



## Simulation Models Illuminate Risks Faced by Public Pension Plans

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Last year, the Rockefeller Institute of Government released [a paper](#) showing how underfunding risks are significantly increased through funding practices commonly employed by public pension plans, such as high discount rates and long open amortization periods. Rockefeller's Donald Boyd and Yimeng Yin are now back with [a new report](#) to consider how investment risks interact with the funding status and contribution rates.

Similar to last year's paper, this paper is based on a stochastic model that simulates a range of outcomes based on a number of varying parameters (actuarial rules, average investment return, return standard deviation, etc.). Unlike deterministic models that produce specific results that are wholly determined by the initial parameters, stochastic models allow for random variations in generating the results, which in this case enables us to examine the distributions of funded ratios and contribution rates.

The report helps answer two important questions:

How investment risks translate to volatility in funded ratios and contribution rates, and

How specific assumed return rates and investment practices are related to this process of investment risk and volatility.

Without looking at the numbers, the first question could be answered intuitively. Riskier investments result in more volatile returns, which in turn lead to a wider range of possible

funded ratios and contribution rates. The wider range of outcomes goes both ways. While taking more investment risk enhances the potential upside, it also magnifies the potential loss. Thus a pension fund that invests in riskier assets raises its chance of reaping a higher funded status and lower contribution rates, but also faces a higher probability of being seriously underfunded. (The simulation model demonstrates this as expected.)

How does this standard risk-return relationship play out in today's public pension funds? The substantial decline in the risk-free rate over the past three decades has not been matched by a similar decline in return assumptions used by public plans. This implies increasing investment risk assumed by those plans. To examine the choices faced by a typical public plan, the report lays out three scenarios:

- Hypothetical "good old days": the risk free rate had not declined and plans could earn a 7.5% return with little risk.
- Lower the return assumption to 3.5% and invest in correspondingly low-risk assets.
- Maintain the high return assumption (7.5%) and invest in riskier assets to keep up with the rising required risk premium.

The first scenario illustrates what public plans were able to do in the past. When the risk-free rate was high and close to the return assumption, the plan could contribute relatively little to the pension fund and maintain a well funded plan with relative certainty in future funded ratios and contribution rates.

The second scenario is similar to the first scenario in terms of low volatility in funded ratios and contribution rates, but requires much higher contribution levels.

This is the reason why most public plans opt for the third scenario: taking more investment risk to maintain relatively high return assumptions and avoid significant hikes in required contributions.

While the first and the third scenarios have roughly the same median outcomes (for funded ratios and contribution rates), the range of likely outcomes for the third scenario is much wider. In particular, the typical plan in the third scenario has a 17% chance of having its funded ratio fall below 40% at any time during the next 30 years, compared to almost 0% chance in the first scenario. Similarly, the typical plan in the third scenario has a much higher chance of having its employer contribution rise by more than 10% of payroll in any 5-year period during the 30 years. By keeping the high return assumptions, public plans today attempt to retain the *average*, expected performance in the past at the expense of significantly higher uncertainty.

But what if the expected (average) long-term investment performance is lower than the return assumption used by the plan, even after the plan takes on more investment risk? The report presents the fourth scenario to illustrate this situation, where the true expected rate of return is lower than (rather than equal to) the assumed rate of return. In statistical terms, this means the “real” distribution of outcomes is lower than the distribution assumed by the plan, though both distributions are characterized by the same degree of uncertainty (measured by the standard deviation).

In this case, the median funded ratio after 30 years falls to 60%, compared to 90% when the return assumption is met. The probability of the funded ratio falling below 40% at any time during 30 years is more than 35%, more than double the probability under the scenario where the true expected return equals the return assumption. Likewise, the median contribution rate

rises to 19% by year 30, 9% higher than when the assumption is met. And the probability of the contribution rate rising by more than 10% of payroll in any 5-year period during the 30 years is more than 20%, compared to about 16% under the scenario where the true expected return equals the return assumption.

This last scenario is perhaps most relevant to the assessment of public pension funds in the U.S. Most public plans today do not only expose their funds to significant investment risks by maintaining high return assumptions and investing in [increasingly risky assets](#), but also likely [overestimate](#) their long-run expected returns.

These are two separate problems that are often lumped together in public discourse. When critics of public pension plans state that the discount rate/assumed rate of return is too high, their argument is in fact twofold:

- The return assumption overestimates the true expected long-run return. In other words, the return assumption is too *optimistic*. (This is the most common understanding.)
- The return assumption is substantially higher than the risk-free rate of return, implying a large required risk premium, which in turn implies significant *uncertainty* in investment returns that are supposed to pay for *virtually certain* benefits.

While the report does not explicitly spell out these two separate aspects, the simulation exercises illuminate these problems nicely.

The combined effect of these two problems means that U.S. public pension plans are faced with significant risks of severe underfunding and rising funding costs in the future. Perhaps, as the report suggests, lowering return assumptions and reducing investment risk, which raise required contributions, is among the most reasonable routes public plans should take to avoid a future crisis.