The Asset Return – Funding Cost Paradox: Some Simple, But Unpleasant Math

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Abstract

This paper shows that a defined benefit pension plan following an immunized fixed income strategy can have lower long-term funding costs than if it were to follow an equity-based investment strategy. This is true even if stocks outperform bonds over the relevant time horizon. Current liability payments for an underfunded plan raise the required investment hurdle rate needed to maintain a constant funding level. Therefore, an underfunded pension plan betting on equities needs to earn a higher return than an immunized pension plan at a higher funding status to not further fall behind. Since funding gaps for equity-based investment strategies usually arise under unfavorable business conditions, companies may be unable or unwilling to immediately close them. This leads to a persistence of underfunding, thus causing above average returns during a stock market recovery to accrue to an insufficient asset base. Lower long-term funding costs due to higher stock market returns can only be assumed if plan sponsors close arising funding gaps as soon as possible.

"*My message is simple: Almost every corporate pension fund should be entirely in fixed dollar investments.*"
Fischer Black [2]

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[2] Black's conclusion, however, stems from an entirely different line of argument than the one put forth in this paper. He invokes the argument of tax arbitrage since different asset types are taxed differently inside and outside a pension plan. A similar claim was made by Irwin Tepper in 1981 who also calls for a full funding policy.

Introduction

Why would a defined benefit (DB) pension plan adopt a Liability Driven Investment (LDI) strategy when equities are expected to outperform bonds over long periods of time? While acknowledging LDI's beneficial effects of reduced funding status and contribution volatility, pension professionals often equate the lower return potential of fixed income assets with higher funding costs and thus refrain from adopting it. However, the conversion of an equity risk premium into lower long term funding costs hinges on certain assumptions that are seldom spelled out and often violated in practice. Consequently, the perception of lower long term funding costs for equity-based DB pension funds may turn out to be a long held myth within the pension fund industry. Contrary to conventional wisdom, LDI based strategies can be a cost effective way of managing DB pension plans. Most surprisingly, they can have lower long term funding costs than equity based investment strategies, even if equities outperform traditional fixed income instruments over the relevant time horizon. As it turns out, maximizing asset returns and minimizing funding costs are not the same.

Required Return on Pension Assets to Maintain Funding Status

It has long been known that, loosely speaking, pension plans need to earn their discounting rate on their assets in order to be able to fulfill future liability payments. This statement, however, is in need of some refinement as it only applies for pension plans with a funding status of 100% or more. Under funded plans that earn their discounting rate (or less) will increase their funding deficit in the next period.

In order to determine the investment hurdle rate *i* that is required to preserve a given funding status FS, let us denote asset values in t and t+1 with AV_t and AV_{t+1}, and the present value of liabilities with PV_t and PV_{t+1}. With a liability payment of LP_t at the end of period *t*, next period's asset value AV_{t+1} is determined as

$$AV_{t+1} = PV_{t+1} \text{ x } FS = (PV_t \text{ x } FS - LP_t) \text{ x } (1+i).$$

Solving for *i* then yields

$$i = \frac{PV_{t+1} \text{ x } FS}{PV_t \text{ x } FS - LP_t} - 1. \qquad (1)$$

Equation (1) shows that ongoing liability payments for under funded plans increase the investment hurdle rate *i* that assets have to earn to only maintain a plan's funding status.[3] Similarly, over funded plans need to earn less than their discounting rate to preserve funding levels. In other words, funding levels tend to have a self-reinforcing tendency. Once a plan is severely under funded it needs to earn substantially more than its discounting rate to earn its way out of its funding deficit.

[3] Equation (1) was arrived by assuming that current liability payments were made at the beginning of the period, i.e., they were not earning a return during that period. For liability payments that are due at the end of the period, equation (1) should be rewritten as $i = (PV_{t+1} \text{ x } FS + LP_t)/(PV_t \text{ x } FS) - 1$. Calculated in this way, the hurdle rates for under funded plans are slightly lower, yet all qualitative conclusions remain the same. In reality, the return to maintain one's funding status falls somewhere half between the two hurdle rates since liability payments usually occur throughout the year.

Figure 1 shows the non-linear increase in the hurdle rate for six actual pension plans as their funding levels decline. It is obvious that for severely under funded plans with large cash outflows, these hurdle rates may well exceed what can reasonably be expected from broad based equity returns.

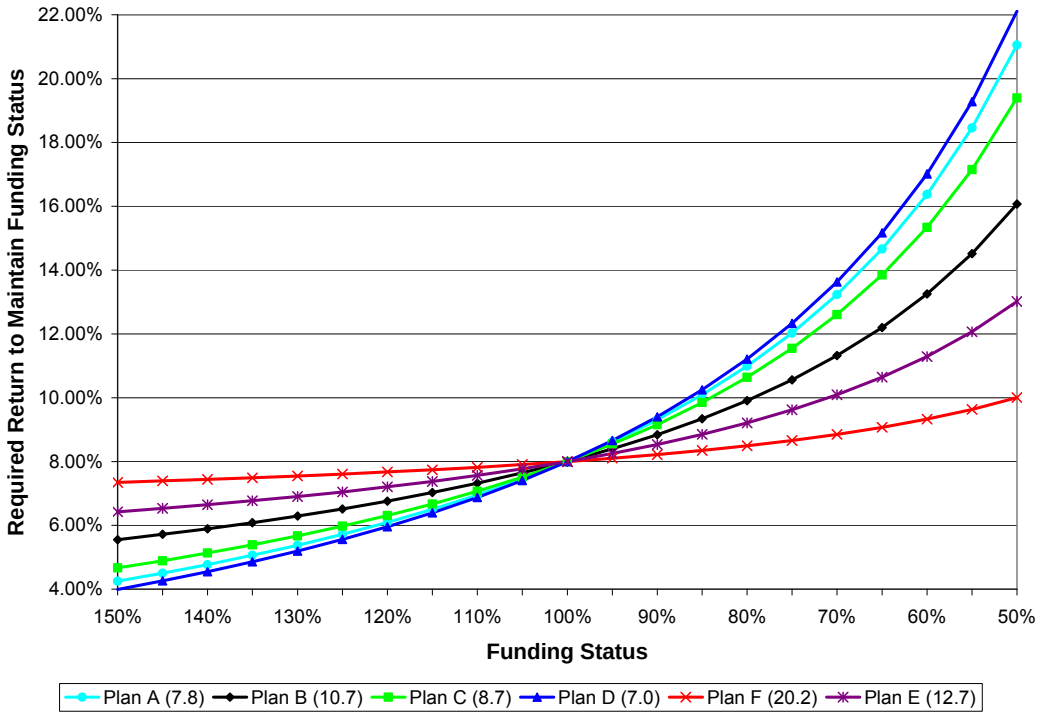

Figure 1: Required asset returns to maintain funding status as a function of initial funding status for six DB pension plans with different liability structures (See appendix). Numbers in parentheses show the plan's modified adjusted durations for an assumed discounting rate of 8%.

The slope of these curves is determined by the size of the next liability payment in relation to the total present value of liabilities. If no liabilities are to be paid out next period, the curves turn out to be flat. As a pension plan matures, current liability payouts tend to increase in proportion to the present value of all liabilities, and the curve steepens. [4] As a rule of thumb, the smaller a plan's duration, the higher the required excess return over the discounting rate to simply maintain a funding level below 100%.

[4] Zion and Carcache (2005) surmised that the higher the benefits paid as a percentage of the pension obligation, the shorter the duration of pension obligations and vice versa. They were looking from an external analyst's point of view, noting that information about duration and maturity about a company's pension plan is generally not disclosed in the annual report. Thus, they constructed the ratio of benefits paid and projected pension obligations to serve as a duration or maturity proxy. Equation (1) provides the mathematical justification why their suggestion makes sense.

The Asset Return – Funding Cost Paradox: The Case for LDI

Anyone who claims that an eventual equity risk premium automatically translates into lower funding costs simply ignores one of the following two conditions: A DB pension plan should either be, on average, fully funded, or should have no current liability payouts. Since the latter is never fulfilled over a plan's lifetime, one needs to focus on average funding levels when gauging funding costs of alternative investments strategies. Every time a pension plan finds itself underfunded, the link between higher equity returns and lower funding costs is weakened and may finally break down over time. Since LDI strategies are designed to lower funding status volatility, the primary reason for them to be cost effective is their ability to avoid large funding deficits. This capability gives rise to the ***Asset Return − Funding Cost Paradox***: Over any given investment horizon, lower yielding LDI strategies can be more cost effective than higher yielding equity based investment strategies.

A Numerical Example

A numerical example may illustrate the Asset Return − Funding Cost Paradox more clearly. Assume a simple pension plan with liability payments of $25 million, $100 million, and $25 million, payable at the end of years 1, 2, and 3. Furthermore, assume that bonds earn a constant annualized return of 6% over this period, while stocks outperform bonds with an average annualized return of 8%.

Scenario 1 in table 1 depicts the case if a pension plan invests in a bond based LDI strategy and uses a discounting rate of 6%. Since we model an LDI portfolio, we can assume that all period returns are identical.[5] To fully fund its future liabilities, the pension plan needs $133.58 million in current assets. Scenario 2 shows a plan that invests in stocks and thus uses a higher discounting rate of 8%. If all period returns equal the discounting rate, this pension plan would only need $128.78 million in assets to fund its future liabilities.

[5] Note that it is reasonable to assume a constant return sequence for bonds since this is a way of modeling perfect immunization. Even if bond returns fluctuate, an immunized bond portfolio is constructed such that discounting rates and bond returns are highly correlated. The same cannot be said for equity based investment strategies as the correlation of stock and bond returns is usually low and varies widely over time and across countries (Li 1999).

Table 1: Example for the Asset Return-Funding Cost Paradox.

Year	Return	Liability payment ($ million)	End of year asset value ($ million)	End of year funding status
Bonds: 6% annualized rate of return				
Scenario 1 : Return sequence of 6%, 6%, and 6%				
0			**133.58**	100.0 %
1	6 %	25.00	116.59	100.0 %
2	6 %	100.00	23.58	100.0 %
3	6 %	25.00	**0.00**	N/A
Stocks: 8% annualized rates of return				
Scenario 2 : Return sequence of 8%, 8%, and 8%				
0			**128.73**	100.0 %
1	8 %	25.00	114.03	100.0 %
2	8 %	100.00	23.15	100.0 %
3	8 %	25.00	**0.00**	N/A
Scenario 3 : Return sequence of 10%, 10%, and 4%				
0			**128.73**	100.0 %
1	10 %	25.00	116.60	102.3 %
2	10 %	100.00	28.26	122.1 %
3	10 %	25.00	**+4.39**	N/A
Scenario 4a : Return sequence of 4%, 4%, and 16%				
0			**128.73**	100.0 %
1	4 %	25.00	108.88	95.5 %
2	4 %	100.00	13.23	57.2 %
3	16 %	25.00	**– 9.59**	N/A
Scenario 4b : Return sequence of 4%, 4%, and 16%				
0			**133.58**	103.8 %
1	4 %	25.00	113.92	99.9 %
2	4 %	100.00	18.47	79.8 %
3	16 %	25.00	**– 3.57**	N/A

It seems that most plan sponsors have scenarios 1 and 2 in mind when thinking about investment returns and funding costs. Earning an overall total return of 8% for stocks, however, can be achieved along different paths. Scenarios 3 and 4 abandon the assumption of constant stock returns and assume two different return sequences which both have the same annualized rate of return of 8%. Scenario 3 assumes two initial years with above average returns followed by a year with below average returns. Even though the annualized return is also 8%, the plan sponsor would enjoy a final funding surplus of $4.39 million. The return sequence of 4%, 4%, and 16% from scenario 4a, on the other hand, would also results in an overall annualized rate of return of 8%, yet the plan sponsors would have to fill a final funding deficit of $9.59 million. The temporary underfunding of the pension plan raises the required asset return to close the funding gap far above the realized 16% in the final period.

In order to directly compare the funding costs of the two investment strategies, scenario 4a starts over funded with the same initial asset value than our LDI strategy. The specific return sequence still leads to a final funding gap of $3.57 million, which clearly shows that an equity strategy with higher overall rates of return over the same time horizon can incur higher funding costs than a lower yielding LDI strategy.

Scenario 3 and 4a demonstrate that there are path dependencies in funding costs if yearly asset returns deviate from the discounting rate. Having to act in volatile asset markets completely changes the investment world for DB managers. No longer is it correct to simply base ones expected long term funding costs on the expected average asset returns. Overall funding costs are dependent on the specific paths with which the average returns are achieved.

There is Nothing New: It's Reverse Dollar Cost Averaging

Is there anything new or surprising in the previous paragraphs? There shouldn't be. Investment professionals have long known the beneficial effects of dollar cost averaging for saving plans. By investing fixed dollar amounts in volatile markets over longer periods of time, the average costs of shares is always lower than their average price.

Financial advisers and retirement planners have also recognized that the opposite effect applies to individual retirees in the drawdown period. Pensioners that follow a fixed schedule of withdrawals from their nest egg are disproportionally hit by market downturns as subsequent market rises are begun with severely depleted balances. In the long run, these retirees will get less out of their investments than historical rates of return suggest and their retirement funds can be depleted earlier than expected. This is known by retirement planners as reverse dollar cost averaging.

DB pension plan managers seem to have escaped the realization that their pension plans with fixed liability schedules face the same economic situation than individual retirees withdrawing from their 401(k) balances. The sale of assets at low prices becomes a permanent loss for an individual retiree and a DB pension plan alike. While individuals may alter their withdrawal plans to dampen the negative effects of reverse dollar cost averaging, underfunded DB pension plans do not have the option of changing their liability payouts and are forced to keep spending at what Arnott (2004) calls an unsustainable rate.

Instead of acknowledging that their DB pension plans are hybrids of accumulation and distribution portfolios at the same time—and frozen plans are pure distribution portfolios—DB pension professionals often argue in the context of accumulation portfolios only. They refer to the long investment horizon that would allow them to capture the equity risk premium. But what is true for the 401(k) plan of an employee retiring in 25 years does not hold for DB pension plans. Ongoing liability payments make them vulnerable to fluctuating asset returns and drive a wedge between average asset returns and overall funding costs. In the DB pension world, maximizing asset returns does not mean minimizing funding costs.

The Asset Return – Funding Cost Paradox: Possibility or Reality?

Of course, one wonders how often the Asset Return – Funding Cost Paradox materializes in the real world. Unfortunately, legal, accounting, and economic realities all seem to nudge the average funding status of DB pension plans below 100%.

For instance, large funding gaps for equity based investment strategies usually occur in times when companies are least able to close them immediately. Asset and liability smoothing not only mask the true economic funding status of pension plans, they tend to make funding gaps persistent. Eventual above average returns following a bear market then systematically accrue to a deteriorated asset base while current liability payments still need to be paid out in full. Therefore, pension plans that invest in assets which are uncorrelated with their liabilities should prepare for a perfect storm of negative equity returns and falling interest rates. Yet the current tax code discourages plan sponsors to create necessary funding cushions in good times.

All these reasons seem to lead to a situation in which the funding levels during the life time of a pension fund are most likely not symmetrically distributed around 100%. They are more likely to be skewed with mean and median funding levels below full funding status. The funding levels of immunized pension plans, on the other hand, are often tightly clustered around 100%. This likely difference in average funding levels is the reason LDI investment strategies may turn out to be more cost effective than other asset-based investment strategies.

Do empirical data support these suppositions? The results of a 2008 survey conducted by PLANSPONSOR and RiverSource Investments raise several red flags. Not only do the reported asset and liability mismatches indicate a low adoption rate of LDI strategies, about three quarters of the 159 survey respondents admitted that their average funding levels over the last ten years (!) were below 100%. More than 60% of plan sponsors said that they smoothed asset and liability values, which in turn implies that their true economic funding levels were most likely even worse than reported. It came as no surprise that non-corporate plan sponsors reported significantly higher liability durations, a higher degree of asset and liability mismatches, more aggressive discounting rates, and a higher use of asset and liability smoothing. 36% of non-corporate plans were less than 80% funded over the last ten years compared to only 8% of the corporate survey respondents. Yet the economic mechanisms that determine long term funding costs apply for corporate and non-corporate DB plans alike, independent of the accounting rules they use. By resisting mark to market accounting for their assets and liabilities, pension plans gamble away the possibility of lower funding costs as it allows them to stay economically underfunded for longer periods of time. It is not hard to predict that many of the public pension plans (along with some airline pension plans) will turn out to be among the most expensive in the country.

Concluding Remarks

The lower return potential of fixed income assets is often cited as one of the main obstacles that prevent many DB pension plans from adopting LDI strategies. Certainly, the existence of an equity risk premium implies a possible return-volatility trade-off in the DB pension world. Yet by allowing themselves to be under funded for extended periods of time, many plan sponsors with equity based investment strategies have contributed to making that trade-off irrelevant. We have shown that maximizing asset returns and minimizing funding costs are two different objectives in the DB pension world.

In contrast to equity based investment strategies, LDI strategies are designed to limit funding status volatility and to avoid large funding deficits. They can solve the Asset Return - Funding Cost Paradox which can arise due to ongoing liability payments. Hence, DB pension plans following LDI strategies may enjoy reduced contribution volatility while, at the same time, having lower long term funding costs than many of their equity focused peers. In other words, they can have their cake and eat it too.

Appendix: Liability Structures of Six Actual Defined Benefit Pension Plans

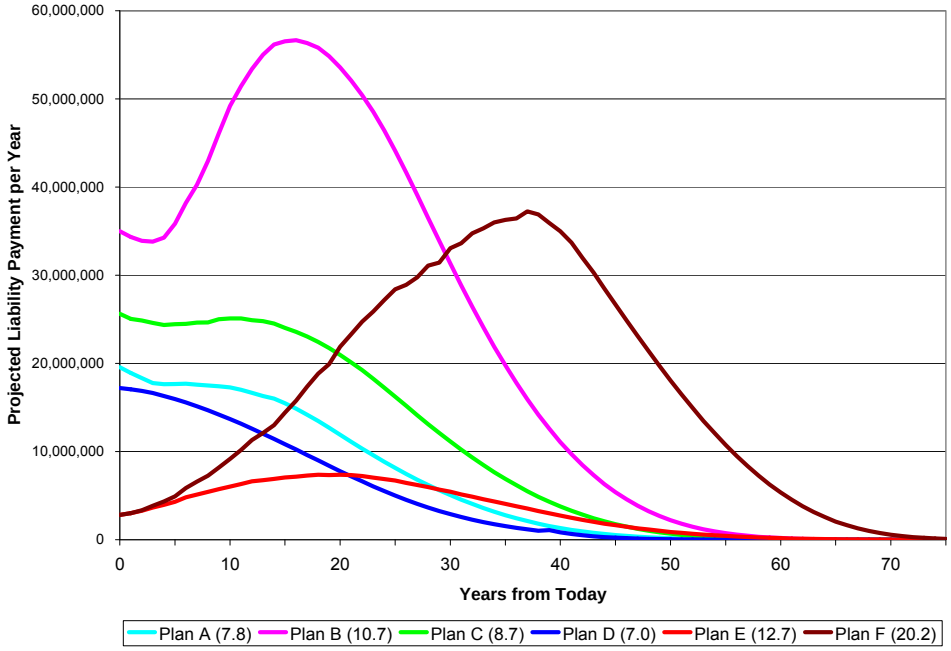

Figure 2: Liability structures of 6 actual DB pension plans. Numbers in parentheses show the modified adjusted durations for an assumed discounting rate of 8%.

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