

# Underfunding of Defined Benefit Pension Plans and Benefit Guarantee Insurance - An Overview of Theory and Empirics<sup>\*</sup>

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**Abstract:** We review the theoretical literature on defined benefit (DB) pension plans, particularly focusing on the issue of plan underfunding and benefit guarantee insurance schemes. The literature shows that underfunding can, under reasonable assumptions, be an equilibrium outcome even in the absence of benefit insurance. The introduction of benefit guarantee funds was a reaction to the problem of underfunding, and we summarize the ensuing standard problems of moral hazard and adverse selection. We briefly discuss the small empirical research on the subject and propose directions for future research.

**Keywords:** Defined benefit pension plans, underfunding, pension benefit guarantee

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## 1. Introduction

There is growing concern about the funding status of defined benefit (DB) pension plans both in Canada and internationally. Although the number of Canadian DB plans has steadily decreased in the last years, there are still a large number of employees (both in the private and public sectors) that rely on this type of plan for their retirement. Unfortunately, DB plans currently seem much less secure than initially anticipated and many current and future retirees might receive less than expected out of their pensions. This has prompted reaction by policy makers and formulated calls for reform of the DB plan institutional framework. Ontario recently appointed the Expert Commission on Pensions and discussions on reforms have been ongoing in the United States.<sup>1</sup>

In this paper we summarize the current state of the art of the literature regarding the aspect of DB pension plan funding and benefit insurance. Our main focus is on the theoretical literature, but we will briefly discuss empirical aspects mainly to outline future directions of research.

The literature converges on two main theoretical results. First, once we step away from perfectly competitive labour and financial markets we generally observe that underfunding of DB plans is an *equilibrium outcome*, even in the absence of pension benefit insurance.<sup>2</sup>

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<sup>1</sup> Wilcox (2006) is an exhaustive discussion paper on the reforms in the U.S.

<sup>2</sup> Besley and Prat discuss DB plans in terms of credibility issues.

Second the introduction of pension benefit insurance is a reaction to the problem of underfunding and gives rise to an additional set of theoretical results along the standard insurance problems of moral hazard and adverse selection.

Underfunding has been documented empirically. However, the effects of benefit insurance have, while well established theoretically, not received much attention. We outline suggestions of future research using the “natural experiment” institutional setting in Canada.

The remainder of the paper is structured as follow. Section 2 reviews the current state of the theoretical literature regarding underfunding as an equilibrium outcome without pension benefit insurance and the issues arising from introducing such insurance. Section 3 briefly discusses empirical work, both existing and future, and Section 4 concludes.

## **2. Review of the theoretical literature**

### *2.1 Underfunding as an equilibrium outcome without benefit guarantee insurance*

Under perfectly competitive markets underfunding of pension plans will not be an issue. The wage rate will be determined by market forces and workers will acknowledge pensions as a part of their remuneration package. Workers will

essentially pay for their pensions, while firms act as insurance providers. As long as firms are less risk averse than individual workers this improves efficiency (see Gustman *et al.*, 1994, p. 422).

While the assumption of perfectly competitive markets renders the studying of pension issues somewhat uninteresting it is also an unrealistic one. Indeed Ippolito (1987) writes “[defined benefit p]ensions appear to offer a classic example of a product that could not survive in an unfettered competitive market...” He offers an “implicit contract” theory (Ippolito, 1985a) of DB pension plans, where workers hold an unsecured bond of the firm. In this framework workers expect firms to fulfill pension promises.<sup>3</sup> As a consequence, the discount rate to calculate economic liabilities is different from the nominal interest rate, and different from what is usually applied in reports to regulatory authorities.<sup>4</sup> Implications of the model are i) a reduced mobility of workers and ii) the incentive of workers to contribute more heavily into the pension plan early in the career (with the respective consequences for the wage-tenure profile). In terms of the funding status of pension plans firms have an incentive to *underfund pension plans in equilibrium*, hence “... workers have a direct financial stake in the firm...” (Ippolito, 1985a, p. 1041). The degree of underfunding can be quite substantial. In a follow up analysis, Ippolito (1986) calculates the funding status of U.S. DB

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<sup>3</sup> Ippolito (1985) describes the alternative framework as a “legal” view of pension plans, where workers expect firms to terminate plans at any point in time. He offers empirical evidence that supports the implicit contract view of pensions, see below.

<sup>4</sup> More specifically, the “legal” framework implies the nominal interest rate as the discount rate, while the rate appropriate within the “implicit contract” framework is the difference between the nominal growth rates of wages and the nominal interest rate.

pension plans for 1978 and 1981. The average funding ratio was 65.5% and 76.8% respectively.

Again Ippolito (1985b) and within the implicit contract framework shows that firms can use underfunded pension plans as a tool to discipline hold-up incentives by unions. Again, within this model, underfunding of plans is an equilibrium outcome.

Cooper and Ross (2002) take a different route. They build a model of an optimal labour contract for risk-averse workers that includes retirement pension. Workers are more risk-averse than firms, hence there is scope for a pension plan arrangement. Their Proposition 1 (p. 674) shows that if firms have sufficient internal funding wage profiles are constant and pensions are fully funded.

Underfunded pensions arise when firms face borrowing restrictions (Proposition 5).<sup>5</sup> If firms do not have access to sufficient internal capital they will offer upward sloping wage profiles while at the same time reducing the funding of the plan. The model rests on a financial market imperfection, however, one that is fairly plausible.

To conclude, under fairly realistic assumptions of the working of labour and financial markets, underfunding of DB pension plans is an equilibrium outcome

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<sup>5</sup> Alternatively, regulation on pension portfolios leading to interest rate differentials can lead to underfunding.

even in the *absence of pension benefit guarantee mechanisms*. We next turn to the consequences of introduction such insurance.

## 2.2 *Theoretical aspects of pension benefit guarantee insurance*

The problem of underfunded DB pension plans was a driving element in the introduction of pension benefit guarantee insurance in most cases such schemes have been introduced, such as the Pension Benefit Guarantee Fund (PBGF) in the U.S. In Canada, where regulation of pension plans is at the provincial level, Ontario is the only jurisdiction with a benefit guarantee insurance.

Interestingly, Ippolito (1987) in the union hold-up model provides an economic rationale for the introduction of the PBGF. In this model, a period of high inflation reduced the incentive of firms to use underfunding as a tool to hold unions in check, hence reducing their opposition to benefit insurance, while, on the other hand, unionized workers were able to obtain a significant transfer from the PBGF. This works in situations where the fraction of beneficiaries is small enough with respect to the overall universe of plan members, such that the additional cost of insurance is negligible for each individual.

Benefit guarantee funds face challenges of their own. As usual in an insurance setting, these challenges can be analyzed along the lines of *moral hazard* and *adverse selection*.

Cooper and Ross (2003) take up their model and discuss the introduction of public insurance in this setting. Again they look at an optimal labour contract with the additional feature that firms might face borrowing constraints. As before, underfunding can be an equilibrium outcome in the absence of benefit guarantee. When introducing a public benefit guarantee fund, they find that the problem of underfunding is accentuated; a standard moral hazard argument. Specifically, while firms with sufficient capital would fully fund pension plans in the absence of insurance and only firms with low levels of capital reduce funding of plans, the introduction of a benefit guarantee induces *all* firms to reduce contribution to the plan.

Additionally, the authors look at the investment decision of plan managers by introducing a risky asset. While a risky asset might increase the funding tendency of firms in their plans it is also the case that risk exposure of the plan increases with minimal funding level. Hence, the introduction of a benefit guarantee might induce firms to increase their risk exposure.

A different feature of moral hazard is presented in Niehaus (1990): High risk firms have the incentive to increase benefit levels. Niehaus builds a simple model, where the benefit insurance represents a put option for the firm, with the particular feature that the insurance fee does not depend on the default risk of

plans.<sup>6</sup> The author shows that, as long as benefits are lower than the upper limit of the guarantee, the value of the put options increases with the level of promised benefits. Furthermore, this form of moral hazard increases with the level of underfunding of the plan.

Finally, benefit insurance where insurance rates do not adequately reflect bankruptcy risks, might induce firms with well funded DB pension plans to terminate their plans (or convert them into defined contribution plans). This gives rise to a problem of adverse selection in the universe of plans benefiting from the insurance (see e.g. Wilcox, 2006, for a discussion).

In summary, the existence of a benefit guarantee insurance can i) increase (but need not cause) the degree of underfunding; ii) induce plan managers to invest in risky portfolios; and iii) induce firms to terminate well funded plans. We next turn briefly to a series of empirical questions.

#### **4. Empirics**

While the theoretical issues of underfunding of DB pension plans, with or without benefit insurance, have been analyzed quite extensively, the number of empirical applications is rather small.

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<sup>6</sup> A so-called flat fee, a feature that was common for the PBGF both in the US and Ontario.



Underfunding of pension plans is well documented. As mentioned above, Ippolito (1986) performs an evaluation on the funding status of a sample of U.S. DB plans and finds significant underfunding. Further, regulatory authorities both in Canada and internationally have been reporting concern about the funding status of plans.<sup>7</sup> Incidentally, Ippolito (1986) presents much lower funding ratios as reported by the PBGC, hence, the fact that regulatory authorities report underfunded plans implies that “true” economic liabilities (as suggested by Ippolito) are even higher.

On the other hand, the effects of a benefit guarantee have been very scarcely explored. Niehaus supports his empirical model on moral hazard in benefit levels with an empirical analysis. He finds that plans which benefited from the introduction of the PBGC have significantly increased the level of benefits in the same period, compared to a control group that was not covered by the insurance (multi-employer plans). One important reason is that the PBGC is a federally administered program, thus, Niehaus’ analysis is based comparing plans before and after the introduction.

The situation in Canada, with Ontario the only Province with a guarantee, is potentially quite different. Either a much more comprehensive sample could be built comparing plans across jurisdictions over time, or, even more promising, a difference-in-difference analysis could be carried out. One could expect much preciser estimates on the effect of benefit insurance, both along the moral hazard

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<sup>7</sup> See, for example, Stewart (2007).

and adverse selection lines. Such work would not only benefit the Canadian reform discussion but could give insights for other, similarly administrated, funds such as in the U.K or the U.S.

To our knowledge, this special institutional setting has so far only been exploited in one study. Nielson and Chan (2006) study a panel of aggregate data on Canadian pension plans. Their explanatory variables are number of plans and plan assets. They find that Ontario DB plans have significantly higher levels of assets per participant than other provinces. The study, unfortunately, has to rely on a limited data set, as no information on plan liabilities is available to the authors. They are thus unable to assess the funding status of plans.

## **5. Conclusion**

The funding situation of defined benefit pension plans poses a significant threat to the retirement income of many current and future pension receivers. Even though the number of DB plans is decreasing, still a large number of workers rely on this type of plans for their retirement. Reforms are thus called for.

In this paper we outline the current status of the theoretical literature on the issue. We highlight that underfunding of DB plan is a likely equilibrium outcome even in the absence of pension benefit guarantee mechanisms. Next, we discuss the consequences of these insurance schemes. Both moral hazard and adverse

selection considerations arise. The degree of underfunding might be accentuated; plan sponsors have an incentive to invest in overly risky assets and increase the level of benefits in financially difficult situations; well funded plans might terminate their DB plans or convert them to DC ones.

Empirical analysis of these theoretical results are very scarce. While the problem of underfunding is commonly reported, few studies look at the effects of benefit insurance. Canada has a unique situation in that only Ontario has such an insurance scheme, while the other provinces (and the federal authorities) do not. This gives the possibility to compare plan behaviour over time across different institutional settings or, potentially even more precisely, estimate the effects of insurance via a difference-in-difference methodology.

## **References**

Besley, Timothy and Andrea Prat (2005) Credible Pensions. *Fiscal Studies* 26(1):119-135.

Cooper, Russell W. and Thomas W. Ross (2002) Pensions: Theories of Underfunding. *Labour Economics* 8:667-689.

Cooper, Russell W. and Thomas W. Ross (2003) Protecting Underfunded Pensions: the Role of Guarantee Funds. *Journal of Pension Economics and Finance* 2(3):247-272.

Gustman, Alan L.; Olivia S. Mitchell and Thomas L. Steinmeier (1994) The Role of Pensions in the Labor Market: A Survey of the Literature. *Industrial and Labor Relations Review*, 47(3): 417-438.

Ippolito, Richard A. (1985a) The Labor Contract and True Economic Pension Liabilities. *The American Economic Review* 75(5):1031-1043.

Ippolito, Richard A. (1985b) The Economic Function of Underfunded Pension Plans. *The Journal of Law and Economics* 28(3):611-651.

Ippolito, Richard A. (1986) The Economic Burden of Corporate Pension Liabilities. *Financial Analysts Journal* 42(1):22-34.

Ippolito, Richard A. (1987) The Implicit Pension Contract: Developments and New Directions. *The Journal of Human Resources*, 22(3): 441-467.

Niehaus, Gregory R. (1990) The PBGC's Flat Fee Schedule, Moral Hazard, and Promised Pension Benefits. *The Journal of Banking and Finance* 14:55-68.

Nielson, Norma L. and David K.W. Chan (2006) Private Pensions and Government Guarantees: Clues from Canada. *University of Calgary Risk Management & Insurance Working Papers* 06-02.

Stewart, Fiona (2007) Benefit Security Pension Fund Guarantee Schemes.

*OECD Working Papers on Insurance and Private Pension.*

Wilcox, David W. (2006) Reforming the Defined-Benefit Pension System.

*Brookings Papers on Economic Activity* 2006(1):235-303.