

Successful Defined Benefit Plans Cost Less with Bonds

By Mark Ruloff

Recent meetings on financial economics have promoted the idea of an all bond asset allocation. Financial economics calls us to take a corporate-centric, rather than plan-centric approach to pension asset allocation selection. However, we can also learn about the risk of investing in stocks by using some traditional actuarial tools, like measuring the “probability of ruin”.

It is commonly known that actuarial liabilities and normal costs are lower using a discount rate based on higher equity returns as compared to lower bond returns. However, if we factor in the probability of ruin (which we learned during our actuarial exams, but rarely use with pension trust funds), we will find that a plan that avoids ruin costs less with a large bond asset allocation.

Cost Without Reflecting Risk

I took a sample plan that I commonly use and did some traditional pension actuarial calculations assuming two asset allocations, a 60% large cap stock and 40% long term corporate bond portfolio and a 100% long term corporate bond portfolio (the bonds were not chosen to match the liability duration). I worked with a public plan in order to avoid all the ERISA funding constraints. Based on historical returns of 10.42% for stocks and 5.69% for bonds, I assumed an 8.61% return for my 60/40 asset mix and a 5.69% return for my 100% bond asset mix. Not surprisingly, the traditional entry age normal costs of the plan were less under the 60/40 portfolio than under an all bond portfolio. The resulting entry age normal costs as a level percent of pay (rounded up to the nearest 50bps) were 4.5% and 8.5%, respectively.

The Price of Risk is Ruin

While “ruin” in the insurance business is commonly defined as not having enough assets to cover liabilities, this test would probably be considered too strict in the current pension environment. Therefore, I will not define ruin at such a level even though I think it is a worthy goal. Instead, I will define ruin as not having enough assets to make the upcoming years benefit payments. There are two primary issues that can cause ruin. One would be an issue directly related to the plan that would cause the plan sponsor to terminate the plan. The other would be an issue directly related to the plan sponsor, but outside of the plan, that would cause the termination of the plan. I decided to only study the first case here.

To test the possibility of ruin, I ran a 100 year stochastic forecast with 1,000 trials. I set the starting assets of my plans at the value of the entry age normal liabilities and set the contribution policy to the cost as a percentage of pay levels mentioned above. My capital market assumptions factored in the 20.44% standard deviation of the stock return and 8.61% standard deviation of bond return; again these were based on historical information. The standard deviation for the 60/40 allocation was 13.49%. I assumed a level population with new hires replacing active employees who decrement. However, I

made no adjustment to the contribution rate to reflect a possible higher cost level for new hires. The following table shows the number of times ruin occurred out of the 1,000 trials in 10 year increments of the forecast.

Table 1

Year	Number of "Ruins" in 1,000 trials									
	<u>10</u>	<u>20</u>	<u>30</u>	<u>40</u>	<u>50</u>	<u>60</u>	<u>70</u>	<u>80</u>	<u>90</u>	<u>100</u>
<u>8.5% of pay contributions</u>										
All bonds	0	0	0	0	0	0	0	0	0	1
<u>4.5% of pay contributions</u>										
60/40	0	1	46	199	322	379	437	483	529	561

Although only 1 of the 1,000 bond trials faced ruin in the 100 year forecast, over 56% of the 60/40 allocation trials did. While the only ruin, for the all bond allocation, occurred in the 99 year, the ruins, for the 60/40 allocation, occurred as early as 20 years. Obviously, if one wanted to have a define benefit plan that would survive rather than face ruin, the all bond allocation is a better option.

While a first thought might be that we could avoid these cases of ruin by adjusting the contribution level, it was obvious to me when I was looking at the resulting extremely large contribution levels, that that would also cause the employer to want to terminate the plan. For example, the plan sponsor might be willing to vary the contribution to be normal cost plus 10 year amortization of the unfunded liability but only as long as the contribution level stayed below 15% of pay. Using that as the new definition of ruin, over 61% of the trials hit ruin over the forecast with the 60/40 allocation.

Although the method for determining contribution levels may be the actual way plan sponsor's determine contribution levels, this may not be a good scientific test because there are several moving variables: the contribution rate, the starting asset value, and the asset allocation. A better scientific test is to keep the contribution rate and the starting asset value constant and just move the asset allocation. Therefore, I set the contribution rate to 8.5%, used the larger starting asset value, and tested both of these allocations again. I also considered a 100% stock allocation for good measure. The results were as follows:

Table 2

Year	Number of "Ruins" in 1,000 trials									
	<u>10</u>	<u>20</u>	<u>30</u>	<u>40</u>	<u>50</u>	<u>60</u>	<u>70</u>	<u>80</u>	<u>90</u>	<u>100</u>
<u>8.5% of pay contributions</u>										
All stock	0	0	3	8	10	12	12	12	13	14
All bonds	0	0	0	0	0	0	0	0	0	1
60/40	0	0	0	2	5	6	7	7	7	9

Even with the same larger contribution level, the allocations to stocks caused more ruins than the all bond allocation.

To complete this, I decided to test what the contribution level would need to be to have only 1 ruin in the 100 year forecast with the 60/40 allocation. The resulting contribution level was between 9.5% and 10%.

Choice Reflecting Risk

Therefore, our choice seems to be:

- Large stock allocations with apparent lower contributions but with periods of defined benefit plans going into ruin,
- Large bond allocations (or other lower risk options) with stable higher contributions and solvent plans, or
- Large stock allocations with even higher contributions (but still with periods of underfunding on a termination basis).

For the sake of the long term solvency of pension plans, and despite the current unpopularity, I choose to speak highly of the natural asset liability match between bonds and pension benefits. I also choose to speak out against funding, accounting, and “ongoing” liability measures that promote the use of stocks by reflecting the increase returns but not the risk of stocks. I hope others will invest more time into learning financial economics or otherwise consider the cost of risk, by perhaps measuring the probability of ruin, before making a choice on how they should speak out.