR Forecast (95% Confidence)
Real Estate	12.4%	1.3%	6.8%	−9.3%
Private Equity	12.0%	1.7%	5.2%	−8.3%
U.S. Equities	17.8%	2.4%	4.4%	−7.7%
International Equities	15.0%	3.2%	4.2%	−7.3%
Absolute Return	4.0%	0.7%	3.2%	−0.7%
Risk Parity	2.4%	2.6%	3.1%	−4.2%
Real Assets	6.0%	1.1%	2.2%	−3.2%
Global Tactical Asset Allocation	9.0%	1.5%	1.9%	−2.4%
Fixed Income	9.7%	1.2%	1.3%	−1.3%
Credit Opportunities	9.5%	0.9%	0.9%	−1.0%
PSPRS Trust	97.8%	1.0%**	2.6%	−4.0%

* For comparison, the monthly volatility of the S&P 500 over the past ten years has been 4.3% per month, or 14.9% per year. All risk values reported as monthly risk based on the past two years of returns.

** For comparison, a volatility of 1.1% per month corresponds to 3.5% per year.

interpreted as the tide that guides portfolio performance ebb and flow.

Various levels of change in these factors can be imposed and the return of the portfolio factor model examined. In order to keep the changes in market factors interpretable, we considered various *standard deviations* of their movements. A one standard deviation movement in the MSCI North America stock index, or the price of the U.S. three-year Treasury note, is the maximum movement that we have observed to occur in 68% of months. Larger movements have occurred, but much less often. The markets have made a two standard deviation movement or greater just 5% of the time and a three standard deviation move or greater just 0.3% of the time.

Table II reflects results of a factor analysis that gauges portfolio response to moves in major market drivers. Whereas a drop in equities (considered in isolation) of two standard deviations would result in the system's total portfolio experiencing a loss of 4.5%, a corresponding hike in equities of two standard deviations would result in the system booking a 6.1% return for its portfolio.

Likewise, whereas a drop of three standard deviations in three-year Treasurys still results in a positive 0.8% gain for the system's global portfolio, a corresponding increase of three standard deviations in three-year Treasurys would result in the system's global portfolio booking a return of 8.2%.

Thus, there is a positive asymmetric correlation between the major drivers of the system's portfolio returns, which one would not expect, for example, from a series of random coin flips that would balance out to an average of zero if executed in sufficiently large number.

In contrast, a poorly diversified portfolio would be expected to deliver equally positive and negative returns in comovement with equally positive and negative stock market movements. But in the system's case, large losses in some portfolio components are partially compensated for by countermovements in others, whereas large gains do not provoke equally sizable counterbalancing negative effects.

We interpret these results to be a by-product of well-designed diversification—a group of low and, at times, negatively correlated investments that

have produced better returns at lower risk than would otherwise be obtained.

Volatility

While not true in every case, a highly diversified portfolio should be less volatile than a highly concentrated one over an extended period. As reflected in Table III, the Arizona system's highly diversified portfolio experienced volatility of just 3.5% last year, which is probably not indicative of the true riskiness of the portfolio because major market volatilities have been at historic lows. The system's risk managers currently forecast an annual volatility for its global portfolio of 9% per year, although it is interesting to note they forecast a 9% volatility rate for 2013 as opposed to the 3.5% actually experienced.

There is little doubt that the system's volatility is materially tempered by its highly diversified structure. Barring circumstances similar to those in effect during the Great Recession when nearly all markets plunged, the volatility of the system's returns should be lower than its peers.

Conclusion

To paraphrase an old cigarette ad, "PSPRS has come a long way, baby." Twelve years after the end of the tech crash, the Arizona Public Safety Personnel Retirement System has one of the best risk-adjusted portfolios in the nation, and it got that way through tough introspection and even harder work.

Today, the system's portfolio, with three-year rolling Sharpe ratios of 1.5% and top-decile risk-adjusted performance, is something of which to be proud. The major structural changes implemented by the system over the past decade will become quite apparent when the next "crash" hits. Results so far indicate the system should not suffer the losses it otherwise would have experienced without the changes implemented. This will greatly benefit the system's members, as well as Arizona's taxpayers.

Endnote

1. A *Sharpe ratio* characterizes how well the return of an asset compensates the investor for the risk taken. Also known as the *reward-to-variability ratio*, the Sharpe ratio is often estimated after the fact as the return on investment, above the current risk-free interest rate (or with that rate of return subtracted off), divided by the standard deviation of returns (or the investment variability encountered most of the time). The capital asset pricing model (CAPM) dictates that the investment with the highest Sharpe ratio has the highest efficiency and should be selected above all others. In practice, Sharpe ratios vary over time, and investors compensate for this uncertainty by investing in a diversified group of investments with expected high Sharpe ratios. The Sharpe ratio is a relative number and is equally powerful for comparing one investment to another, or one investment portfolio to another, regardless of the investment application—personal or professional, private or public. Most experienced investors would agree that a positive Sharpe ratio is preferable, as it infers profit rather than loss; a Sharpe ratio above 0.5 is good, and a Sharpe ratio above 1 is excellent.

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