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The Distribution of Investment Risk in Defined Benefit Pension Plans

A Reconsideration

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The "textbook" description is that members of defined benefit pension plans bear no investment risk, in sharp contrast to members of defined contribution plans. Yet formal or informal bargaining may focus on the size of required employer contributions to a defined benefit plan. If at least some of the costs of such employer contributions are shifted back to workers, then members of defined benefit plans do bear investment risk. We utilize three sources of empirical evidence (a survey of pension specialists, econometric analysis, and case studies) to support the proposition that employees do bear at least some of the investment risk associated with pension fund performance. Poor fund performance leads to larger employer contributions to maintain the defined benefit obligation and this in turn leads to lower levels of other forms of compensation. We conclude that risk-shifting does occur, in at least some plans, and that the textbook distinction is overstated.

Defined benefit pension plans pay retired workers a benefit based on a formula which takes into account years of service and earnings (or a flat dollar amount). Sponsors of defined benefit plans are required to establish

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a fund which contains assets sufficient to discharge the expected pension obligation. If at any point in time the fund's assets are insufficient to cover the liabilities, the employer is required to make additional payments to buttress the fund. In contrast, the benefit from a defined contribution (or money purchase) pension plan is based on accumulated contributions, made on the plan members' behalf, to an investment fund. Unlike defined benefit plans, the size of the benefit due upon retirement ultimately depends on the investment performance of the fund.

Since the legal obligation to cover financial deficiencies falls exclusively on the plan sponsor, the "textbook" description is that members of defined benefit pension plans bear no investment risk, in sharp contrast to members of defined contribution plans. Correspondingly, plan sponsors have typically argued that they also hold the reciprocal and exclusive right to surplus assets which may accumulate. However, the spate of challenges to pension surplus asset reversions by employers suggests that there is a belief among plan members that they also have an interest in defined benefit pension fund finances.¹ Supported by the predictions of the economic theory of compensating wage differentials, employees and their representatives argue that a pension plan is paid for, in effect, by concessions in other components of the compensation package. This view is summarized by O'Grady (1991: 54):

... no single element of employee compensation is determined in isolation from other elements. An increase in pension costs will inevitably shape an employer's position at the bargaining table in the same way as any increase in payroll costs.

The implication of this view, if verified, is clear — defined benefit plan members do, in fact, bear at least some of the risk of pension fund investment performance through concessions in other components of the compensation package. This would effectively blur a key distinction between defined benefit and defined contribution pension plans.

The purpose of our paper is to challenge the textbook treatment of the distribution of investment risk in defined benefit plans. We advance the hypothesis that members of defined benefit plans often share in the downside risk of fund performance. Risk shifting will occur if, the defined nature of the pension benefit notwithstanding, formal or informal collective bargaining focuses on the size of required employer contributions. The mechanism for risk shifting is thus the internalization, into cash wages or fringe benefits, of the on-going costs to the sponsor of financing the pension plan. As is well

1. Pesando and Hyatt (1993) review and summarize some of the Canadian and U.S. litigation and arbitration decisions. They conclude that the notion that plan members bear pension fund investment risk has been accepted in some, but certainly not all, of these rulings.

known, the impact and the ultimate incidence of a tax may differ. So too may the impact and the ultimate incidence of unplanned contributions by the employer to the corporate pension plan. The ultimate incidence of additional employer contributions required to amortize investment-driven experience deficiencies may well fall upon employees. If so, employees — not the plan sponsors — will bear at least some of the cost of adverse investment performance. Because there is no single source of data which would permit a direct test of our hypothesis, we seek to marshal evidence from a number of sources, including: a survey of pension professionals; a regression analysis of wage-pension tradeoffs; and case studies.

The need to look beneath the formal terms of defined benefit plans, in order to distil the true economics, has ample precedent in the pension literature. Bulow and Scholes (1983) sketch a model in which, in the form of quasi-rents to the specific human capital of the employee group as a whole, older workers are effectively equity holders in the firm. As a result, the employee group as a whole has a shared interest in the profitability of the firm, including the returns on the pension fund. Ippolito (1987) and other researchers have argued that implicit pension contracts, as distinct from the “legalistic” pension contracts set forth in official plan documents, reflect the true economics of defined benefit pension plans. Most defined benefit plans, for example, promise only nominal pension benefits at retirement. Yet, this provision notwithstanding, many plan sponsors award ad hoc cost-of-living adjustments to the pensions of retired plan members. The likelihood that the true economics of the defined benefit plan may vary from establishment to establishment is also acknowledged in the pension literature. Researchers have noted, for example, that implicit pension contracts may exist, but not be universal (Allen, Clark and McDermid 1991). This fact is important in light of the exploratory results reported in the present paper: econometric tests of wage-pension tradeoffs suggest that required employer contributions *may* be internalized into cash wages, while our case studies confirm the fact that risk-sharing does exist in at least some plans.

The paper is organized as follows. We first motivate and set forth the hypothesis that additional payments required from employers to amortize investment-driven “experience deficiencies” are likely to be reflected elsewhere in the employees’ compensation package. Next, we show that many in the pension field — as evidenced by a recent Canadian survey — believe that bargaining does focus on the cost of required employer contributions, the defined benefit formula notwithstanding. We then report the results of an econometric investigation of the tradeoff between wages and pension benefits, based on a sample of union pension plans in Ontario. The purpose of this investigation is to determine if employers’ contributions *per se*

are reflected in negotiated wage-pension tradeoffs. Since these results are mixed, in part due to data limitations, we present two case studies which confirm that the sharing of downside risk does occur in at least some plans in Canada. We conclude that the textbook distinction between defined contribution and defined benefit plans concerning the bearing of investment risk is clearly overstated, and that this fact has several important implications.

RISK-SHARING AND THE INCIDENCE OF REQUIRED EMPLOYER CONTRIBUTIONS

Actuarial evaluations of future pension liabilities are based on assumptions regarding a number of demographic factors (age at time of retirement, mortality rates, salary growth rates and employee turnover), as well as returns on pension fund assets. When actual experience differs from these assumptions, "experience deficiencies", or "experience surpluses" will arise. That is, as a result of ultimately inaccurate assumptions, the pension plan will become under- or over-funded. Pension regulations generally require that experience deficiencies be rectified within a well-defined period of time. For example, since the passage of Ontario's Pension Benefits Act in 1965, employers in Ontario have been required to amortize experience deficiencies by a series of special payments over a period of not more than 5 years². Since the passage of the Employee Retirement Income Security Act (ERISA) in 1974, employers in the United States are required to amortize experience deficiencies over a period of not more than 15 years. If a substantial experience surplus arises, tax laws require that it be eliminated through increased benefits, retroactive enrichments, contribution holidays or withdrawal of the surplus funds.

Our hypothesis is that the *ultimate* incidence of additional employer contributions required to amortize experience deficiencies falls, at least in part, on employees. The higher are the actual contributions of the employer to the pension plan, the more aggressive will be the employer's attempt to contain wage increases and/or the improvement in the pension plan and other fringe benefits. Ippolito (1985) argues that the underfunding of flat benefit plans serves to limit the ability of a unionized workforce to threaten

2. In Canada, the regulation of employer-sponsored pension plans is largely a provincial responsibility, although Ontario's Pension Benefits Act has been quite influential. Prior to the passage of ERISA, employers in the United States were not required to fully fund their pension plans, and there were no requirements regarding the amortization of experience deficiencies. In Ontario, if a separate solvency test indicates that the plan is fully funded on a wind-up basis, the amortization period for experience deficiencies can be extended to 15 years.

the financial solvency of the employer, by giving the workforce an additional stake in the long-run solvency of the employer. Pesando, Gunderson and Shum (1992) argue that this underfunding is the byproduct of a process designed to redistribute wealth to older, long-service workers. Both explanations are consistent with our hypothesis.

Our hypothesis is also consistent with the two polar models of the labour market used by economists to analyze pension issues. Consider, first, the spot model of the labour market, as applied to pensions by Bulow (1982). In this model, workers receive compensation in every period that is exactly equal to the value of their marginal product. With no loss of generality, let c denote the *employer* contribution required to fund the promised pension benefit (L) due at the end of the period, based on the valuation rate r_v . Let w denote the cash wage paid to the employee, and let VMP designate the value of the worker's marginal product. Then:

$$w_t + c_t = \text{VMP}_t \quad (1)$$

$$c_t(1 + r_v) = L_{t+1} \quad (2)$$

The plan will be underfunded at the end of the period if the realized return r_t is less than r_v . Suppose that this is the case and, as a result, the employer is required to make an additional payment ($c_t^*(r_v - r_t)$) to amortize this experience deficiency in period $t+1$. In period $t+1$, the worker's total compensation consists of the special payment required from the employer to amortize the experience deficiency, the employer contribution necessary to fund the accruing pension benefit, and the employee's cash wages. The sum of these three components must equal the value of the worker's marginal product:

$$c_t(r_v - r_t) + c_{t+1} + w_{t+1} = \text{VMP}_{t+1} \quad (3)$$

If L_{t+2} (and hence c_{t+1}) is given, then w_{t+1} must be lower *ceteris paribus* by $c_t(r_v - r_t)$ to satisfy this condition of market equilibrium. In other words, the *full* incidence of the additional "employer" contribution falls upon the employee. If employees refuse to fund the amortization payment by accepting the appropriate adjustment in their cash wages, the employer will simply terminate the pension plan. Employees will then receive $c_t(1+r_t)$ rather than the promised benefit L_{t+1} .³ This is the mechanism that ensures that the full incidence of additional employer contributions to fund experience deficiencies falls upon employees.

The alternative model that economists have used to analyze pension plans is an implicit contract model in which, over the expected worklife of

3. Note that $c_t(1+r_t)$ represents the assets of the pension plan. In the event of plan dissolution (and in the absence of plan termination insurance), employees receive the lesser of the plan's assets and the pensions due under the terms of the plan's benefit formula.

the plan member, the employer commits to maintaining the pension plan, except in the event of economic distress (see, for example, Ippolito 1987). In the implicit contract model, market-clearing requires that the present value of the employee's total compensation from the date of hire (H) to the date of retirement (R) be equal to the present value of the employee's marginal product:

$$\int_H^R (w_t + c_t) e^{-rt} dt = \int_H^R VMP_t e^{-rt} dt \tag{4}$$

As formulated in (4), it is the employer's *contributions* to the pension plan which are reflected in the employee's lifetime compensation. If r_t is less than r_v , the employer will be required to make a higher contribution (c_{t+1}) during the next period. Unlike the spot model, however, there is no requirement that w_{t+1} decline so as to internalize the higher pension contribution. Nonetheless, in the absence of unexpectedly favourable investment performance ($r > r_v$) at some point in the future, the suggestion in (4) is that the employee *will* bear the full incidence of an unexpected increase in pension costs, if this cost increase persists over the long run. Those who support the "traditional view" regarding the sharing of investment risk in defined benefit pension plans must argue that a measure of the employee's accruing pension benefit, *not* the employer's contribution, should appear on the left-hand-side of (4).

Ippolito (1987) reviews the literature on implicit pension contracts. He suggests that determining whether the pension liabilities of the firm are indeed independent of the plan's investment performance is an important and a timely question. In effect, Ippolito raises the possibility that unexpectedly favourable or unfavourable investment performance will be internalized into a specific component of the employee's total compensation: the pension benefit *per se*. Ippolito observes that workers and the employer may implicitly agree that the performance of the pension fund will influence the level of pension benefits.

Even if this implicit contract framework is not formalized as in (4), there is nothing to rule out the shifting of all or part of the cost of experience deficiencies back to employees. Such shifting would be facilitated by the existence of firm-specific human capital, so that the value of the worker's marginal product is less in alternative employment, or the existence of deferred compensation, which also discourages mobility. In this regard, it is useful to note that Topel (1991) finds strong evidence that cash wages do rise with an employee's seniority, the key prediction of the theory of specific human capital.

The preceding analysis suggests that it is useful to distinguish the role of risk sharing in plans that are not fully funded, and hence where pension

assets (A) are less than accrued liabilities (L), from the role of risk sharing in plans that are overfunded ($A > L$).

For underfunded plans, workers bear the risk of adverse investment performance under a legalistic interpretation of the pension contract. One need *not* invoke an implicit contract in order to argue that workers will bear the full incidence of the additional employer contributions required as the result of an investment shortfall. The existence of insurance by a third party complicates, but does not fundamentally alter, this basic result.

In the United States, there is a third party insurer of pension benefits, the Pension Benefit Guarantee Corporation (PBGC). The level of guaranteed benefits (G) is typically well beneath the level of accrued pension benefits, for a variety of reasons.⁴ In an underfunded plan, workers bear the risk of an investment shortfall if the plan's assets exceed the guaranteed level of benefits (i.e., if $L > A > G$). In very poorly funded plans, where assets are less than the guaranteed level of benefits ($L > G > A$), it is the third party insurer which bears the risk of adverse investment outcomes.

In Canada, only the Province of Ontario provides third party insurance for pension benefits. Although there are some differences in institutional detail,⁵ the analysis parallels that of the PBGC. In all other provinces, workers in underfunded plans bear the risk of adverse investment performance, without qualification, in a legalistic interpretation of the pension contract.

For an overfunded plan ($A > L$), the analysis is different. Workers bear the risk of adverse investment outcomes *only* if implicit contracts exist, such that some (or all) of plan surpluses are targeted to enhancing workers' compensation, presumably in the form of enriched pension benefits.

In much of the pension literature, authors appear to assume that pension plans are overfunded. For the flat benefit (or pattern) plans which predominate in the union sector, however, underfunding *is* prevalent. As discussed by Pesando, Gunderson and Shum (1992), the retroactive enrichment of these plans (for example, from \$10.00 per month for each year of service to \$13.00 per month for each year of service) virtually assures that significant numbers of these plans are continually underfunded.⁶

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4. These reasons include, for example, the fact that benefit enrichments become guaranteed over a 5-year phase-in period, and the existence of a ceiling on the maximum benefit that each employee could receive.
 5. The Pension Benefit Guarantee Fund (PBGF), introduced in 1980, insures benefits *only* in the event that the sponsoring firm goes bankrupt. In the United States (in the mid-1980s), an on-going firm could terminate its underfunded plan at a (maximum) cost of the plan's assets plus 30 percent of the market value of the firm's equity.
 6. For evidence on the underfunding of flat benefit plans in the United States, see Ippolito (1985). For Canadian evidence, see Ezra (1983).

In later empirical work, we examine the issue of risk-sharing for a sample comprised of large flat benefit plans in Ontario. These plans are retroactively enriched on a periodic basis. Since these retroactive enrichments become fully insured only after a 3-year phase-in period, workers in these plans are likely to bear the risk of adverse investment performance, even in the absence of implicit pension contracts.

EXISTING VIEWS ON COLLECTIVE (OR INFORMAL) BARGAINING FOR PENSION BENEFITS

Our hypothesis is that an investment-driven increase in experience deficiencies will, other things equal, lead employers to demand concessions in cash wages or other components of the employee's compensation package. In this section, we demonstrate that this view of the bargaining process is widespread, which adds to the *a priori* credibility of our hypothesis.

In advance, however, it is useful to review historical data on median pension fund performance in Canada. Annual data are reported, for the period 1967 to 1991, in Table 1. Also shown in Table 1 are estimates of the valuation interest rates used, over time, by pension plan sponsors in Ontario. In 1969-1970, 1973-1974 and in 1990, median fund returns were well beneath the valuation interest rates, and many plans undoubtedly experienced significant deficiencies on this account. In 1974, the year of the most dramatic shortfall, median investment returns fell short of the representative valuation rate by 18 percent. A pension plan that was fully funded at the beginning of 1974 would thus have an accumulated deficit equal to 18 percent at year-end, based on median fund performance. Interestingly, median pension fund performance fell short of the valuation rate in only three subsequent years (1981, 1987, and 1990). During this later period, median pension fund performance *far* exceeded the valuation rate (1982, 1983, 1985, and 1991) in several years. These facts suggest that investment-driven experience deficiencies are likely to have played a less important role in recent pension history.⁷ Indeed, in light of the strong pension fund

7. The data cited in Table 1 are potentially misleading as to the magnitude of the importance of investment shortfalls, for two reasons. First, plan sponsors in Ontario are required to report the results of a formal plan valuation every third year. These triennial valuations, which identify any experience deficiencies and the associated special payments, clearly allow for some smoothing of investment returns. Second, plan sponsors are not required to value their pension assets at market value. In the early 1970s, plan sponsors in Ontario frequently used book values, so that gains and losses were realized only upon disposition (Livsey and Short 1988). Now, sponsors typically smooth investment returns by phasing in capital gains or losses over a period of 3 to 5 years. Further, as previously noted, experience deficiencies can be amortized by a series of level payments extending over a period of 5 years.

performance in the mid-1980s, it is easy to understand why most of the public policy discussion in recent years has focused on competing claims to the ownership of *surplus* assets.

TABLE 1

Annual Rates of Return on Pension Fund Investments in Canada, 1967 to 1991

Year	(1) <i>SEI Median Return</i>	(2) <i>Average Interest Rate Assumption</i>	(3) <i>Column (1) less Column (2)</i>
1967	7.6	5.2	2.4
1968	9.4	5.2	4.2
1969	-3.2	5.2	-8.4
1970	1.3	5.2	-3.9
1971	12.5	5.2	7.3
1972	18.4	5.2	13.2
1973	-2.1	5.2	-7.3
1974	-12.7	5.3	-18.0
1975	13.2	5.4	7.8
1976	12.4	5.5	6.9
1977	8.7	5.6	3.1
1978	13.5	5.7	7.8
1979	15.0	5.8	9.2
1980	18.3	5.9	12.4
1981	1.5	6.0	-4.5
1982	21.1	6.1	15.0
1983	20.0	6.2	13.8
1984	8.8	6.3	2.6
1985	23.5	6.4	17.1
1986	12.8	6.4	6.4
1987	3.8	6.4	-2.6
1988	10.4	6.4	4.0
1989	15.9	6.4	9.5
1990	-0.8	6.4	-7.2
1991	17.3	6.4	10.9

Source: Livsey and Short (1988), Tables 1 and 11, and SEI Financial Services.

Data are not presented in Livsey and Short on the average interest rate assumption for the years 1967 to 1972 and 1986 to 1991. We have fixed the former at the 1973 rate of 5.2 percent, and the latter at the 1985 rate of 6.4 percent. The median return of the pension funds in the SEI Financial Services database is before allowance for investment and related expenses.

The Perspective of Pension Specialists

In June 1988, a questionnaire designed by one of the authors was circulated by the International Foundation of Employee Benefit Consultants to its Canadian members. These members represent the trustees of employee benefit funds (both management and labour), as well as administrators, advisers, actuaries and other consultants. There were 132 replies to the questionnaire. The questions regarding the bargaining process, and a summary of the replies, are presented below:⁸

The traditional view is that the plan sponsor bears the investment risk in defined benefit plans. Yet a plan sponsor might take a hardline position in negotiations after a market collapse, citing the need to make large payments to amortize experience deficiencies. If so, plan members may ultimately bear a substantial portion of the risk of adverse investment performance.

	<u>Yes</u>	<u>No</u>	<u>Don't Know</u>
1. <i>Are plan sponsors likely to grant smaller wage increases or other enrichments if large experience deficiencies emerge as the result of an adverse investment climate?</i>	45	42	13
2. <i>Has this ever happened in the plan(s) with which you are associated?</i>	10	79	11
3. <i>If there is an experience surplus as the result of favourable investment performance, are plan sponsors likely to grant enrichments to the pension plan?</i>	70	25	5
4. <i>Has this ever happened in the plan(s) with which you are associated?</i>	70	26	4

A significant number of respondents, in effect, express disagreement with the "textbook" view that plan sponsors bear all of the investment risk in defined benefit pension plans. Forty-five percent believe that sponsors of defined benefit plans are likely to grant smaller wage increases or other enrichments if large experience deficiencies emerge as the result of an adverse investment climate. If there is favourable investment experience, 70 percent indicate that sponsors of these plans are likely to grant enrichments in pension benefits. In other words, employees are likely to benefit from favourable investment performance and, to a lesser degree, suffer from

8. See Pesando (1988) for a review of the other responses, together with data on the respondents. Of potential importance is the fact that 34 percent of the respondents are associated with multi-employer plans. In these plans, there is no corporate guarantor of promised benefits, and hence there may exist a closer link between fund performance and the level of benefits than in single employer plans.

adverse investment performance. Interestingly, only 10 percent of respondents indicated that employees had helped bear the brunt of adverse investment performance in *their* plans, while 70 percent indicated that employees had shared the benefits of favourable investment performance. However, the lack of “sharing” the impact of adverse investment performance may simply reflect the relatively strong investment performance of pension funds from the mid-1970s to 1989, when the survey was conducted.

The view that employees are likely to bear some of the risk of *adverse* investment performance thus appears to be widespread, although not universal. Proportionately more respondents indicate that employees are likely to share the benefits of *favourable* investment performance.⁹ The view that collectively bargained outcomes focus on the size of required employer contributions to the pension plan, in spite of the defined benefit formula, is found, though in no way is it suggested that this view is universally held. If correct, this implies that employees *do* bear at least some of the risk of adverse investment performance. To date, this possibility — or likelihood — has not been addressed in the mainstream literature on pension economics.

SOME ECONOMETRIC EVIDENCE FROM WAGE-PENSION TRADEOFFS

Under our null hypothesis, employer pension plan contributions *per se* elicit concessions elsewhere in the compensation package, even in defined benefit pension plans. In principle, this proposition can be tested by estimating a standard model of the tradeoff between wages and pension benefits. Holding constant the defined benefit formula and other factors

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9. One can also find descriptions of the bargaining process in public policy documents which, if accurate, support our hypothesis. Frank Russell Canada Limited (1987), in a background report prepared for the Ontario Task Force on the Investment of Public Sector Pension Funds, observes (page 15):

Suppose the investment return is lower than the employer anticipated. This means that the employer will subsequently have to contribute more than anticipated for the benefits promised. Will the employer simply accept that he originally mis-priced the benefit, or will he attempt to recover some or all of the additional cost in subsequent negotiations with the employees? Similarly, if the investment return is unexpectedly high, will labour be content to let the advantage accrue to the employer, or will they attempt to secure some or all of the employer's cost-saving in subsequent negotiations with the employer?

The authors of this background report, on the basis of the comments of plan sponsors, unions and other interested parties, conclude that the sharing of investment risk with plan members is a prevalent feature of most defined benefit pension plans in Canada. The authors also acknowledge the difficulty of “proving” this hypothesis, in view of the large number of factors *other* than unexpected pension surpluses or deficits which impact on formal or informal labour negotiations.

which elicit compensating wage differentials, the wage rate should be lower, the higher are employer contributions to the pension plan.¹⁰

Economic theory predicts that there will be a negative tradeoff between wages and pensions if firms operate in competitive product and labour markets, if there are no transactions costs in enforcing or negotiating contracts, and if all parties have full information regarding the value of pension benefits. Existing studies, as surveyed by Gunderson, Hyatt and Pesando (1992), provide mixed results regarding the existence of a tradeoff between wages and pension benefits. These inconclusive results are typically attributed to the difficulty in holding constant the myriad of job characteristics that can impact on wages, and in controlling for selectivity and unobserved differences in worker quality. Further, a defined benefit plan may serve to enhance worker productivity by reducing both turnover costs and shirking, either through self-selection or the bonding associated with the deferral of compensation. Since higher productivity is likely to translate into higher total compensation, the cash wage paid to workers need not be lower if the employer provides a pension plan. This possibility further complicates the problem of identifying a wage-pension tradeoff (Montgomery and Shaw 1992).¹¹

In order to test the hypothesis that workers implicitly share in the investment risk of pension funds, we extend the data set used by Gunderson, Hyatt and Pesando (1992) to investigate the empirical tradeoff between wages and pension benefits. In particular, we construct alternative measures of employer contributions for a sample of 98 flat benefit pension plans in the Province of Ontario, appropriately matched with detailed data on wages and related components in the 1984 collective agreements.¹² We then

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10. Additional employer contributions will serve, *other things equal*, to improve the funded status of the plan and hence the security of promised pension benefits. However, plan termination insurance does exist in Ontario, which reduces the potential importance of this channel. Ehrenberg (1980), in his study of public sector plans in the United States, provides evidence that underfunding may be associated with smaller wage concessions in the absence of plan termination insurance.
 11. Gustman and Steinmeier (1987) offer a different reason why total compensation may be higher in firms which sponsor occupational pension plans: pensions may be a component of "efficiency" wages, designed both to attract high quality workers and to impose a significant penalty on workers who are dismissed from the firm.
 12. Flat benefit plans pay a fixed dollar amount (such as \$20 per month) for each year of service. These plans predominate in the unionized private sector. The pension plan information was drawn from the Statistics Canada Pension files. The pension data set contains detailed information on non-contributory, flat benefit pension plans for firms in Ontario. The wage and other collective agreement data are drawn from the data base maintained by the Ontario Ministry of Labour. The collective agreements cover 200 or more workers. Both the pension data and the collective agreement provisions were in effect on June 30, 1984. The two data sets were merged by visually matching company names, since this was the only piece of information which both data sets had in common.

regress the natural logarithm of the base hourly wage paid at these establishments on measures of pension compensation, holding constant a large number of factors which are likely to impact on the level of wages.¹³ Many of these other components are included in the regressions, as described in detail in Gunderson, Hyatt and Pesando.¹⁴

We construct two measures of employer contributions. The first is the size of the special payment required in 1984 to amortize existing unfunded liabilities and/or experience deficiencies, divided by annual payroll. The second is the sum of the special contribution and the employer's normal contribution, again scaled by payroll.¹⁵ We control for the level of pension benefits using the most tractable measure of the value of the flat benefit pension plan: the flat benefit rate (i.e., the number of dollars per month that members earn for each year of service). The flat benefit rate is scaled by the hourly wage rate in one set of regressions, and enters in level form in a second set of regressions.

The estimation results are summarized in Table 2. Equation (1), as is similar to Gunderson, Hyatt and Pesando, reveals a statistically significant, negative association between the hourly wage rate and flat benefit, when the latter is scaled by the wage. In regressions (2) and (4), the contribution measures are entered, without controlling for the defined benefit levels. In both of these regressions, the coefficients on the measures of employer contributions are negative, as expected, but not significant. If benefits are held constant by entering the flat benefit scaled by the hourly wage, as in equations (3) and (5), the coefficients on the contribution variables turn positive, but remain insignificant. The coefficient of the defined benefit variable is still negative and significant in both regressions.

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13. Note that, in this regression, the tradeoff between wages and pension benefits takes place at the level of the *employee group as a whole*. For collectively bargained plans, this appears to be the appropriate assumption. There is thus no need to calculate the expected lifetime values of either the wages or the pension benefits of individual workers.
 14. In order to capture the essence of the collective agreement, and mindful of degrees of freedom constraints, dummy variables were created for each of more than 80 contract provisions. The dummy variables were set equal to one if the provision, valued by workers, exists and zero otherwise. These provisions were classified into ten groups, and the number of provisions within each category summed for each observation.
 15. Special payments were required in 64 of the 98 pension plans in the data set. These payments ranged in amount from (about) \$950 to over \$1.6 million. The means and, in brackets, standard deviations for the pension measures are as follows: Flat Benefit/Hourly Wage 1.04 (0.42); Flat Benefit \$10.21 (4.52); Special Payment/Payroll 0.018 (0.037); Total Contributions/Payroll 0.046 (0.042).

TABLE 2
Wage-Pension Tradeoffs, Various Measures

	1	2	3	4	5	6	7	8
Flat Benefit/ Hourly Wage	-0.111 (-2.16)		-0.114 (-2.16)		-0.120 (-2.05)			
Flat Benefit						0.012 (2.17)	0.013 (2.24)	0.017 (2.76)
Special Payment/ Payroll		-0.094 (-0.16)	0.183 (0.31)				-0.371 (-0.63)	
Total Contributions/ Payroll				-0.365 (-0.69)	0.197 (0.33)			-1.028 (-1.82)
Employee security	0.015 (1.79)	0.016 (1.87)	0.016 (1.80)	0.016 (1.81)	0.016 (1.81)	0.017 (1.95)	0.016 (1.85)	0.014 (1.71)
Grievance procedures	0.006 (0.25)	0.005 (0.17)	0.008 (0.30)	0.003 (0.10)	0.008 (0.30)	0.003 (0.13)	0.001 (0.02)	-0.005 (-0.19)
Overtime and premium pay	-0.009 (-0.36)	0.002 (0.06)	-0.008 (-0.31)	-0.002 (-0.06)	-0.008 (-0.31)	0.012 (0.46)	0.010 (0.37)	0.005 (0.19)
Pay guarantees	0.117 (1.23)	0.122 (1.25)	0.115 (1.21)	0.124 (1.28)	0.115 (1.21)	0.107 (1.13)	0.110 (1.15)	0.110 (1.18)
Vacations and leaves	0.013 (0.96)	0.012 (0.89)	0.012 (0.91)	0.013 (0.95)	0.012 (0.91)	0.010 (0.73)	0.011 (0.79)	0.012 (0.90)
Allowances and benefits	0.004 (0.41)	0.003 (0.37)	0.004 (0.40)	0.004 (0.39)	0.004 (0.40)	0.002 (0.25)	0.002 (0.26)	0.002 (0.27)
Technological change	0.013 (1.04)	0.014 (1.10)	0.012 (0.92)	0.015 (1.21)	0.011 (0.91)	0.013 (1.10)	0.015 (1.22)	0.018 (1.50)
Health and safety	0.102 (2.63)	0.092 (2.31)	0.101 (2.58)	0.095 (2.39)	0.101 (2.58)	0.060 (1.44)	0.060 (1.45)	0.057 (1.41)
Union-management relations	0.005 (0.28)	-0.001 (-0.06)	0.004 (0.24)	0.001 (0.04)	0.004 (0.24)	-0.006 (-0.38)	-0.005 (-0.29)	-0.002 (-0.12)
Fringe benefits	0.030 (1.62)	0.031 (1.59)	0.030 (1.57)	0.032 (1.64)	0.030 (1.57)	0.026 (1.40)	0.027 (1.43)	0.028 (1.49)
Proportion female	-0.299 (-3.32)	-0.262 (-2.87)	-0.296 (-3.26)	-0.271 (-2.96)	-0.296 (-3.26)	-0.208 (-2.28)	-0.213 (-2.31)	-0.218 (-2.41)
Bargaining unit size (100's)	-0.005 (-0.74)	-0.008 (-1.37)	-0.005 (-0.72)	-0.008 (-1.31)	-0.005 (-0.72)	-0.010 (-1.84)	-0.012 (-1.86)	-0.011 (-1.88)
Durable manufacturing	-0.155 (-1.96)	-0.170 (-2.07)	-0.159 (-1.97)	-0.162 (-1.99)	-0.158 (-1.97)	-0.178 (-2.26)	-0.171 (-2.14)	-0.155 (-1.97)
Non-durable manufacturing	-0.126 (-1.53)	-0.164 (-1.99)	-0.127 (-1.53)	-0.157 (-1.90)	-0.127 (-1.53)	-0.193 (-2.38)	-0.190 (-2.34)	-0.181 (-2.26)
Intercept	2.148	2.071	2.152	2.074	2.153	2.028	2.021	2.015
R ²	0.49	0.46	0.49	0.46	0.49	0.49	0.49	0.51
n	98	98	98	98	98	98	98	98

Notes: ^a The dependent variable is the log hourly base wage rate in the collective agreement, with a mean of 2.26, or 9.84 dollars in natural units.

^b Bracketed figures are t-statistics. The critical values, for significance at the 0.01 level and 0.05 level, on a one-tailed test are 2.39 and 1.67.

When the flat benefit is entered in level form (i.e., not scaled by the wage rate), its coefficient is incorrectly signed (positive) and significant, as shown in equation (6). When the variables measuring employer contributions are entered with the flat benefit in level form, the coefficients of both are negative, as shown in equations (7) and (8). Further, the coefficient of total employer contributions is significant at the 5 percent level ("t"-statistic is 1.82), based on a one-tailed test.

We thus find that the estimates of the tradeoff between wages and pensions are not robust across alternative specifications. The results differ sharply depending upon whether the flat benefit is expressed as a fraction of the hourly wage or in level form. In the latter case, there is a significant role for the employer's total contribution to the plan, expressed as a percentage of payroll.

There are, as discussed, widely-acknowledged difficulties in estimating the tradeoff between wages and pensions. These difficulties are further complicated by an important limitation in the present data set. Based on the ready availability of these data, we ran the cross-section regressions for the year 1984. In 1982 and 1983, the median return on pension fund assets in Canada were 21.1 percent and 20.0 percent, respectively (Table 1). These returns are far in excess of the rates of return assumed in the plan valuations, and suggest that probably few employers in 1984 were required to make amortization payments for investment-driven experience deficiencies. For most of the plans in the sample, the special payments variable is undoubtedly dominated by payments required to amortize initial unfunded liabilities.¹⁶ Special contributions required to discharge an unfunded liability arising from retroactive enrichments in the pension plan are more likely to be associated with the payment of efficiency wages than are special contributions required to amortize experience deficiencies. For this reason, it may be difficult to detect a tradeoff between wages and special employer contributions in our data set.

For the purpose of testing our hypothesis, an ideal data set would isolate employer contributions required to amortize investment-driven experience deficiencies and encompass a period (such as 1973-1974) in which the investment performance of pension funds was well beneath anticipated levels. In addition, an ideal data set would permit researchers to construct measures of the *change* in the generosity of pension plans (for example, the amounts of the flat benefit formulas). This would permit an investigation of the possibility that the internalization of unexpected employer contributions

16. Flat benefit plans, such as those in our sample, are enriched on a periodic basis. These enrichments are invariably retroactive, and thus create new unfunded liabilities (Pesando, Gunderson, and Shum 1992).

to the pension plan occurs *within* the pension plan itself, rather than in the level of wages. This possibility, raised implicitly by Ippolito (1987), is worth investigating.

Finally, we note that employers have at least some discretion to manipulate the size of required plan contributions. Employers can, for example, alter the key actuarial assumptions, including the assumed rate of return. At a time when cash flow considerations are of paramount concern to the employer, and hence when the pressure to demand wage concessions in return for plan contributions is the highest, the employer may be able to reduce contributions *cæteris paribus* by appropriate revisions in the actuarial assumptions. If so, it might be difficult to detect a tradeoff between cash wages and employer contributions to a defined benefit pension plan.

CASE STUDIES

A Major Public Sector Plan in Ontario

Beginning on January 1, 1992, one of Ontario's largest public sector plans adopted a formula whereby pensions paid to retired workers will be increased by 70 percent of the percentage change in the consumer price index, to a maximum guaranteed increase of 6 percent in any year.¹⁷ Further, *if the surplus in the plan permits*, the inflation adjustment may be "topped up" to 100 percent of the increase in the consumer price index. The first annual increase under this new arrangement was, in fact, equal to the 5.47 percent rise in the consumer price index in the base period. This inflation adjustment consisted of a 3.83 percent adjustment under the guaranteed formula, plus a "top-up" of 1.64 percent permitted by the plan surplus.

The valuation rate in this plan, in *real* terms, is 4.5 percent. Suppose that the plan is fully funded (but not overfunded) at the beginning of the year. Then retired plan members will receive inflation adjustments in excess of 70 percent of the percentage change in the consumer price index if the real return on the fund exceeds 4.5 percent, other things equal. The *explicit* provisions in this plan thus suggest that members share in unexpectedly favourable fund performance.

In fact, it is immediately apparent that plan members *also* share in unexpectedly poor investment performance. Suppose, for example, that the plan experiences a deficit because the real return in year one falls short of 4.5 percent. Suppose, in year two, that the real return on the fund exceeds 4.5 percent, but not by a sufficient amount to bring the plan into a surplus

17. This same formula applies to deferred pensions.

position.¹⁸ In year two, as well as in year one, there will be no “top-up” to the guaranteed inflation adjustment paid to retirees. Retired plan members, as a result, clearly share in the *downside* risk of investment performance.

There are two points that merit emphasis. First, if “top-up” inflation adjustments or other plan enrichments are linked to the existence of fund *surplus*, then plan members share in downside as well as upside investment risk since adverse outcomes serve to reduce or eliminate surpluses. Second, the *risk-sharing arrangement* in this defined benefit plan is explicit, and thus is particularly instructive on this account. We believe that the implicit agreements in many defined benefit plans are likely to mirror this explicit arrangement.

A Large “Quasi-Public” Sector Plan in Ontario

This plan is a career average plan, in which the pension benefit is linked to the average earnings of the plan member during the “base” period. As is the case with many career average plans, this “base” period is periodically updated, to offset the eroding impact of inflation. This policy of periodic updates is well established, and plan members factor the timing and the magnitude of these updates into their retirement decisions.

On 1 January 1980, the base period for this plan was updated to the period 1976–79; that is, the average earnings of each plan member for the purpose of the pension benefit calculation was set equal to the plan member’s average earnings during this new four-year period. Traditionally, the base period in this plan is updated every two years. Plan members thus anticipated that the next update would occur on January 1st, 1982. Indeed, many members who were eligible for early retirement postponed their retirement in order to benefit from this anticipated increase.

In 1981, however, the return on the fund was only 4.8 percent, as a result of the weakness in both the bond and stock markets. This was well-beneath the nominal rate of return assumed for the fund, which was

18. In fact, the policy of this plan is to provide “top up” adjustments only if the plan surplus *exceeds* a target amount.

As discussed in footnote 2, plan sponsors in Ontario can amortize experience deficiencies over a period of 5 to 15 years. In addition, the valuations required by statute — which serve to identify experience deficiencies — occur every 3 years. As a result, employer contributions required to eliminate an investment-driven experience deficiency will *not* return the plan quickly to a fully-funded status, and hence the sharing of the risks of adverse investment outcome will occur in the manner described in the text.

7 percent.¹⁹ As a result, the update anticipated for January 1st, 1982 did *not* occur. Plan members thus shared the impact of this adverse investment performance. Interestingly, the return on the fund rose sharply in 1982 (in line with the recovery of both the stock and bond markets), to 17.7 percent. As a result, the base period was updated to the period 1979 to 1982 on January 1st, 1983. Further, this enrichment was extended retroactively to plan members who retired in 1982.

SUMMARY AND IMPLICATIONS

The defined benefit formula notwithstanding, formal and informal collective bargaining may focus on required employer contributions to the pension plan in order to identify the compensating wage adjustment. If so, members of defined benefit plans — not the firms who sponsor these plans — bear the investment risk associated with the performance of the pension fund.

In this paper, we draw attention to some exploratory evidence which suggests that bargaining, at least in some cases, *does* focus on the size of required employer contributions — a survey of pension professionals and two case studies. In addition, based on a previously assembled data set, we conduct an econometric study of the tradeoff between wages and pensions at 98 unionized establishments in Ontario. There is a statistically significant role for employer contributions *per se* in only one of several regression models that we tested. However, these results must be assessed in light of the lack of robustness in the estimated coefficients, together with the fact that investment-driven experience deficiencies are not likely to have been an important factor in our data set. Further, as evidenced by the two case studies, the internalization into total compensation of additional (unanticipated) employer contributions may take place within the pension plan itself, and not the level of cash wages.

We conclude that the “textbook” emphasis on the fundamental difference between defined benefit and defined contribution plans, which focuses on the allocation of investment risk, is overstated.²⁰ We would also

19. This valuation rate was well beneath the then prevailing interest rate on Government of Canada bonds, and was designed to produce the surpluses that would provide the basis for the periodic updates.

20. Nonetheless, it is important to note that significant differences *do* exist between these two types of pension plans. Defined benefit plans, through self-selection or incentives linked to the deferral of compensation, may serve to enhance worker productivity. The benefit formula, particularly the provisions pertaining to early retirement, can influence the age at which employees elect to retire. Defined benefit plans, unlike defined contribution plans, are easy to enrich retroactively. As a result, defined benefit plans are likely to be favoured in those settings, such as union establishments, where there are substantial intergenerational transfers.

emphasize that the question of risk-bearing in defined benefit plans has important implications for topical issues in the pension field. Consider, for example, the debate on the ownership of surplus pension fund assets.

A common argument among defined benefit pension plan sponsors is that because they exclusively bear the risk of funding deficiencies, they should also have exclusive access to surplus assets. Evidence of *de facto* risk-sharing by employees creates an important challenge to this argument and suggests the right of employees to share in surplus assets.

This important implication underscores the relevance of further research on the distribution of investment risk in defined benefit pension plans.

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RÉSUMÉ

La distribution du risque dans certains régimes de retraite à prestations déterminées

Sous l'égide de régimes de retraite à cotisation déterminée, les rentes dépendent des contributions versées au nom des travailleurs et de la performance d'investissement du fonds de pension. Par conséquent, les participants à un tel régime supportent les risques associés aux fluctuations des marchés financiers. En contraste, les régimes de retraite à prestations déterminées promettent aux participants des rentes préétablies qui ne dépendent pas des performances d'investissement des fonds de pension. Parce que ces régimes de retraite à prestations déterminées semblent déplacer le fardeau du risque d'investissement directement sur les employeurs, on croit sans contestation qu'ils sont, toutes choses étant égales par ailleurs, supérieurs aux régimes de retraite à cotisation déterminée.

Nous remettons ici en question ce point de vue traditionnel selon lequel les participants aux régimes de retraite à prestations déterminées sont

exempts des risques d'investissement. Les mécanismes par lesquels ils partagent le risque d'investissement sont les réductions de salaires et d'avantages sociaux ou des diminutions de d'autres particularités du fonds de pension telles l'indexation, les clauses de préretraite ou les enrichissements rétroactifs. Les employeurs ont traditionnellement soutenu que, parce qu'ils sont les seuls responsables du financement des à-courts du régime, ils devaient avoir le droit réciproque et exclusif de s'accaparer des surplus du régime. Si notre hypothèse est ici prouvée, cet argument des employeurs est alors attaqué.

En utilisant deux modèles de marché du travail, nous démontrons que l'incidence ultime de contributions patronales additionnelles requiert d'amortir les déficits du régime de retraite sur les employés, au moins en partie. Nous démontrons également que l'existence d'une assurance pour les prestations de pension, comme celle offerte par le gouvernement de l'Ontario, ne sert qu'à compliquer, sans l'altérer fondamentalement, notre hypothèse de base.

La recherche de données pour documenter le fait que les travailleurs supportent le risque d'investissement dans les régimes de retraite à prestations déterminées mène à trois sources. La première est une enquête auprès de spécialistes canadiens en matière de régimes de retraite. Lorsqu'on leur demande si les employeurs accordent de plus petites augmentations de salaires ou limitent l'enrichissement du fond lorsque celui-ci connaît de grands déficits, 45 % répondent par l'affirmative.

En second lieu, nous estimons une série de régressions basées sur un échantillon de 98 régimes de pension à prestations fixes en Ontario pour examiner la relation d'arbitrage entre les salaires et les prestations de pension. Nous régressons le logarithme naturel du salaire horaire de base sur des mesures alternatives de contributions patronales et un certain nombre d'autres variables susceptibles d'influencer les salaires. Les résultats n'infirment ni ne confirment notre hypothèse. Nous notons que, en plus des problèmes habituels associés à l'estimation de la relation d'arbitrage entre salaires et pensions, nos données proviennent d'une période (1984) qui a suivi deux années de très grand rendement sur les actifs des fonds de pension. Comme résultante, nous nous attendons à ce que peu d'employeurs dans nos données aient eu à effectuer des paiements spéciaux pour couvrir les pertes d'investissement et que toutes contributions spéciales de pension qui aient pu survenir l'aient été fort probablement pour amortir les responsabilités provenant des enrichissements périodiques des prestations.

Finalement, nous examinons deux études de cas, encore de l'Ontario. Le premier, un important régime de retraite dans le secteur public, lie les ajustements des prestations à l'inflation au surplus existant du fonds de pension. Si le fonds souffre d'une pauvre performance d'investissement pour

une année donnée, les prestations de pension ne seront pas pleinement indexées pour compenser pour l'inflation. Comme cette indexation est liée à la performance d'investissement du fonds, les participants supportent explicitement le risque d'une faible performance d'investissement (et aussi les avantages d'une bonne performance d'investissement). Dans la seconde étude de cas, les enrichissements prévus aux prestations de pension furent retardés à cause de la faible performance d'investissement de fond. Ces études de cas sont éloquentes en ce qu'elles démontrent que les travailleurs peuvent partager le risque d'investissement non seulement par des salaires plus bas, mais aussi par des réductions dans la générosité de certains éléments du régime de retraite à prestations déterminées.

Selon nos résultats, nous concluons que l'on exagère l'emphase sur la différence fondamentale entre les régimes de retraite à prestations déterminées et ceux à cotisation déterminée en ce qui a trait au partage des risques entre les employeurs et les travailleurs. L'argument courant des supporteurs des régimes de retraite à prestations déterminées est à l'effet que vu qu'ils supportent exclusivement le risque des pertes du fonds, ils devraient avoir accès exclusif aux actifs excédentaires. La preuve que les employés partagent ce risque *de facto* défie cet argument et suggère le droit des employés à partager les surplus.

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