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Dead on Time or Late Again?

Does mortality really matter for Pension Plan Valuations?

by Gene Kalwarski and Peter Hardcastle

Editor's Note: The editor attended Gene Kalwarski's presentation at the 2001 Enrolled Actuaries Meeting at which the effect of improving mortality was compared to other sources of gain and loss, namely rates of return, payroll inflation and award of cost of living increases. That study used the Social Security Administration's mortality improvement assumptions. This article extends this work to examine the impact of updating mortality tables from those used recently to the latest draft mortality study recently published by the Society of Actuaries.

Introduction:

The crises with Social Security systems around the world rest, to a large degree, on a declining support ratio, partly the result of improvements in mortality. For a 'pay as you go' (PAYGO) system mortality improvement projections are critically important. To test and measure the sensitivities, the U.S. Social Security Administration produces low, intermediate and high solvency projections using different mortality assumptions. It is noteworthy that all three solvency projections use improving mortality tables. This contrasts with what we see for actuarial funding valuations, where the use of year-by-year improvements in mortality is not common, and the mortality tables in everyday use are often those developed for more than a decade ago.

At the 2001 EA meeting Milliman compared the baseline of the current year SSA mortality table with the three projected mortality tables to test whether allowing for mortality improvement had a material impact on the results of a valuation. The methodology used (which we continue to follow in this article) was to look at three populations (young, mature and old) valued under the aggregate funding method at various levels of plan funding. We summarize the methodology at the end of this article.

The conclusions from the EA meeting work were as follows:

- The better funded a system is the less sensitive or noticeable mortality losses are, as annual asset gains become increasingly larger, relatively speaking.
- The impact of improving mortality increases:
- The younger the participants are
- The longer the delay to a change in the mortality table, reflecting increased longevity.
- The impact is usually less significant than economic factors besides investment returns, (payroll inflation, cost of living increases)
- Nevertheless it is prudent to anticipate changes in mortality
- External factors also add pressure for change (plan option factors, public disclosure, etc.)

At the EA meeting these conclusions were drawn from a baseline of the mortality rates used by Social Security for the current year. Since many pension plans are using mortality tables developed for the 1980s and 1990s this paper investigated if the conclusions still hold true with an outdated mortality table. For this purpose we will examine the effect on our valuations of assuming that population mortality is in accordance with the recent RP2000 tables with cohort projection (as published by the Society of Actuaries in July 2000) while the valuation mortality is one of the following tables:

- UP 84 minus two years
- GAM 71
- RPA (GAM 83)
- UP 94
- UP 94 with cohort projection

Analysis:

We studied this issue in both static and dynamic terms. Our static analysis compares the relative difference in liabilities between various tables, for a typical plan[1] with a young, mature, and old population.[2] We then compare those differences to differences that would result with various differences between salary increase assumptions and discount rates. This type of analysis (present value based), while enlightening as far as the long term impact, does not reveal what may happen year to year, as the gradual mortality improvements get recognized in the annual valuation process. So finally, utilizing forecast valuations, we further examine the mortality improvement impact dynamically, in terms of emerging gains and losses that would occur from using out-dated tables, and compare these to corresponding annual gains or losses in pay increases and actual investment returns, with different levels of funding (assets to liabilities)

1. *Static Analysis: Impact on the present value of future benefits by plan maturity*

The table on page 24 shows the value of the PVB for our three sample populations valued using the various mortality tables.

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[1] The plan is salary related, with a five-year final average earnings formula and no integration. Also, to magnify the potential mortality impact for this analysis, it is further assumed that there is a 3% automatic annual post retirement pension increase for all retirees.

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	INDEX OF PRESENT VALUE OF FUTURE BENEFITS		
	Young	Mature	Old
RP2000	1,000	1,000	1,000
UP 84-2	950	958	964
GAM71	948	947	946
RPA	1,004	1,009	1,011
UP 94	987	979	968
UP 94 Projected	1,055	1,038	1,026

The above table shows that the maximum error in the PVB is about 5.5%. Also, the variation is greatest for the young population with the exception of GAM71 and the unprojected UP 94 table. But there are other potential sources of gain (loss) in a funded system, for example the rate of return achieved on plan assets. We can change the valuation interest rate to equate the above PVBs and then consider how material is the difference.

	EQUIVALENT RETURN ASSUMPTION		
	Young	Mature	Old
RP2000	8.00%	8.00%	8.00%
UP 84-2	7.79%	7.73%	7.66%
GAM71	7.78%	7.65%	7.48%
RPA	8.02%	8.05%	8.10%
UP 94	7.95%	7.86%	7.71%
UP 94 Projected	8.21%	8.23%	8.23%

Judging from the experience of pension plans over the last 40 years, the above differences in return assumption are all well within an acceptable range. Alternately, the pay increase assumption could be changed.

	EQUIVALENT PAY INCREASE ASSUMPTION		
	Young	Mature	Old
RP2000	5.00%	5.00%	5.00%
UP 84-2	5.34%	5.53%	6.18%
GAM71	5.35%	5.67%	6.75%
RPA	4.97%	4.89%	4.65%
UP 94	5.08%	5.26%	6.01%
UP 94 Projected	4.65%	4.54%	4.18%

[2] The populations have the following characteristics:

	Young	Mature	Old
Active Average Age	36	46	55
Active Average Past Service	8	13	17
Proportion of PVB for Actives	80%	60%	40%

The table on page 24 shows that for the young and mature sample populations the differences in the pay increase assumptions required to equate the PVBs is well within the range of experience of pension plans over the last 40 years. However, because of the leverage effect of the inactive population, the old sample population shows significantly larger pay increases are needed to equate PVBs.

2. Dynamic Analysis: Impact in terms of annual emergence of gains and losses

While the static analysis gives some insight into the relationships between the mortality tables, using the "wrong" assumption from one valuation to the next results in a stream of experience gains and/or losses as the actual population dies quicker or slower than the assumption. The old tables are not uniformly heavier or lighter than RP2000 so the incidence of gains and losses depends to some extent on the make-up of the population as well as the assumption. The following table measures the present value of the gain (loss) that will emerge over the first five years after the valuation as a percentage of the liability booked at that valuation using each mortality table.

	GAIN (LOSS) ARISING IN NEXT FIVE YEARS		
	Young	Mature	Old
RP2000	0.00%	0.00%	0.00%
UP 84-2	1.04%	-0.30%	-0.68%
GAM71	-0.89%	-1.19%	-1.44%
RPA	0.53%	31.00%	26.00%
UP 94	-1.92%	-1.52%	-1.62%
UP 94 Projected	0.49%	0.28%	0.24%

In every case the error emerging over the five years following the valuation is less than 2% of the liability. Again these differences are small compared to the error observed between the return on typical actuarially smoothed valuations of assets and the valuation interest rate. Of course, the impact of error in the interest rate assumption depends on the level of funding. For a poorly funded system the impact is less than for a well funded system. To examine this we looked at the mature population and assumed that the fund's assets were equal to 40% (poorly funded), 60% (intermediate), 80% (well funded) and 100% (extremely well funded) of the present value of future benefits, as measured on the RP2000 assumptions. We then assumed that returns averaged 9% over the next five years rather than the valuation rate of 8% and computed the gains that would emerge from the investment experience so that we can compare these with the gains and losses in the table above. The ratio of the investment gain to the absolute mortality gain / loss is shown below.

	Importance of 1% p.a. Asset Gain to Mortality Experience			
	Poorly Funded	Intermediate	Well Funded	Extremely Well Funded
RP2000	N/A	N/A	N/A	N/A
UP 84-2	570%	850%	1130%	1420%
GAM71	140%	220%	290%	360%
RPA	520%	780%	1050%	1310%
UP 94	110%	160%	220%	270%
UP 94 Projected	560%	840%	1110%	1390%

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Our final comparison is to look at the cost of switching to the correct mortality table after five years. This is of itself a static projection but with a five-year delay.

	INDEX OF PRESENT VALUE OF FUTURE BENEFITS (2005)		
	Young	Mature	Old
RP2000	1,000	1,000	1,000
UP 84-2	945	951	955
GAM71	944	938	933
RPA	1,005	1,010	1,013
UP 94	987	976	962
UP 94 Projected	1,058	1,044	1,033

The point of this table is to compare it to the earlier table, so that we can see if delaying the switch in the mortality assumption might cause a bigger shock to the fund when the change is made. Thus the final table is the ratio of the above table to the first table, which represents the incremental impact of delaying the update.

	INDEX OF PRESENT VALUE OF FUTURE BENEFITS (2005)		
	Young	Mature	Old
RP2000	0.00%	0.00%	0.00%
UP 84-2	0.48%	0.78%	0.97%
GAM71	0.41%	0.94%	1.42%
RPA	-0.06%	-0.07%	-0.21%
UP 94	-0.01%	0.29%	0.67%
UP 94 Projected	-0.32%	-0.60%	-0.64%

As can be seen, delaying the update does not automatically result in a larger impact to the plan.

Conclusions:

The conclusions presented at the EA meeting are largely supported by this analysis.

- The better funded a system is the less sensitive or noticeable mortality losses are, as annual asset gains become increasingly larger, relatively speaking.
- The impact is less significant than economic factors besides investment returns, (payroll inflation, cost of living increases)

We also continue to believe that it is prudent to anticipate changes in mortality and that a move to a cohort projected mortality table should be considered. The assumptions we use in our valuations should be "best estimates" after all.

We leave you with a caveat. The above analysis assumes that the mortality will exactly follow the RP2000 table with projection. As we know experience rarely follows assumptions exactly. Therefore one result that the reader should not necessarily draw is that UP94 will give rise to mortality gains. Indeed, the committee involved with constructing the table has noted that significant differences in mortality exist between white and blue collar sub-populations, which would indicate a heavier table than RP2000 is required for some plans.

So, does mortality really matter for pension plan valuations? Yes; but not as much as we actuaries might like to think.

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