SOCIETY OF ACTUARIES

Article from:

The Pension Forum

August 2001 – Volume 13 – Issue 1

The Pension

Forum

Volume 13, Number 1 July 2001

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A Look at Dynamic Pension Plan Valuations

by Chris Clark

Abstract: This paper discusses the usage of dynamic (i.e. open group) pension plan valuation in the current and possible future regulatory environment. Attention is initially given to various technical formulae and different theoretical approaches that may be used to perform this type of valuation in a reasonable and appropriate manner. Further discussion entails key assumptions for this methodology, as well as, assumption sensitivity, and reasonable bases for determining appropriate distributions for the number of new entrants (annually) and the age distribution of said new entrants. Usage of this type of valuation within the framework of the regulatory environment of the United States is reviewed and potential challenges associated with the use of dynamic valuation are also evaluated. The primary intent of this paper is to foster further discussion on this topic.

I. Introduction

This paper will proceed to discuss the following concepts related to dynamic pension plan valuation: various approaches to dynamic valuation; key assumption determination and sensitivity of said assumptions; uses of dynamic pension plan valuation in the current business environment; problems associated with dynamic pension plan valuation; and dealing with said problems. In Section II, effort will be made to show that performing a dynamic pension plan valuation is computationally viable with only minimal formulaic effort. Section III will emphasize the level of care that must be exercised in selecting new entrant assumptions, as well as, the sensitivity of plan costs to changes in new entrant assumptions. Section IV will then entail the value of the information provided by a dynamic pension plan valuation for a wide variety of applications and for a variety of layperson audiences. Lastly, Section V will discuss some of the more significant issues to be dealt with when performing a dynamic valuation. Additionally, Section V will attempt to show that, like most cost methods, the difficulties of the dynamic pension plan valuation approach can be overcome by exercising care in assumption selection and method application. Throughout, the basic purpose of this paper is to encourage additional discussion on the topic of using forecast-inclusive valuation methods.

II. Various Approaches to Dynamic Pension Plan Valuation

A. Background on Dynamic Pension Plan Valuation

As stated by Mr. Donald R. Fleischer, “the forecast valuation method is not a new concept for pension actuaries” [1, “The Forecast Valuation Method for Pension Plans”, Fleischer, TSA XXVII, 93]. Indeed suggestions for a formalized methodology have included: population projections with traditional cost methods evaluating plan liabilities on future, hypothetical valuation dates; complex, ongoing, open group valuations designed to maintain contributions as a level percent of payroll; and projections that are open group for a pre-determined period of time and then moved to a closed group analysis with a variety of spread-cost measures to mention but a few. Additionally, the United

States' Social Security system has, of course, utilized population projections from the beginning while, the PBGC currently has a "stochastic dynamic micro-simulation model" called PIMS (Pension Insurance Modeling System) that is used to "forecast and analyze [the] financial position of [the] PBGC and its insured plan sponsors" [2, "Computer Models for Retirement Policy," Anderson, SOA handout from the 2000 Spring Meeting – Las Vegas, 44]. Regardless of the many variations that have been considered in formal papers (and the unknown number of other, unique projections that have been utilized and/or developed at a client's request), the reality remains that the current regulatory environment has made forecast-inclusive methods unpopular by restricting their usage for purposes of funding and FASB valuations. As such, the following analysis of dynamic pension plan valuation will attempt to highlight the value of using a forecast-inclusive valuation method and, will discuss the uses for which such a method is best suited.

B. Formulae for Dynamic Pension Plan Valuation

While the concept of dynamic—or open group—valuation is certainly nothing new to the pension world, its typical usage has long been "to inform an employer about the future costs, funding obligations, and cash flow of the pension plan" [3, *Fundamentals of Private Pensions*–Seventh Edition, McGill et al, University of Pennsylvania Press, 500]. The value of such information to company management and stakeholders is obvious. Unfortunately, the current business environment does not generally lend itself to extensive usage of or even frequent requests for, such information. While much of this is readily explainable, the 'why' questions will be set aside temporarily to first discuss the intriguing question of 'how'.

The basic premise of this approach to dynamic pension plan valuation is to project expected PVFB for new entrants utilizing distributions for age of the new entrants and the number of new entrants annually. As use of a salary distribution versus an expected salary does not affect the results of the expected PVFB calculation; an expected salary is utilized to simplify the calculations.

$$PVFB_j = \int v^t * {}_tp_x^{(t)} * [AS_{j,x}] * \left(\left\{ \sum_{w=t-2}^{t} S_{x+w} \right\} \Big/ \{3 * S_x\} \right) * \%^{(s)} * [k_j + t] * [m_{x+t}^{(r)} * \%_{x+t}^{(r)} * \ddot{a}_{x+t}^{\{m\}} + m_{x+t}^{(d)} * \%_{x+t}^{(d)} * \ddot{a}_{y+t}^{\{m\}} + m_{x+t}^{(i)} * \%_{x+t}^{(i)} * \ddot{a}_{x+t}^{(i-t)\{m\}} + m_{x+t}^{(w)} * \%_{x+t}^{(w)} * {}_{NRA-x-t}\ddot{a}_{x+t}^{\{m\}}] * dt$$

$$\text{Total PVFB} = \sum_{i=1}^{n} PVFB_j$$

Key: $\%_{x+t}^{(r)}$ - percent of accrued, projected benefit paid immediately for early or normal retirement at age x + t (i.e. early retirement factors applied w/ factor at and beyond normal retirement age equal to 1)

$\%_{x+t}^{(d)}$ - percent of accrued, projected benefit paid immediately to beneficiary for death at age x + t (ex.: 50%* factor to convert from a single life annuity to a 50% joint-and-survivor annuity)

$\%_{x+t}^{(i)}$ - percent of accrued, projected benefit paid immediately for disability retirement at age x + t (frequently 1)

$\%_{x+t}^{(w)}$ - percent of accrued, projected benefit paid at normal retirement for withdrawal at age x + t

$\%^{(s)}$ - percent of salary used in calculation of accrued, projected benefit

${}_t p_x^{(t)}$ - aggregate probability of remaining active in the pension plan from age x to age x + t where the mortality decrement is viewed from a pre-retirement and pre-disability perspective

$\&\&_{x+t}^{(i-t)\{m\}}$ - single life annuity where the mortality decrement utilized is viewed from a post-disabled perspective

$\&\&_{x+t}^{\{m\}}$ - single life annuity for non-disabled retirees; x + t representing the participant's age and y + t representing the spouse's age

$AS_{j,x}$ - annual salary at age x for participant j

S_{x+w} - salary scale factor for age x + w

$$[AS_{j,x}]^* \left(\left\{ \sum_{w=t-2}^{t} S_{x+w} \right\} \Big/ \{3 * S_x\} \right) * \%^{(s)} * \left[k_j + t \right]$$

- this is the example used for calculating the accrued, projected benefit at age x + t. Obviously, this example is for a three-year final average salary plan for a participant that is not within three years of retirement.

n - total number of participants in the plan being evaluated

k_j - years of service for participant j

New Entrant information:

n_e - number of new entrants to the plan annually

f(n_e) - distribution of number of new entrants to the plan annually (zero inclusive); ultimate only

$f^{SU}(n_e)$ - distribution of number of new entrants to the plan annually (zero inclusive); select-and-ultimate

E(n_e) - expected number of new entrants to the plan annually

$PVFB_e$ - present value of future benefits for all new entrants to the plan; for this example, this should be the same as with (annual salary) replaced by (expected average new entrant salary), initialized to zero, and the formula valued against a distribution of new entrant ages

z - evaluation period for new entrants (typically one year)

x_e - new entrant age

f(x_e) - distribution of new entrant ages; ultimate only

$f^{SU}(x_e)$ - distribution of new entrant ages; select-and-ultimate

$$PVFB_{x_e} = PVFB_j * ES_{j,x} / AS_{j,x}$$

$$PVFB_e = \int PVFB_{x_e} * f(x_e) * d_{x_e}$$

$$PVFB_e^{SU} = \int PVFB_{x_e} * f^{SU}(x_e) * d_{x_e}$$

(for ultimate only assumptions)
or

Revised Total PVFB = $\sum_{i=1}^{n} PVFB_j + \&_{z|} * \int PVFB_e * f(n_e) * d_{n_e}$

(for select-and-ultimate assumptions)

As you will note from the information shown above, the evaluation period variable, z, is listed as typically being set to one year. The primary reason for this is to coincide with the period for which contributions are being made on behalf of the funding of the plan. Of course, this means there will be one more type of participant migration on which to perform gain/loss analysis. However, the expected liability calculation should be more accurate if an aggregate cost method is used so that the effect of the new entrants on the PVFB is limited to the PVFNC portion of the PVFB = PVAL + PVFNC equation. By only including one year's worth of new entrants into the NC calculation, the expected liability equation of: ExpPVAL(t+1) = PVAL(t) + NC(t) - benefit payments (all interest adjusted to the following time of plan valuation) should more accurately reflect the actual PVAL(t+1). Thusly, a typical plan would no longer expect to see actuarial losses each year in which the actuarial assumptions happen to be completely accurate.

Unfortunately, use of the modified PVFB calculation from the preceding paragraph with either the Aggregate or FIL cost methods may lead to a temporarily biased funding evaluation. This is due to the increase in NC which will, generally, increase contributions to assets and, the fact that the aforementioned methods assume that PVAL is equal to assets or, assets plus some amortized UAL, respectively. If we assume that assets are initially equal to some "true" PVAL value for the plan then, when the value of the increase in the prior year's NC due to using this approach (as accumulated with interest earnings to the point of the current year's valuation) exceeds the "true" liability that the plan has accrued for new entrants during the prior year, the inherent assumption that plan assets equal PVAL will overstate the PVAL value for the current year. Of course, this is not a new challenge to using either the Aggregate or FIL cost methods. In fact, this issue is somewhat self-correcting in that overstating one year's PVAL value reduces the PVFNC for that same year and, therefore, the respective NC as well. Additionally, it should be noted that until full funding is reached, this effect is similar to that which would result from simply contributing more than the minimum required contribution each year.

However, due to the potential for even short-term abuse that this methodology might imply for companies seeking to lighten their tax burden, it is suggested that a further modification to the aggregate funding approach be considered. Under this revised methodology PVAL would be defined as the PVAL resulting from the one of the individual cost methods. Consequently, PVFNC would simply be the modified PVFB less the AL resulting from the individual cost method. This leaves us with the entire PV for expected future entrants consistently and appropriately included in the PVFNC.

As use of a dynamic pension plan valuation removes the bias towards actuarial losses that is inherent in traditional methods, this type of approach seems to be theoretically preferable. Furthermore, this methodology has the value of producing results that represent a more realistic picture of plan liabilities. Therefore, it is particularly important to ensure that the assumptions unique to this type of approach are selected with care.

III. Key Assumptions Unique to Dynamic Valuations

Obviously, the distribution of new entrant ages, the expected average new entrant salary, and the distribution of the number of new entrants to the plan (annually) are the key assumptions that would not otherwise be dealt with in evaluating the liabilities of a defined benefit pension plan. Notably, "assumptions on the size of the work force can make a substantial difference in the long-range dollar costs of a pension plan" [4, "The Forecast Valuation Method for Pension Plans," Fleischer, TSA XXVII, 105]. Furthermore, "it is also necessary to picture accurately the characteristics of people who will enter the work force" [5, "The Forecast Valuation Method for Pension Plans," Fleischer, TSA XXVII, 105]. Therefore, it is crucial that the utmost care be taken to ensure that the assumptions be as accurate as possible for the period being evaluated. To this end, "it seems incumbent upon us [actuaries] to develop techniques that permit a best estimate regarding future participant group growth rates" [6, Discussion on "The Forecast Valuation Method for Pension Plans," Schnitzer, TSA XXVII, 130].

Some basic information regarding annual rates of new entrants is readily available from the age-service distributions prepared for Form 5500, however, detailed tables regarding annual entrant rates are not always so easily obtainable. This can lead to difficulties regarding what assumptions are reasonable for new entrants to plans connected with varying industries. To a lesser extent, this problem already exists in withdrawal tables. Currently, use of unnecessarily conservative withdrawal tables allows plans to load their valuation liabilities indirectly for new entrants. The option of a plan valuation method that specifically includes assumptions for new entrants would allow for (and hopefully, encourage the use of) more realistic assumptions throughout the plan valuation process. It may also lead to additional exhibits regarding gain/loss analysis by migration type for government forms filings.

When discussing how assumptions of this nature are to be determined, it seems clear that proper assumptions regarding new entrants should not be based solely on actuarial judgment. While studying a plan's experience involving new entrants is valuable, it provides little or no insight about the direction in which the employer/company may be headed. Beyond simple evaluation of current and expected hiring practices, changes to the business environment on a variety of levels (ex.: nationally, industry-wide, company specific, etc.) could have a dramatic impact on the company's hiring results. As such, utilizing select-and-ultimate new entrant projection rates would be preferable to ultimate only projection rates when projecting multiple years worth of new entrants. Of course, "a simple approach is to replace the deaths and terminations by employees of the same age while replacing retirements and allowing for expansion by introducing employees at selected younger ages" [7, "The Practical Application of Cash Flow Techniques to Pension Plans," Smith and Howe, CIA March 1974, 242]. Regardless, the plan sponsor's "management should assist the actuary in deciding on an appropriate set of assumptions" so that all information of relevance and significant value is fully considered when the assumptions are set [8, "The Forecast Valuation Method for Pension Plans," Fleischer, TSA XXVII, 95]. This does not mean to imply that actuarial techniques regarding population theory should be ignored. On the contrary, techniques for population projection are extremely useful when forecasting plan size. However, the subject of population theory is too extensive to include in this discussion.

IV. Uses of Dynamic Pension Plan Valuation

As previously stated, the current regulatory environment in the United States does not allow for the inclusion of expected new entrants in calculations for minimum required contributions, maximum tax-deductible contributions, or FASB 87/88 reporting. While this does limit the current potential for using dynamic pension plan valuation, it does not remove the value of the information provided by this type of valuation. Despite the regulatory restrictions, a wide variety of uses abound for the information provided by projecting pension valuation results.

As is obvious, a common reason for projecting pension valuation results is to provide information for budgetary planning purposes. Depending on the views of the plan sponsor, this may be restricted to simply projecting expected plan population characteristics and performing hypothetical funding and/or FASB valuations using traditional cost methods. However, the plan sponsor may be interested in utilizing dynamic pension plan valuation for:

- Projecting funding timelines and targets—such as funding for plan terminations and/or plan conversions;
- Evaluating the reasonability and practicality of funding goals—such as negotiated funding goals/ratios for collectively bargained plans or, the timing of plan terminations;
- Completing more detailed costs analyses on the effects of early-retirement windows, plan design changes, mergers/acquisitions, or other, miscellaneous possibilities (an example of which might be corporate restructuring for a single employer with multiple plans); or
- Simply in having a more realistic 'picture' of the effect of various contribution levels on expected plan liabilities and funding ratios—this is particularly important for company management, stakeholders, plan participants, and benefit guarantors. Additionally, this might best be accomplished by use of distributions instead of averages—regarding new entrant characteristics—when performing said valuation(s) and, if possible, stochastic simulation (or, more probably, by simply completing multiple projections with varying new entrant scenarios) to present a 'most probable' range of results for the various audiences. (Presumably, this should "do a better job" of providing a more realistic picture for the various audiences [9, Discussion on "Projections—How to Make Them and How to Use Them," Bronson, TSA II, 258].)

Furthermore, it is valuable to note that choosing to assume there will be no new entrants—as is done with traditional cost methods—is still a choice [10, Response to Discussion on "The Forecast Valuation Method for Pension Plans," Fleischer, TSA XXVII, 153].

It is the author's hope that, at some point in the future, some restricted version of a valuation method that allows for projecting new entrants might be considered acceptable for funding purposes by the Internal Revenue Service. The 'restricted' note is added in recognition of the sensitivity of the PVFB and normal cost results to new entrant

assumptions and consequently, the potential impact that changing normal cost would have on both the minimum required and the maximum tax-deductible contributions if such a method were summarily abused. For example, let us assume that we have approval for a method that allows us to define actuarial accrued liability as the accrued liability resulting from the Entry-Age Normal cost method. Further assume that normal cost for this method is defined as (PVFB - EANAL) / PVFS(alary) * (Total Salary of Participants Adjusted for New Entrants) with PVFB and PVFS having been calculated to include one year's worth of new entrants. (Realistically, the consideration of new entrants in the sum of the salary of participants would require one to take the present value of the projected new entrant salary for the coming plan year—a calculation in which timing considerations would be crucial.) Given the above situation, a change in the expected salary of new entrants would affect three portions of the normal cost calculation but, depending upon the selected salary scale assumption, might well affect the PVFB more significantly than the PVFS or the Adjusted Total Annual Salary. This would result in an increase in the normal cost portion of both the minimum required and maximum tax-deductible contributions. Assuming the plan in question is not fully funded, such a change would directly raise both contribution levels and offer the plan sponsor the opportunity to take a larger tax deduction than before.

As discussed in Section II, restricting the period for which new entrants are accounted for in performing the valuation is a simple and sensible method by which dynamic pension plan valuation can be utilized while making abuse of the new entrant component somewhat more difficult to hide. Certainly, there are a variety of other methods in existence by which sufficient restriction of the effect of new entrants on the calculations may be achieved—while maintaining a rational inclusion of new entrants in the valuation results—so as to provide the more realistic 'picture' of expected plans liabilities that was previously mentioned (and generally considered desirable). Furthermore, detailed discussion of these various methodologies is too extensive for inclusion in this brief paper. The key point is the same as noted by Mr. A. M. Niessen, "if a projection is to be more than just a very crude illustration, it should be prepared with great care, and should be as far as possible realistic" [11, "Projections—How to Make Them and How to Use Them," Niessen, TSA II, 237].

While the advent of modern computing technology certainly simplifies the mechanics of completing pension plan valuation projections, it does not remove the burden of (or need for) reasonable assumptions—both individually and in the aggregate. Careful tracking of and attention to gain/(loss) analysis on the plan immigration of new entrants will help to validate the accuracy of new entrant assumptions (an important factor given the sensitivity of plan cost estimates to new entrant assumptions). Regardless, there remain a number of issues that must be addressed before the use of dynamic pension plan valuation for funding purposes could be a realistic option.

V. Issues of Concern Associated with Dynamic Pension Plan Valuation

Dynamic pension plan valuation—much like the traditional cost methods—does have its challenges. First and foremost, is estimating the informational value to the plan sponsor of results from performing a hypothetical funding valuation using a dynamic pension plan valuation approach. This can be particularly challenging since the range of minimum required to maximum tax deductible contributions may not necessarily encompass the hypothetical contribution value from the dynamic pension plan valuation results. While this is all reasonably obvious, there are several important implications of the above information that should be separately considered.

Perhaps the most significant implication regards convincing a plan sponsor that the additional time and cost necessary to perform a valuation using a dynamic pension plan valuation approach for a specific plan is worthwhile given the value the resulting information carries for: the company's management, the company's stakeholders, the plan's participants, and the plan's benefit guarantors. The difficulty associated with showing that the information's value equates to or exceeds the value of the additional time and cost necessary to complete a dynamic pension plan valuation (beyond the standard, required valuation using currently available cost methods) will, of course, depend heavily on what the reasons for doing a dynamic pension plan valuation for the given plan happen to be. As discussed in Section IV, there are a variety of uses for the information from performing a dynamic pension plan valuation and not all will be valuable to all plan sponsors in all situations. Consequently, the informational needs of the individual plan sponsor need to be considered when discussing whether or not a dynamic pension plan valuation adds sufficient value to warrant the time and expense.

Another significant issue is whether or not reasonable accuracy can be achieved by utilizing selected assumptions for a single set of results. Projecting a probable range of results certainly has value (an excellent discussion of which is found in Mr. Robert J. Myers' paper entitled "Some Considerations in Pension Fund Valuation," TASA XLVI, 51-58). However, plan sponsors often prefer information to be provided on a 'most probable' basis, which a range of results does not—by itself—provide. In the author's opinion, the best set of results for a forecast-inclusive valuation method would include both a probable range of results and a separate set of 'most probable' results. Of course, time and cost are generally key determining factors as to whether or not the above would be practical to provide. Still a single set of 'most probable' results would seem to be preferable to both maintain consistency with typical valuation standards and to help simplify the "major problem facing all pension actuaries, namely, making the results understandable to non-actuaries" [12, Discussion on "Projections—How to Make Them and How to Use Them," Myers, TSA II, 254].

Further complicating the above issue is the ease with which a single assumption set may be manipulated to abuse the dynamic pension plan valuation methodology. In fact, given how sensitive valuation results can be to minor changes in key assumptions, it is

conceivable that a set of assumptions that utilize averages instead of distributions could significantly distort a single set of results. In attempts to both avoid abuse of the dynamic pension plan valuation methodology and to help ensure the use of reasonably accurate assumptions, the following suggestions are made:

1. Distributions should always be used for the assumptions regarding number of new entrants (annually) and ages of new entrants. As an example of the importance of using distributions, readers should consider the implications of the following quote: "In our current United States and Canadian practice, . . . the number of employees at relatively advanced ages but with short service is substantial. This occurs in part because of relatively high job mobility on this continent." [13, Discussion on "Projections—How to Make Them and How to Use Them," Stark, TSA II, 269]. Of particular note is the fact that Mr. Stark made this comment in 1950 and job mobility has risen significantly since then.

2. Gain/(loss) analysis should be performed separately for the new entrant portion of expected liability. Additionally, it is the author's opinion that if a form of dynamic pension plan valuation was to become an approved cost method for funding purposes, such gain/(loss) analysis should be required for annual Form 5500 disclosure. Given the additional time and expense that evaluating this additional disclosure would cost the IRS, this would seem a rather significant obstacle to be overcome before a broad-based forecast-inclusive valuation method would be generally accepted for funding purposes.

While the above discussion of the challenges associated with dynamic pension plan valuation is far from complete (nor was it intended to be), it would seem that the most significant problems of dynamic valuation have been addressed. The primary purpose of this discussion was twofold. First, to show that although dynamic pension plan valuation has its problems, they are not insurmountable. Secondly, to note that there are problems inherent with any cost method and, that proper selection and use of any valuation methodology requires the judicious use of professional judgment.

VII. Conclusions

This paper has shown that performing a dynamic pension plan valuation is a feasible and practical alternative to traditional valuation methods. Furthermore, while the sensitivity of plan cost estimates to changes in new entrant assumptions is an important issue, the need for reasonably accurate assumptions (particularly on a select-and-ultimate basis) is not a new item of consideration for pension actuaries and is a manageable concern. As has been discussed (albeit briefly), forecast-inclusive methods are useful in a variety of situations and can provide valuable information to plan sponsors, company stakeholders, plan participants, and benefit guarantors. Lastly, the discussion of some of the more significant issues connected with performing a dynamic pension plan valuation has demonstrated that, like most cost methods, the difficulties of using a dynamic pension plan valuation methodology can be overcome by exercising care in assumption selection and method application. Throughout, the primary intent of this paper has been to encourage additional discussion regarding the use forecast-inclusive valuation methods. It is the author's sincere hope that this last point, in particular, has been accomplished.

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