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THE USEFULNESS OF THE WIND-UP MEASURE OF PENSION LIABILITIES: A LABOUR MARKET PERSPECTIVE

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ABSTRACT

Financial economists have long favoured the use of a wind-up measure of the firm's pension liabilities. Yet the pension liabilities of the firm also represent the pension wealth of its workers. It is reasonable to presume that workers and shareholders have a common view of the pension contract. If the wind-up measure depicts the true pension liabilities of the firm, then the wage concession granted by its workers must reflect the fact that the firm may choose to terminate the plan at any time. Data on the wage-service characteristics of the membership of a sample of final earnings plans in Canada suggest, contrary to the implications of the wind-up measure, that workers' wages do not internalize accruing pension benefits on a year-to-year basis. Instead, the data suggest that pension plans may be a vehicle through which a significant portion of the total compensation of individual employees is deferred until their later work years, and that the wind-up measure may well understate the pension liabilities of an on-going firm.

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1. Introduction

The Financial Accounting Standards Board [4] or FASB recently proposed that net pension assets or liabilities appear on the corporate balance sheet. In order to make operational the concept of the augmented balance sheet, one must construct measures of both pension assets and pension liabilities. The non-controversial view (at least among economists!) is that pension assets be valued at market. The FASB endorses this view. The measurement of pension liabilities, on the other hand, remains controversial. Financial economists such as Sharpe [10] have traditionally advocated a market or wind-up measure of the firm's pension liabilities. The pensions due under the terms of the plan if it were to be immediately terminated are calculated, and these pensions are then costed at current annuity rates. The accrued benefit method without salary projection is the actuarial valuation method used in the calculation. The wind-up measure is the market value of the firm's pension liabilities since it identifies the precise amount that the firm would require to discharge its legal obligation if the plan were terminated.[1]

Yet the FASB now rejects the use of this method of calculating the firm's pension liabilities.[2] Instead, the FASB proposes the use of the accrued benefit method with salary projection to identify the pensions due under the terms of the plan. Because this method uses the wage projected at the date of the worker's retirement rather than his current wage, it generates a larger measure of the firm's pension liabilities. In effect, its use presumes that the pension liabilities of an on-going firm exceed those implied by the wind-up measure.

In principle, one can bring evidence to bear on the empirical validity of these (or other) measures of the firm's pension liabilities. Financial economists may wish to explore the extent to which net pension liabilities, calculated in alternative ways, are capitalized into share prices. If capital markets are efficient, one may be able to choose between the competing measures on the basis of which set of results conforms most closely to that predicted by economic theory. Unfortunately, this task is difficult. First, complications posed by tax considerations[3] and the existence in the United States of the

Pension Benefit Guarantee Corporation (PBGC) suggest that the dollar-for-dollar capitalization of net pension liabilities into share prices is not the predicted theoretical result (Bulow, Mørck, Summers [3]). Secondly, it is undoubtedly difficult in practice to control for profitability, risk, growth and other factors which influence share prices.

There is, however, an alternative way to approach this problem. To measure the pension liabilities of the firm, under the reasonable assumption that workers and the shareholders of the firm have a common interpretation of the pension contract, is also to measure the pension wealth of its workers. If the wind-up measure accurately reflects the firm's pension liabilities, the individual worker must view his pension wealth at each point in time as a long-term bond whose market value is the present value of the nominal pension payments legally due him under the formal terms of the plan. As first pointed out by Bulow [1], the rational worker will forgo cash wages in each period exactly sufficient to purchase the deferred annuity to which he becomes legally entitled during that period. The worker will not forgo any greater amount of cash wages since he is aware of the fact that the firm may choose to terminate the pension plan (or his employment) at any time.

If the worker is a member of a final earnings plan, then his pension benefit will be proportional to his years of service and his final wage. Any wage increase that he receives will raise the value of previously accrued pension benefits and thus his pension wealth. A given wage increase will produce a magnified increase in the pension wealth of an older, long-service employee. If the wind-up measure is correct, then such workers cet. par. must receive smaller wage increases than their younger colleagues. If not, the wind-up measure will understate the true pension liabilities of an on-going form. In principle, wage increases could internalize this tendency for benefit accruals to rise with years of service, even if they do not internalize discontinuities associated with vesting and early retirement provisions. (Pesando [8] and others have argued that these discontinuities are unlikely to be fully internalized into cash wages.)

The wind-up measure presumes, in effect, that the worker is tied to the firm for a single period at a time. Yet it is important to emphasize that there is rich literature in labour economics designed to explain why firms and their employees may choose to enter

into lifetime contracts. Lazear [6,7], for example, links both mandatory and early retirement provisions to lifetime labour contracts in which old workers receive total compensation that exceeds the value of their marginal product (and conversely for young workers) in order to increase productivity and to discourage shirking. The rapid accrual of pension benefits as a worker ages under the terms of a final earnings plan may be an effective way of accomplishing this restructuring of the payments stream. If the worker is bound to the firm by a lifetime contract which requires the deferral of a substantial portion of his total compensation, and if this is accomplished through the vehicle of a pension plan, then the wind-up measure will understate the firm's pension liabilities. This could occur, for example, if older long-service members of final earnings plans were to receive wage increases that were not significantly different from those received by younger plan members.[4]

This paper first performs a simulation experiment designed to identify how rapidly wage increases should decline with years of service if members of final earnings plans value their pension wealth on a wind-up basis. Longitudinal data on the wage-service characteristics of members of a sample of 7 final earnings plans in Canada are then analyzed in light of this experiment.

2. Wage Increases, by Service Cohort, Under the Wind-up Measure

The Analytical Framework

Consider the case of a worker who belongs to a final earnings plan which provides a benefit, in the form of a life annuity, equal to a specified fraction of his earnings during his final year of employment for each year of service. For simplicity, assume that benefits vest immediately (i.e. the worker immediately qualifies for the benefit due under the terms of the plan) and that there are no early retirement provisions. In return for his promised pension benefit, the worker forgoes current wages. In the absence of an implicit lifetime contract, competitive conditions dictate that the worker receive total compensation equal to the value of his marginal product in every period. If the worker values his pension wealth on a wind-up basis, then he will forgo only that amount of

current wages necessary to "buy" the pension benefit that he legally accrues during the period. The worker, like the shareholders of the firm, is cognizant of the fact that the firm may terminate the plan at any time.

Let w_t be the current wage paid the worker during period t, let k be the fraction of the worker's final earnings which he receives for each year of service, let V_t be the value of the worker's marginal product in period t, let A be the value of a unit life annuity at his retirement age, let normal retirement under the plan occur when the worker has completed T years of service, and let r be the nominal interest rate.

In the first period, the worker's total compensation is defined by:

$$w_1 + kAw_1(1+r)^{-(T-1)} = V_1 \qquad (1)$$

The first term is his current wage, and the second is the value of the pension benefit that he accrues in this initial period. In the next period, this becomes:

$$w_2 + kAw_2(1+r)^{-(T-2)} + kA(w_2-w_1)(1+r)^{-(T-2)} = V_2 \qquad (2)$$

The pension accrual now includes the enhancement, through the final earnings formula, of the pension benefit earned in the previous period. In addition, the benefit accrued is made more valuable by the fact that the worker is one year closer to retirement. Because any wage increase enhances the value of a successively larger number of past service credits as the worker ages, wage increases are likely to fall sharply with the worker's age, ceteris paribus. In the t-th year, the worker's total compensation is broken down as follows:

$$w_t + kAw_t(1+r)^{-(T-t)} + (t-1)\,kA(w_t-w_{t-1})(1+r)^{-(T-t)} = V_t \qquad (3)$$

Solving (3) yields the following time path for the worker's wage:

$$w_t = (V_t + (t-1)kAw_{t-1}(1+r)^{-(T-t)})/(1 + tkA(1+r)^{-(T-t)}) \qquad (4)$$

The wind-up measure of the firm's pension liability (L_t) at time t, which is also the wind-up measure of the worker's pension wealth, is:

$$L_t = tkAw_t(1+r)^{-(T-t)} \qquad (5)$$

Because the worker must receive total compensation that exactly equals the value of his

marginal product in all future periods, L_t measures the present value of the excess of future payments promised to the worker over the future value of his labour services. If the firm were to terminate the plan at any time t, L_t would be the payment required by the firm to discharge its legal pension obligation to the worker. Note also that L_t is nothing more than the accumulated value (at interest rate r) of the wages previously forgone by the worker in return for the pension benefit to which he is legally entitled at that point in time.

The Simulation Exercises

Assume that a male worker begins work at age 30 and retires at age 65 (T=35) and then draws the life annuity due him under the terms of the plan. To add realism, assume that the final earnings formula provides the worker with a nominal pension benefit equal to 2% of his average earnings during the last 5 years for each year of service. The worker thus retires with a total pension benefit equal to 70% of his final average earnings. Because most large employers have granted ad hoc cost-of-living adjustments to retired workers, and because one of the plans in the sample provides for fully indexed life annuities, it is also useful to examine the case in which the annuities due under the terms of the plan are real. Following Pesando [9], the risk-free real interest rate used to value these annuities is set equal to one percent.

The simulated rates of growth of real wages are presented in Table 1 under the "No Early Retirement Column". The simulations assume an inflation rate (9%), nominal interest rate (12%) and a rate of growth of the worker's marginal product (11%) that correspond roughly to market conditions in 1980.[5] The decline in the rate of growth of real wages is more apparent when cumulative wage increases are examined. Between service years 10 and 15, real wages rise by 8.16% (6.72%) when the pension is nominal (real). Between service years 30 and 35, real wages decline by 3.66% (10.1%) when the pension benefit is nominal (real).

These results are readily extended to the case in which the real value of a worker's marginal product declines in his later years. If this is so, as suggested by some authors,[6]

then the wage increases identified in Table 1 will exceed those due long-service employees. Any evidence that wage increases do not decline with the employee's years of service would then constitute stronger evidence against the hypothesis that workers value their pension wealth on a wind-up basis.

Typically, a plan member becomes eligible for an early retirement pension after he has reached age 55 and met a minimum service requirement. Early retirement provisions result in a different time path for benefit accruals, and thus for wages if they internalize fully the value of benefit accruals on a period-by-period basis. To focus attention on this issue, assume that the employee becomes eligible at age 55, after completing 25 years of service, for an early retirement pension. The early retirement pension equals the accrued pension that the worker would otherwise receive at the normal retirement age of 65, less 3% for each year by which his actual retirement age precedes age 65. (If the worker retires at age 55, he receives 70% of the pension that would otherwise commence at age 65; at age 56, 73%, and so on.) The rates of growth of real wages conditional[7] upon the worker's qualifying for the early retirement benefit are also presented in Table 1.

The differences in benefit accruals, and thus in the wages that internalize them, are fairly dramatic. Absent early retirement, the rate of growth of real wages declines steadily with years of service and becomes negative when the employee has 30 (24) years of service when the benefit is nominal (real). Conditional upon the employee becoming entitled to an early retirement benefit at age 55, the rate of growth of real wages declines more rapidly. The growth rate first becomes negative when the employee completes 23 (16) years of service when the benefit is nominal (real). Further, the growth rate rises sharply in the employee's 56th year. Having qualified for the early retirement benefit at age 55, the benefit that the worker accrues during his 56th year is much smaller, and the growth rate of his real wages rises commensurately. In years 57 through 65, the growth rate is positive and fluctuates on a yearly basis to reflect the averaging in the earnings base.

3. Longitudinal Data on Wage and Service Characteristics of the Membership of a Sample of Final Earnings Plans

The Sample

GBB Associates Ltd. has provided data on the wage and service characteristics of plan members for a sample of 7 final earnings plans in Canada. All plans have early retirement provisions. Only one plan provides for the contractual indexing of pension benefits, while one other has a stated policy of providing ad hoc cost-of-living adjustments.

The simulation exercises presume that the worker enters the plan at age 30 and remains at the firm until he reaches normal retirement age. In effect, the worker's age and years of service are assumed to be perfectly correlated. Inspection of the cross-tabulations by age and years of service indicates that the vast majority of male workers joined their plans between the ages of 25 and 30. In interpreting the empirical results, it is thus useful to view the representative male worker with s years of service as having attained age $s + 28$. Because of their relatively small number and less homogenous age and service characteristics, females are excluded from the empirical analysis.

Wage Increases by Service Cohorts

The simulations in Tables 1 indicate that wage increases that internalize benefit accruals on a year-to-year basis decline monotonically, although not strictly linearly, with a worker's years of service until either his retirement age or the date of his eligibility for an early retirement benefit. To provide evidence on these predictions, regressions of the annual wage increases granted each service cohort on its years of service are presented in Table 2. Because the number of years for which annual wage increases could be calculated varies across plans, so does the number of regressions. Regressions are also presented for the cumulative wage increases received by each service cohort over the full period for which data are available. Finally, because the "raw" data are also of interest, summary data on wage increases by 5-year service cohorts are presented in Table 3.

Regressions are run for cohorts with from 11 to 35, and with from 11 to 26, years of service. Because most plans have a vesting requirement of 10 years service, it seems appropriate to exclude those cohorts with 10 or less years of service. Because the maximum number of years of pensionable service is typically 35, it also seems appropriate to exclude those cohorts with 36 or more years of service. The truncated sample is motivated by the desire to focus on wage increases prior to the employee's qualifying for an early retirement benefit, typically at age 55. If the representative worker joins the plan at age 28, he will have 26 years of service at age 54. For plan number five, the corresponding regression is run for cohorts with from 11 to 24 years of service, since the eligibility requirement for the early retirement benefit is age 50 and 25 years service. No employee with 24 years of service has yet qualified for the early retirement benefit.

For only 2 of the 7 plans (numbers one and five) is there any evidence of a significant negative relationship between the wage increases granted a cohort and its years of service. For plan number five, in which this evidence is strongest, the actual benefit accruals and thus the total compensation of each service cohort were calculated. These results, available from the author upon request, indicate that the negative relationship between wage increases and years of service was not sufficient to prevent the total compensation granted each cohort from rising with its years of service. For the other plans, there is no evidence that the wage increases granted male employees decline significantly with their years of service, with or without consideration of early retirement provisions.

4. Wage Increases, by Service Cohort, under the Accrued Benefit Method with Salary Projections

Since the FASB [4] recommends the use of the accrued benefit method with salary projection, it is instructive to consider the rates of growth of wages by service cohort that one would expect to observe if this method provides the correct measure of the firm's pension liability. For this to be the case, the liability so identified must equal the present value of the excess of future payments promised

to the worker over the future value of his labor services. Of particular interest is the question of whether the rate of growth of wages should decline with the worker's years of service, as implied by the wind-up measure.

Under the accrued benefit method with salary projection, the pension liability is again calculated on the basis of the worker's years of service to date, but his projected wage at the date of his termination or retirement now enters the calculation. The labor market "story" is as follows. The worker receives total compensation equal to the value of his marginal product in each and every period. However, he (and the shareholders of the firm) value his accruing pension benefit on the basis of his projected wage at retirement rather than his current wage. The worker forgoes cash wages in excess of those required to purchase the pension benefit to which he would be legally entitled if the plan were terminated or if he were to quit the firm. In effect, the worker has agreed to defer the receipt of a portion of his total compensation beyond that which he would recover if he were to leave the firm. In this sense, the worker is tied to the firm, perhaps for the incentive reasons sketched by Lazear [6, 7].

As previously noted, the worker's pension wealth (and thus the firm's pension liability) is equal to the accumulated value of the cash wages previously forgone by the worker in return for his pension benefits. If the worker forgoes greater cash wages, the firm's pension liability is greater. This is the labor market perspective on why the firm's pension liability is greater under the accrued benefit method with salary projection, if it indeed depicts the true pension liability of the firm.

To determine the time path of the worker's wage, note that the pension benefit accrued in the final period (T) becomes payable immediately, so that the worker's total compensation in this period is:

$$w_T + kAw_T = V_T \tag{6}$$

In all earlier periods, the worker's total compensation is:

$$w_t + kAw_T e^{-r(T-t)} = V_t \qquad (7)$$

The time path of wages (w_t) follows immediately from (7). If the value of the worker's marginal product grows continuously at the rate g and has an initial value V_0, then:

$$\frac{dw/dt}{w} = \frac{gV_0 e^{gt} - rkAw_T e^{-r(T-t)}}{V_0 e^{gt} - kAw_T e^{-r(T-t)}} \qquad (8)$$

From (8), it follows that the rate of growth of wages may exceed, equal or fall short of the rate of growth of the worker's marginal product. If $r=g$, however, then $(dw/dt)/w = g$. In short, there need be no tendency for the rate of growth of wages to decline with a worker's years of service if the accrued benefit method with salary projection provides the correct measure of the firm's pension liability. If the interest rate and the rate of growth of the worker's marginal product are (or are approximately) equal, then the rate of growth of the worker's cash wage will be independent of his years of service if (as previously assumed) the rate of growth of his marginal product is similarly independent of his years of service.

5. Conclusions

If workers value their pension wealth on a wind-up basis, then wage increases granted to members of final earnings plans must decline with their years of service, but only until the date at which they qualify for early retirement benefits. Quantitatively, this effect should be visible in raw data on the wage increases granted alternative service cohorts, especially if the wage increases are averaged over several years (for example, the average wage increase over the past 5 years to the cohort which now has 25 years of service, relative to the cohort which now has 20 years of service).

This paper invokes the assumption that the (non-observable) value of a worker's marginal product grows at a rate independent of his years of service. For only 2 of the 7 plans examined is there any evidence that wage increases granted a service cohort decline with its years of service.[8] These results are best viewed as exploratory

since (1) the sample is quite small and (2) it was not possible to compare the wage increases granted these members of final earnings plans to those granted workers with comparable years of service in paired firms which provide either no pension plans or substantially "inferior" ones. Nonetheless, the suggestion is that a final earnings plan may be a vehicle for deferring a portion of an employee's lifetime compensation to his later work years, and that the wind-up measure may well understate the pension liabilities of an on-going firm.[9] By implication, the accrued benefit method with salary projection (or perhaps a projected benefit method[10]) may provide a better measure of these pension liabilities.

FOOTNOTES

1. This statement presumes that there are sufficient assets in the pension plan to discharge fully the pension liabilities, and abstracts from the existence of plan provisions which may require that as yet unvested benefits become vested in the event of a voluntary plan wind-up.
2. In Statement of Financial Accounting Standards No. 35, "Accounting and Reporting by Defined Benefit Plans", issued in March 1980, the Financial Accounting Standards Board (FASB) required that plan liabilities be reported using the accrued benefit method without salary projection.
3. Note that a firm which has a surplus of $1 in its pension plan would, if the plan were liquidated immediately, add $1 * (1-T) to its retained earnings where T is the tax rate faced by the firm. If the firm can keep the plan overfunded by $1 forever, the value of the firm will rise by $1, as shown by Bulow, Mørck, Summers [3]. Analogous arguments pertain to the case in which the plan has an unfunded liability of $1.
4. If a substantial portion of the total compensation of workers is deferred to their later years, then firms may have implicit liabilities quite independent of their pension arrangements. This important point is explored, but not resolved, by Bulow, Mørck and Summers [3] in their recent study of the market's valuation of unfunded pension liabilities.
5. The data examined later in the study pertain to 1980 or thereabouts. To calculate benefit accruals, nominal wages must be identified, and hence the rate of inflation is an important input as well.
6. Wise and Kotlikoff [11], in order to illustrate pension accruals by age for a stylized pension plan, postulate a time path for real wages that exhibits very little growth after the worker reaches age 55. Wise-Kotlikoff do so on the basis of longitudinal data contained in the Retirement History Survey and the Current Population Survey.

7. If the worker is to receive wages plus accruing pension benefits which equal the value of his marginal product in every period, and assuming that the worker does not qualify for the early retirement benefit if his employment is terminated prior to age 55 (as appears to be the usual case), the worker must "pay" for the early retirement benefit in the form of a dramatic wage reduction at the date that he first qualifies for it. It is straightforward to show that if the worker's pension benefit is nominal, the worker's real wage in his 55th year must fall to 17.5% of its value in the 54th year. If the benefit is real, the worker's cash wage in his 55th year must be negative!

   The rather strong message is that worker's do not value their pension wealth exclusively on a wind-up basis. It remains possible, however, that wages do internalize the tendency for benefit accruals to rise sharply with the worker's years of service, perhaps conditional upon the worker's qualifying for the early retirement benefit. The latter is the possibility that is examined in the text.

8. Ippolito [5] performs a similar investigation with U.S. data and arrives at the same conclusion.

9. A caveat to this conclusion is the possibility that the tradeoff between wages and pension benefits takes place at the level of the employee group as a whole, as noted by Bulow-Landsman [2]. If older members of the employer group receive wage increases that produce benefit accruals that are quite large, this may be offset by concessions made by other members of the employee group. This type of behaviour is, one might conjecture, more likely to characterize the total compensation packages negotiated formally in the union sector. Yet it is in the non-union sector that earnings-based pension plans, are concentrated.

10. Under a projected benefit method, the worker's future service and wage rate are both projected to determine the total pension benefit that will be due him on the date of his retirement. Normal pension contributions are then established,

typically as a level percentage of the worker's wage, to discharge the projected benefit over his active work life. The pension liability under this method is the present value of the total pension benefit projected for the worker at the date of his retirement, less the present value of future normal contributions to the plan. Because contributions are "large" relative to accruing benefits when the worker is young and "small" when he is old, the pension liability under the projected benefit method will exceed that calculated under either of the accrued benefit methods.

REFERENCES

1. Jeremy Bulow. "What are Corporate Pension Liabilities?" Quarterly Journal of Economics 97 (August 1982): 435-52.
2. _____ and Wayne Landsman (1983). "The Relationship Between Wages and Benefits". Paper presented at NBER Conference on Pensions, Labor and Individual Choice, Dorado Beach, Puerto Rico.
3. _____, Randall Mørck and Lawrence Summers (1984). "How Does the Market Value Unfunded Pension Liabilities?". Mimeograph.
4. Federal Accounting Standards Board. Preliminary Views: Employer's Accounting for Pensions and Other Postemployment Benefits, November 1982.
5. Richard A. Ippolito. "The Labor Contract and True Economic Pension Liabilities". Mimeograph, 1984, forthcoming in the American Economic Review.
6. Edward P. Lazear. "Pensions as Severance Pay" in Zvi Bodie and John B. Shoven, editors, Financial Aspects of the U.S. Pension System (Chicago: University of Chicago Press for the National Bureau of Economic Research).
7. _____. "Why is there mandatory retirement?" Journal of Political Economy 87 (December 1979): 1261-84.
8. James E. Pesando. "Employee Valuation of Pension Claims and the Impact of Indexing Initiatives". Economic Inquiry 22 (January 1984): 1-17.
9. _____. "Valuing Pensions (Annuities) with Different Types of Inflation Protection in Total Compensation Comparisons". Canadian Journal of Economics 17 (August 1984): 569-87.
10. William F. Sharpe. "Corporate Pension Funding Policy". Journal of Financial Economics 3 (January 1976): 183-93.
11. David A. Wise and Laurence J. Kotlikoff. "Labor Compensation and the Structure of Private Pension Plans: Evidence for Contractual versus Spot Labor Markets". NBER Working Paper No. 1290, March 1984.

TABLE 1

ANNUAL RATE OF GROWTH OF REAL WAGES
UNDER THE WIND-UP MEASURE OF PENSION WEALTH (LIABILITIES)

Nominal Interest Rate = 12% Inflation Rate = 9% Growth Rate of VMP = 11%

	Nominal Benefit			Indexed Benefit[c]	
Year	No Early Retirement[a]	Early Retirement At Age 55[b]	Year	No Early Retirement	Early Retirement At Age 55
10	1.68	1.44	10	1.50	0.90
11	1.65	1.35	11	1.43	0.56
12	1.62	1.30	12	1.39	0.55
13	1.59	1.22	13	1.32	0.39
14	1.55	1.13	14	1.25	0.21
15	1.51	1.04	15	1.16	0.02
16	1.46	0.93	16	1.07	-0.20
17	1.40	0.81	17	0.97	-0.40
18	1.34	0.68	18	0.85	-0.63
19	1.27	0.54	19	0.73	-0.87
20	1.20	0.38	20	0.59	-1.11
21	1.11	0.21	21	0.44	-1.36
22	1.02	0.03	22	0.28	-1.61
23	0.91	-0.16	23	0.11	-1.87
24	0.80	-0.36	24	-0.08	-2.13
25	0.67	-0.57	25	-0.28	-2.29
26	0.53	11.90	26	-0.48	24.62
27	0.38	1.60	27	-0.70	1.38
28	0.22	1.39	28	-0.92	1.28
29	0.05	1.37	29	-1.15	1.31
30	-0.13	1.60	30	-1.39	1.35
31	-0.32	4.16	31	-1.63	9.84
32	-0.53	1.88	32	-1.87	2.49
33	-0.74	2.14	33	-2.11	2.51
34	-0.95	1.90	34	-2.35	2.37
35	-1.18	1.98	35	-2.59	2.82

Notes:

[a] The value of worker's marginal product grows in nominal terms at 11 percent per year. The (purely nominal) pension benefit is 2 percent of the worker's average earnings for the prior 5 years for each year of service. Worker enters plan at age 30, retires at age 65 and then draws the life annuity earned under the terms of the plan.

[b] At age 55 (after completing 25 years of service), the worker becomes eligible for an early retirement pension. If he elects to retire at age 55, he receives immediately a life annuity equal to 70 percent of the benefit due him at age 65; at age 56, 73 percent; and so forth. The calculated wage paths are conditional upon the worker's becoming eligible for early retirement at age 55.

[c] The present value of an indexed life annuity, on its commencement date, is calculated at an interest rate of one percent.

TABLE 2

REGRESSIONS OF WAGE INCREASES GRANTED MALE EMPLOYEES ON THEIR YEARS OF SERVICE[a]

	Year	11-35 Years of Service[b]			11-26 Years of Service[b]		
		α_0	α_1	R^2	α_0	α_1	R^2
Plan No. 1							
	1983	0.02 (0.37)	0.0006 (0.23)	.00	0.10 (1.61)	-0.0042 (1.27)	.10
	1982	0.17* (2.76)	-0.0018 (0.70)	.02	0.23** (3.63)	-0.0055 (1.68)	.17
	1981	0.09 (1.11)	-0.0004 (0.11)	.00	0.22* (2.63)	-0.0081 (1.80)	.19
	1980	0.05 (0.96)	0.0005 (0.26)	.00	0.18 (2.04)	-0.0074 (1.57)	.15
	1980-1983	0.11** (3.95)	-0.0015 (1.30)	.07	0.18** (5.26)	-0.0054** (3.11)	.41
Plan No. 2							
	1982	0.02 (0.44)	0.0043 (1.93)	.14	0.06 (6.79)	0.0025 (0.60)	.02
	1981	0.12 (1.70)	-0.0004 (0.14)	.00	0.13 (1.44)	-0.0013 (0.27)	.05
	1979	0.17* (3.93)	-0.0025 (1.34)	.07	-0.05 (0.33)	0.0089 (1.11)	.08
	1979-1982	0.13** (4.21)	-0.0090 (0.72)	.02	0.10* (2.68)	0.0003 (0.17)	.00
Plan No. 3							
	1982	0.11* (4.93)	-0.0002 (0.16)	.00	0.07* (2.10)	0.0026 (1.58)	.17
	1981	0.10* (2.62)	0.0003 (0.21)	.00	0.07 (1.38)	0.0017 (0.64)	.03
	1980	0.15** (4.95)	-0.0008 (0.57)	.02	0.23* (2.98)	-0.0050 (1.57)	.11
	1980-1982	0.12** (10.34)	-0.0002 (0.46)	.01	0.12** (10.45)	-0.0003 (0.45)	.02
Plan No. 4							
	1982	0.10* (2.56)	-0.0001 (0.02)	.00	0.14** (3.19)	-0.0026 (1.24)	.08

	Year	11-35 Years of Service[b]			11-26 Years of Service[b]		
		α_0	α_1	R^2	α_0	α_1	R^2
Plan No. 5							
	1982[c]	0.15** (22.95)	-0.0009** (3.23)	.31	0.15** (20.91)	-0.0010* (2.42)	.33
	1980	0.18** (12.25)	-0.0013* (2.09)	.16	0.18* (10.91)	-0.0015 (1.60)	.18
	1980-1982	0.16** (31.28)	-0.0012** (5.51)	.57	0.17** (23.96)	-0.0015** (3.74)	.54
Plan No. 6							
	1982	0.09** (4.33)	0.0009 (1.11)	.05	0.08* (2.97)	0.0011 (0.74)	.04
	1981	0.22** (4.24)	-0.0012 (0.57)	.01	0.25* (2.76)	-0.0031 (0.65)	.03
	1980	0.23** (5.34)	-0.0029 (1.59)	.10	0.32** (4.27)	-0.0080 (2.04)	.23
	1979	0.19** (5.14)	-0.0017 (1.14)	.05	0.11 (1.93)	0.0031 (1.04)	.07
	1979-1982	0.17** (15.23)	-0.0008 (1.73)	.11	0.18 (9.51)	-0.0012 (1.20)	.09
Plan No. 7							
	1982	0.15** (6.41)	-0.0010 (0.98)	.04	0.16** (4.31)	-0.0015 (0.76)	.04
	1981	0.15** (7.79)	-0.0001 (0.01)	.00	0.18** (6.11)	-0.0017 (1.11)	.08
	1980	0.08* (2.13)	0.0010 (0.66)	.02	0.08 (1.67)	0.0012 (0.49)	.02
	1980-1982	0.12** (7.01)	0.0001 (0.18)	.00	0.11** (4.72)	0.0006 (0.48)	.02

Notes:

[a] Regression equation is: $\dot{w}_t(s)=\alpha_0+\alpha_1 s+u_t$ where $\dot{w}_t(s)$ is the wage increase in year t for service cohort with years of service s. Bracketed figures are t-statistics. Single (double) asterisks denote significance at the 5% (1%) level.

[b] In many plans, 10 years service is the minimum vesting requirement. The maximum number of years of pensionable service is typically 35. Because many employees commence their employment at or around the age of 28, truncating the sample at 26 years of service is an attempt to focus on wage increases prior to the employee's attaining age 55 and thus qualifying for an early retirement benefit. In plan no. 5, an employee qualifies for an early retirement benefit if he has reached age 50 and completed 25 years of service. The sample is thus truncated after 24 years of service.

[c] Annualized wage increase, 1980-1982.

Table 3

WAGE INCREASES GRANTED MALE EMPLOYEES, BY SERVICE COHORT, SAMPLE OF FINAL EARNINGS PLANS IN CANADA

Plan No. 1	1983 (n=996)	1982 (n=988)	1981 (n=827)	1980 (n=782)	1979
Years of Service	% Change Wages	% Change Wages	% Change Wages	% Change Wages	
6 - 10	2.02	10.50	7.36	10.94	N.A.
11 - 15	5.32	14.62	11.08	8.10	
16 - 20	0.07	12.78	10.06	2.72	
21 - 25	3.28	12.34	3.48	2.80	
26 - 30	5.60	15.16	4.68	7.78	
31 - 35	3.76	10.66	11.32	9.34	
mean	3.53	13.11	8.13	6.16	

Plan No. 2	1983	1982 (n=1,084)	1981 (n=1,211)	1980	1979 (n=1,672)
Years of Service		% Change Wages	% Change Wages		% Change Wages
6 - 10	N.A.	16.33	8.72	N.A.	3.68
11 - 15		9.52	12.41		12.02
16 - 20		9.10	10.02		12.28
21 - 25		11.64	11.13		18.20
26 - 30		13.16	7.63		8.00
31 - 35		18.60	12.48		8.28
mean		12.39	10.74		11.78

Plan No. 3	1983	1982 (n=1,533)	1981 (n=1,5340)	1980 (n=1,560)	1979
Years of Service		% Change Wages	% Change Wages	% Change Wages	
6 - 10	N.A.	14.69	13.74	12.32	N.A.
11 - 15		12.26	9.62	15.94	
16 - 20		12.32	11.77	16.85	
21 - 25		10.78	8.50	9.74	
26 - 30		11.85	13.30	13.40	
31 - 35		9.81	9.80	15.40	
mean		11.03	10.76	13.49	

Plan No. 4	1983	1982 (n=3,390)	1981	1980	1979
Years of Service		% Change Wages			
6 - 10	N.A.	14.20	N.A.	N.A.	N.A.
11 - 15		12.24			
16 - 20		9.16			
21 - 25		4.96			
26 - 30		9.78			
31 - 35		12.56			
mean		9.74			

Plan No. 5	1983	1982[a] (n=5,939)	1981	1980 (n=5,912)	1979
Years of Service		% Change Wages		% Change Wages	
6 - 10	N.A.	14.52	N.A.	17.02	N.A.
11 - 15		13.92		16.60	
16 - 20		16.05		14.92	
21 - 25		13.14		15.10	
26 - 30		13.04		13.50	
31 - 35		11.92		14.14	
mean		13.08		15.07	

Plan No. 6	1983	1982 (n=391)	1981 (n=399)	1980 (n=558)	1979 (n=581)
Years of Service		% Change Wages	% Change Wages	% Change Wages	% Change Wages
6 - 10	N.A.	8.49	16.12	18.56	16.32
11 - 15		8.92	18.94	23 64	15.24
16 - 20		12.14	21.98	14.34	16.38
21 - 25		9.98	17.96	14.14	20.26
26 - 30		10.18	14.48	17.08	11.84
31 - 35		12.18	20.96	14.46	13.81
mean		10.69	18.88	16.75	15.52

Plan No. 7	1983	1982 (n=352)	1981 (n=353)	1980 (n=357)	1979
Years of Service		% Change Wages	% Change Wages	% Change Wages	
6 - 10	N.A.	18.20	15.85	11.40	N.A.
11 - 15		15.38	14.66	8.50	
16 - 20		12.02	16.88	11.54	
21 - 25		13.02	13.20	10.12	
26 - 30		11.50	15.44	11.18	
31 - 35		12.98	15.32	11.23	
mean		12.99	15.15	10.53	

Notes: [a]Wage increase, annualized, between 1980 and 1982.
Bracketed figure under year indicates number of plan members in that year. Each plan is sponsored by a different firm.
"N.A." indicates that data do not permit the calculation of wage increases for that year.