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A DURATION RULE FOR EVALUATING CORPORATE PENSION PLAN GENEROSITY

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UNE REGLE D'EVALUATION DE LA GENEROSITE D'UN PLAN DE RETRAITE D'ENTREPRISE, FONDEE SUR LA DUREE

114 UNE REGLE D'ÉVALUATION DE LA GÉNÉROSITÉ D'UN PLAN DE RETRAITE D'ENTREPRISE, FONDÉE SUR LA DURÉE

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RESUME

La durée a été largement utilisée dans l'élaboration de stratégies d'investissement associées aux portefeuilles de retraite. Toutefois, son utilisation dans la gestion des engagements en matière de retraite est restée extrêmement limitée. Cet article expose une règle fondée sur la durée, applicable à l'évaluation de l'évolution de la générosité d'un plan de retraite et de ses effets sur l'entreprise sponsor. La règle emploie une mesure de la durée fondée sur le modèle d'évaluation bien connu de Gordon, pour élaborer une expression de forme fermée de la relation entre le coût marginal pour l'entreprise et l'économie résultant du changement de générosité du plan de retraite. Ainsi, la règle élimine la nécessité d'incorporer des projections actuarielles et des incidences fiscales dans le processus d'évaluation de l'évolution de la générosité du plan de retraite. Un exemple numérique illustre l'application de la règle de durée.

A DURATION RULE FOR EVALUATING PENSION PLAN GENEROSITY

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ABSTRACT

Duration has been used widely in the development of investment strategies f a pension portfolios. However, its use in pension liability management has remained extremely limited. This paper develops a duration rule for evaluating changes in pension plan generosity and their effects on the sponsoring firm. The rule employs a duration measure based on the well - known Gordon model of stock valuation, to develop a closed - form expression of the relationship between the firm's incremental costs and savings from changing pension plan generosity. In this manner, the rule eliminates the need to incorporate actuarial projections and tax effects into the process of evaluating pension plan generosity changes. A numerical example is provided to illustrate the application of the duration rule.

With greater emphasis being placed on integrating the benefit area into the pension management process, [1] there is a growing need for procedures that can be used in evaluating a firm's pension benefit policy. A key element of benefit policy and, increasingly, of the collective bargaining process, is pension plan generosity [2]. Evidence from the labor market indicates that a systematic increase in real generosity of the U.S. private pension system has taken place over the entire 30 - year period since World War II[3]. Firms' apparent motivation for granting such generosity increases consists of extracting current wage concessions from their workers. However, this wage - pension tradeoff has been examined primarily from an employee perspective? whereas procedures for evaluating its effects on firms have yet to be developed.

This paper develops a procedure in which a duration measure, based on Gordon's constant growth model, is employed to evaluate corporate policy towards pension plan generosity. Durand, who first developed this measure for common stocks, suggested that it might be useful for selecting growth stocks for pension portfolios, whenever the duration of the pension liabilities was too long to be matched by portfolios consisting entirely of bonds.[5] Ever since, the measure's use in pension management has been confined to the investment area.[6] By extending its application to the pension benefit area, this paper demonstrates that the constant - growth duration measure may also have a role to play in pension liability management.

Duration and Constant Growth : Basic Relationships

For a perpetual stream which grows at a constant rate g, and for which the appropriate discount rate is k ($k > g$), duration is expressed as :[7]

$$D = \frac{1 + k}{k - g}. \tag{1}$$

Two other expressions occur in the development of the duration rule below. The first is $(1 + g) / (k - g)$, and it can readily be obtained from Equation (1) as follows :

$$D - 1 = \frac{1 + k}{k - g} - 1$$

$$= \frac{1 + k - k + g}{k - g}$$

$$= \frac{1 + g}{k - g}. \tag{2}$$

The second expression is $(1 + g) / (1 + k)$, and it can be obtained from Equation (2) as follows :

$$(D - 1)(k - g) = 1 + g. \tag{3}$$

Dividing by $1 + k$:

$$(D - 1)\frac{(k - g)}{(1 + k)} = \frac{1 + g}{1 + k}. \tag{4}$$

From Equation (1), we *can* write Equation (4) as :

$$(D - 1)\frac{1}{D} = \frac{1 + g}{1 + k}, \tag{5}$$

which further simplifies to :

$$1 - \frac{1}{D} = \frac{1 + g}{1 + k}. \tag{6}$$

Derivation of the Duration Rule

For simplicity, we consider the case of a defined benefit pension plan which uses a service - related final salary formula.[8] If the firm grants a non - retroactive increase in the plan's generosity, then the firm's resulting incremental pension costs will have a present value :

$$C_0 = \left(b^* W_0^* - bW_0\right) \quad T \quad \left(\frac{1 + g}{1 + k}\right)^T, \tag{7}$$

where

b = initial pension benefit rate as a percentage of final salary,

b* = increased **benefit** rate,

W_o = current wage demand, given benefit rate b,

W^*_o = reduced wage **demand,** given an increased benefit rate b*,

T = years remaining until retirement,

g = salary growth rate assumption, and

k = discount rate for valuing the pension liabilities.

Substituing the left - hand side (LHS) of Equation (6) into Equation (7), we have :

$$C_o = \left(b^*W^*_o - bW_o\right) T \left(1 - \frac{1}{D}\right)^T. \quad (8)$$

The firm's incremental savings from such a negotiated increase in pension plan generosity consist of the current wage **concession** extracted from the **workers.** projected as a stream over the next T **years. The present** value of this stream is :

$$S_o = \left(W_o - W^*_o\right) \sum_{t=0}^{T} \left(\frac{1+g}{1+k}\right)^t. \quad (9)$$

A closed - form expression of Equation (9) can be obtained by **recognizing** that the summation appearing in this equation is equivalent to (i) the present value of a $1 **perpetuity** which starts at t = *0* and grows at *g,* minus (ii) the present value of another perpetuity which starts with $ $(1 + g)^{T+1}$ at time T + 1 and grows at g. This difference between (i) and (ii) is represented by the **term** appearing in square **brackets,** in the following closed - **form** expression of Equation (9) :

$$S_o = \left(W_o - W^*_o\right)\left[1 + \frac{1+g}{k-g}\left\{1 - \left(\frac{1+g}{1+k}\right)^T\right\}\right]. \quad (10)$$

Pursuant to Equations (2) and (6), Equation (10) can be written in terms of duration, as follows :

$$S_o = \left(W_o - W^*_o\right)\left[1 + (D - 1)\left\{1 - \left(1 - \frac{1}{D}\right)^T\right\}\right]. \quad (11)$$

In order to adhere to the **value - maximization** rule, the firm **should** only grant an increase in pension plan generosity if $C_o \leq S_o$. **From Equations(8)** and **(11), this** requires that :

$$\left(b^*W^*_o - bW_o\right) T \left(1 - \frac{1}{D}\right)^T \leq \left(W_o - W^*_o\right)\left[1 + (D - 1)\left\{1 - \left(1 - \frac{1}{D}\right)^T\right\}\right]. \quad (12)$$

Rearranging terms and simplifying, we have :

$$\frac{b^*W^*_o - bW_o}{W_o - W^*_o} \leq \frac{1}{T}\left[1 + D\left\{\frac{1}{\left(1 - \frac{1}{D}\right)^T} - 1\right\}\right]. \quad (13)$$

Relation (13) provides a greatly simplified rule for financial evaluation of corporate pension benefit policy. Its simplicity lies in that it is based entirely on current wage and pension data : thus the need for projections does not arise. In particular, it eliminates the need to consider actuarial decrements (mortality, disability and withdrawal) which affect the stream of incremental costs and savings, since the effects of such decrements are common to the numerator and denominator of the LHS of Relation (13) ; thus, these effects cancel out. Similarly, tax effects need not be considered, since they also cancel out in the same way.

A Numerical Illustration

The following example illustrates the use of the duration rule. Consider a pension plan of the type described above, and let b = 2%. Assume the firm's valuation of its pension liability is based on g = 3% and k = 10%. From Equation (1), D = 1.10 / (0.10 - 0.03) = 15.71 years. Assume further that the workforce is equally divided between two age cohorts, 20 years and 50 years d d respectively. For the 20 - year - olds, W_o = $30,000 per worker ; for the 50 - year - olds, W_o = $50,000 per worker. Management can extract wage demand concessions equal to 1% of W_o from both cohorts, if the pension benefit rate is increased to b* = 3%. That is, W^*_o = 0.99 ($ 30,000) = $29,700 for the 20 - year - olds, and W^*_o = 0.99 ($ 50,000) = $49,500 for the 50 - year - olds. Retirement occurs at age 65 ; thus T = 45 f a the younger cohort and T = 15 for the older cohort. Using Relation (13), we have :

LHS = 0.97	and	RHS = 6.40	for 20-year-olds;
LHS = 0.97	and	RHS = 1.83	for 50-year-olds.

Since LHS < RHS for both cohorts, the proposed increase in pension plan generosity is favorable to the firm. In the event that LHS < RHS f a one *cohort* and LHS > RHS for the other, the overall effect of increasing pension plan generosity would be favorable to the firm, if the LHS -RHS difference for the first cohort overwhelms (in absolute magnitude) the LHS - RHS difference for the second cohort.

Finally, the duration rule can readily be generalized to retroactive increases in pension plan generosity. If N denotes total years of service, from hiring date *to* retirement (N ≥ T), then such generosity increases *can* be analyzed by substituting 1/N in place of 1/T in the RHS of Relation (13).

FOOTNOTES

1. See R. J. Arnott and P. L. Bernstein, 'The Right Way to Manage your Pension Fund", Harvard Business Review, January/February 1988, pp. 95 - 102.

2. See D.M. McGill, Fundamentals of Private Pensions, 5th e d (Homewood, IL : Richard D. Irwin, Inc., 1984), p. 95.

3. See R. A. Ippolito, Pensions, Economics and Public Policy (Homewood, IL : Dow Jones - Irwin, 1986). p. 90.

4. See, for example, B . Schiller and R. Weiss, "Pensions and Wages : A Test for Equalizing Differences", Review of Economics and Statistics, November 1980, pp. 529

-538 ; and R.S. Smith, "Compensating Differentials for Pensions and Underfunding in the Public Sector", Review of Economics and Statistics, August 1981, pp. 463 - 467.

5. D. Durand, "Growth Stocks and the Petersburg Paradox", Journal of Finance, September 1957, pp. 348-363.

6. See, for example, J.A. Boquist, G.A. Racette and G.G. Schlarbaum, "Duration and Risk Assessment for Bonds and Common Stocks", Journal of Finance, December 1975, pp. 1360 - 1365 ; A.O. Williams and P.F. Pfeifer, "Estimating Security Price Risk Using Duration and Price Elasticity", Journal of Finance, May 1982, pp. 399-411 ; and P.A. Casabona, F.J. Fabozzi, and J.C. Francis, "How to Apply Duration to Equity Analysis", Journal of Portfolio Managemet, Winter 1984, pp. 52 - 58.

7. Durand, "Growth Stocks", op. cit.

8. For a detailed discussion of pension plan design, see McGill, Fundamentals of Private Pensions, op. cit.

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