How Does a Public Sector Pension Plan's Optimal Funding Ratio Target and Time Horizon for Funding Affect the Interest Rate Assumption Used to Value Future Liabilities?

By Barry Kozak[1] ©2008

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Talking Points (to be hashed out over the next week or so):

- We start by assuming that public sector plans have the flexibility to plan on longer time horizons to fund their plans than private-sector plans have since municipalities (other than states) rarely avail themselves of Chapter 9 of the Bankruptcy Code and because they have the authority to tax to sure up any actual under funding.
- Unlike private-sector plans, which value plan liabilities based on a current market rates of high quality corporate bonds (through a yield curve required by PPA 2006 amendments to ERISA), *my theory is that* each respective government plan should determine its own time horizon needed to achieve full funding and then assume a rate of return on assets based on high quality corporate bonds that have an average maturity tied in to the current time horizon determination (the time horizon will be a moving target that changes each year).
- The time horizon can be determined in several ways, including:
  - Average future expected working horizon based on current workforce;
  - Matching assets to the projected distribution streams; or
  - *My theory* – Estimating the projected population growth rate and the projected income growth rate of the governmental unit, and comparing it to the projected pension growth rate.
- Assuming the research of D'Arcy, Dulebohn and Oh in their 1999 paper is correct ("Optimal Funding of State Employee Pension Systems" published in The Journal of Risk and Insurance), then a government unit can determine a proper funding ratio target with the following assumed inputs in a simple two-period model, where the pension system is funded in the first period and closed in the second period:
  - r = asset growth rate (*i.e.*, the assumed interest rate of return on pension fund assets);

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- e = pension growth rate (*i.e.,* larger workforces promised current benefits, salary increases, and improvements in benefits);
- d = population growth (*i.e.,* all tax paying constituents, regardless of whether they work for the government and earn a pension); and
- g = income growth (*i.e.*, increase in Gross Income of the representative taxpayer)
- x = optimal funding ratio
- The formula is a simple equation where the optimal funding target is determined by a numerator, which is the sum of asset growth and pension growth, and a denominator, which is the sum of the tax base growth rate (which is the product of population growth and income growth) and the asset growth:

$$x = \frac{(1 + r) + (1 + e)}{(1 + d)(1 + g) + (1 + r)}$$

  - observation - their model assumes an interest rate to calculate a funding target, and since it is incorporated in both the numerator and denominator, then changes in the rate only minimally affect the resulting funding target. I believe that I can use their formula as a starting point, and after manipulations as explained below, can develop a formula that determines a time horizon rather than a funding target.

- They then transform this two-period model into a multi-period model, where they assume a long-term commitment, and that employees each work for 20 years and then collect a pension for 20 years (and some other simplifying assumptions).
  - The ultimate model developed incorporates already existing pension systems and different aged and serviced employees.
  - The inputs for the multi-period model are:
    - t = time period
    - r = asset growth rate
    - q = discount rate
    - A(t) = accumulated assets at time t
    - C(t) = pension tax paid at the beginning of year t (pension tax is basically the contribution)
    - P(t) = benefit payments paid out at the end of year t
    - L(t) = accumulated liabilities at the end of year t
    - D(t) = accrued benefits at the end of year t
    - x(t) = optimal funding ratio in year t

- the multi-period model is comprised of the following formulae:
    - accumulated assets are determined by

      $A(t + 1) = [A(t) + C(t)][1 + (r(t + 1)] – P(t)$
    - accumulated liabilities are determined by

      $L(t + 1) = L(t)[1 + q] + D(t) – P(t)$
    - the funding target is determined by

      $x(t) = A(t) / L(t)$ for $t = 1, 2, 3, \ldots$
- other formulae are used to determine a constant projected tax rate, as well as other parameters

- Under the multi-period model, the optimal funding target actually becomes a mathematical function over time that eventually culminates in a 100% funded ratio:
    - If the funding ratio starts above 100% and the tax base growth rate is greater than the pension growth rate, then the function is a convex curve down to 100%;
    - If the funding ratio starts above 100% and the tax base growth rate is less than the pension growth rate, then the function is a concave curve down to 100%;
    - If the funding ratio starts below 100% and the tax base growth rate is higher than the pension growth rate, then the function is a convex curve up to 100%; and
    - If the funding ratio starts below 100% and the tax base growth rate is greater than the pension growth rate, then the function is a concave curve up to 100%.
- **However, in their multi-period model, they use a standard 80 year time horizon (based on existing data from 1995) for all state plans.**
- ***<u>My research</u>*** **will use their model as a starting point, but will develop a new formula for each governmental unit to use to determine its unique proper time horizon to get to 100% funding, and that time horizon will then represent the average maturity term of high quality corporate bonds to use to value plan liabilities.**