

MEMORANDUM

To: House Pensions and Benefits Committee

From: Alan D. Conroy, Executive Director

Date: March 13, 2013

Subject: Probability of KPERS' Returns Exceeding Certain Thresholds

We have been asked to provide information regarding the probability that the KPERS' investment portfolio will produce returns in excess of certain thresholds.

KPERS' consulting actuary, Cavanaugh MacDonald, prepared the attached letter, which provides an explanation of the assumptions used in their analysis and issues related to calculation of mathematical probabilities. Because this type of analysis is highly dependent upon the underlying assumptions, it is essential to review the information provided in that letter and to remember the following additional points -

- The probabilities were prepared using capital market assumptions developed by KPERS' investment consultant, Pension Consulting Alliance (PCA) and applied to KPERS' target asset allocation.
- PCA develops its capital market assumptions for the near term - a 10-year timeframe.
- Actuarial investment return assumptions take into account the long-term horizon over which pension plans are funded (30-50 years).
- This creates a mismatch between the long-term actuarial return assumptions and the capital market assumptions used in the probability analysis.
- In the current interest rate environment, applying PCA's shorter-term assumptions over a longer timeframe is a conservative approach and is likely to understate long-term returns.
 - This approach results in a projected geometric (compound) return of 7.04% for the portfolio
 - As a point of comparison, the KPERS portfolio returned 8.2% over a trailing 10-year period, as well as 8.2% over a 26-year period beginning 1986 (both as of December 31, 2012).
 - In particular, the current short-term capital market assumption for bonds is not appropriate for a long-term assumption given historically low interest rates in the current market.



- To the extent that the assumptions are indeed understated, then the probabilities of exceeding the various thresholds shown below would be greater.

Given these assumptions and constraints, Cavanaugh MacDonald has calculated the probability of KPERS' portfolio producing returns in excess of the following thresholds:

Threshold Return	Probability of Exceeding over 15 Years	Probability of Exceeding over 30 Years
5.25% (Current cash balance plan guaranteed interest credit)	71%	78%
5.00% (HB 2301 guaranteed interest credit)	74%	82%
4.00% (In the range of current market yields for taxable pension obligation bonds)	83%	91%

KPERS will be available to provide additional information that you may require to evaluate this information.



Cavanaugh Macdonald

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March 7, 2013

Mr. Alan Conroy
Executive Director
Kansas Public Employees Retirement System
611 S. Kansas Ave., Suite 100
Topeka, KS 66603-3803

Re: Analysis of Probability of Exceeding Interest Crediting Rate

Dear Alan:

We have been asked to provide information regarding the probability that the KPERS investment portfolio will produce returns in excess of the 5.25% interest crediting rate for the cash balance plan that will be in place for members hired after December 31, 2014. Because the answer is highly dependent upon the underlying assumptions, we first provide some explanation of the underlying issues before discussing the results. **Please note that considering the results in the absence of a complete understanding of the issues may be very misleading and may lead to unsound conclusions.** Consequently, any user of this letter should first make the effort to understand this material before drawing any conclusions.

Background

When calculating probabilities, there must be an underlying mathematical probability distribution. This probability distribution may be determined in a variety of ways, but is designed to model the likelihood of specific outcomes of an event where the actual outcome cannot be known in advance. Generally, there is no way to know the exact likelihood of all possible outcomes, so mathematical models are developed to predict the probabilities of the outcomes. In the case of investment returns, the most commonly used probability distribution is the log-normal distribution. This has sound theoretical underpinnings and has typically served practitioners well. The log-normal distribution model relies on two parameters – one which relates to the expected value of the investment return (the mean) and one which relates to the volatility of the returns (the standard deviation). These two variables suffice to define the mathematical probability model.

To use the log-normal distribution in measuring the probability of meeting a particular target return, estimates must be made of the mean and standard deviation. As might be expected, the rate of return of a portfolio is dependent upon the asset allocation within the portfolio. Investment consultants typically

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develop estimates of the mean and standard deviation for each asset category in the portfolio based upon historical observations. These may be adjusted to reflect fundamental changes in the current environment. For instance, although interest rates are currently at historic lows, assuming that returns on bonds in the long term will be similar to those in the short term is not reasonable. Consequently, the mean (i.e. expected) long term returns for bond classes may need to be adjusted. There may be other asset classes that require some adjustment as well for the long term (30-50 year time horizon).

Typically, investment returns are initially modeled over a one-year period. Two common measures that are frequently analyzed are the average expected return and the median return. Because of the asymmetric nature of the log-normal distribution, the median will be less than the average. When return information is desired for a multi-year period, usually the result is expressed as a compound return. Sometimes this compound return is referred to as the geometric average (or mean). Mathematically, the geometric return will be less than the arithmetic average of the one-year returns, and will actually converge to the median as the time period under consideration increases. This geometric mean is generally the number actuaries focus on when analyzing expected returns and setting the actuarial assumed rate of return.

As has already been suggested, when investment advisors develop return assumptions for each asset class (which are typically set for a 5 to 10 year timeframe), they reflect expectations about the future which may differ from historical data. Frequently, there will be information available about circumstances and situations that provide insight regarding how returns may behave over the short term that will differ from how returns would be expected to behave over the longer term. Consequently, investment consultants make assumptions that they believe to be reliable in the near term – usually 10 years or less. As actual events unfold, these assumptions are revised, most often annually, but sometimes even more frequently. It is extremely important to keep in mind that the investment consultants set their assumptions for near term asset allocation purposes rather than the much longer time frames that actuaries consider in performing their calculations for funding purposes. Because of this mismatch, actuaries face a challenge in using the assumptions developed by investment consultants to set the actuarial assumption for the expected rate of return.

Analysis

For the analysis in this letter, we have utilized the current capital market assumptions developed by the Pension Consulting Alliance (PCA), KPERS' investment consultant. Details of those assumptions are included in an attachment to this letter. PCA developed these assumptions based on a ten year time frame. Because of the current interest rate environment, this results in the assumption that many bond classes will return less than inflation during the ten-year time period. It is doubtful that negative real returns on bonds can continue indefinitely, since ultimately there would be little incentive for anyone to purchase new bonds as an investment. Despite this fact, we have utilized PCA's assumptions for our analysis, recognizing that the shorter term assumptions should tend to be conservative and that over the long term actual results are likely to be better.

Currently, the interest crediting rate for the cash balance plan is 5.25%. Under certain conditions, the KPERS Board has the discretion to provide an additional "interest dividend," resulting in a higher interest crediting rate for a given year. The interest crediting rate is a key factor in defining the benefits provided in the Tier 3 cash balance plan. Significantly, this rate can be varied by the Board (through the discretionary interest dividend) and the Legislature (by statutory authority to change the 5.25% rate prospectively), thereby providing the ability to share some of the investment risk with members. Please



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note that in the cost studies prepared for the plan, the assumption for the interest crediting rate anticipates that the Board will grant the maximum discretionary additional credit once the overall funding ratio improves to 80% or better.

We have been asked to determine the likelihood that KPERS' fund will have compound investment returns that exceed the 5.25% interest crediting rate. Because the interest crediting rate is used to calculate benefits ultimately paid by KPERS, it makes sense to look at longer time periods that are related to typical employment periods (ignoring short term employees). If we consider a 15-year time horizon, the probability of the compound return exceeding the interest crediting rate of 5.25% is 71%. Similarly, over a 30-year time horizon, the compound return exceeds the interest crediting rate 78% of the time.

We anticipate that the probabilities shown here may be lower than what might be desired or expected. We believe it is important to re-emphasize that the assumptions we are using are reflective of expectations for the next ten years, and include an anticipated increase of interest rates resulting in the decline in the value of existing bonds in the KPERS portfolio. If longer term assumptions had been used, these probabilities would be somewhat higher. It is worth noting that over the last ten years, KPERS has a compound return of 8.2%, higher than what is being projected with the current PCA estimates.

We also note that because of the volatility in investment returns, there is a probability of higher returns as well. Current law indicates that the KPERS Board may grant an additional interest credit (dividend) only when the return exceeds 10%. We estimate that this would occur approximately 40% of the time based on PCA's assumptions (and more often if higher, long-term rates of return were used). There is an upper limit on the additional interest credit of 4%, which applies anytime the rate of return exceeds 13% (since 4% is 80% of the excess of 13% over 8%). We estimate that this upper limit would apply more than 30% of the time. However, the Board has some discretion as to whether the additional interest credit is granted and might not always apply the maximum possible additional interest credit allowed. Choosing to grant less than the maximum additional interest credit allowed would permit the funded status of KPERS to improve without any reduction in the minimum benefits promised to members (although the benefits would be less than if the additional interest credit were granted).

In this letter we have focused on the probability of the investment return exceeding the 5.25% interest crediting rate. However, it is important to note that exceeding this interest crediting rate does not necessarily mean that KPERS would experience an investment gain. Investment gains arise when the rate of return on the smoothed actuarial value of assets exceeds the assumed rate of return, not the 5.25% interest crediting rate. Cost calculations we have performed in the past have been based on the fund earning the assumed rate of return, unless otherwise specified.

While the law provides for a specified interest crediting rate that acts as a minimum, currently 5.25%, it also provides that this rate may be changed prospectively by the Legislature. This important feature provides some protection on the cost of the plan since the interest crediting rate could be reduced to respond to fundamental changes in market returns or changes in asset allocation policy.

In preparing this report, we have reflected the current Tier 3 provisions in Kansas law resulting from the passage of HB 2333 in the 2012 legislative session. We have also relied upon the capital market assumptions developed by PCA as shown in the attachment to this letter. Furthermore, we have assumed that the current asset allocation remains unchanged in the future. These are very significant assumptions and all are clearly subject to change over time.



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It is important to note that probabilities are based on mathematical models. While we believe the models that were used are appropriate for this purpose, it is impossible to capture all of the complexities in the financial markets. In addition, the substantial variation within a given year's returns means that a few good years or bad years do not invalidate the model. Thus, the validity of the model cannot be assessed for a number of years. While probability distributions other than the log-normal are occasionally used to model rates of return, for the purposes of this letter and the general range of probabilities involved, the log-normal distribution is appropriate.

We, Patrice A. Beckham, FSA and Brent A. Banister, FSA, are consulting actuaries with Cavanaugh Macdonald Consulting, LLC. We are members of the American Academy of Actuaries, Fellows of the Society of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

If you have any questions or additional information is needed, please let us know.

Sincerely,

Handwritten signature of Patrice Beckham in cursive.

Patrice A. Beckham, FSA, EA, FCA, MAAA
Principal and Consulting Actuary

Handwritten signature of Brent A. Banister in cursive.

Brent A. Banister, PhD, FSA, EA, FCA, MAAA
Chief Pension Actuary



Attachment with Capital Market Assumptions

	Global Equity	Private Equity	Real Estate	Real Return	Fixed Income	Yield Driven
Annual Arithmetic Mean	9.00%	12.00%	8.90%	5.65%	2.25%	8.00%
Annual Standard Deviation	18.50%	26.00%	15.35%	6.50%	4.50%	15.00%
Correlation Coefficients:						
Global Equity	1.00	0.850	0.450	0.100	0.200	0.750
Private Equity	0.85	1.00	0.450	-0.100	0.000	0.700
Real Estate	0.45	0.45	1.00	0.000	0.050	0.500
Real Return	0.10	-0.10	0.00	1.00	0.400	0.500
Fixed Income	0.20	0.00	0.05	0.40	1.00	0.300
Yield Driven	0.75	0.70	0.50	0.50	0.30	1.00
KPERS Portfolio Allocation	47%	8%	11%	11%	15%	8%

Sources: Pension Consulting Alliance publications "2013 Ten-Year Capital Market Assumptions", November 2012 Asset Allocation Review, and direct communications.