Pension Fund Governance and the Choice Between Defined Benefit and Defined Contribution Plans*

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Abstract

Recent events in several countries have underscored the importance of good governance in private occupational pension plans. The present paper uses contract theory to analyze the interplay of residual claims and control rights in private pensions. The residual claimant is the plan sponsor in a defined benefit (DB) plan and the pool of beneficiaries in a defined contribution (DC) plan. The main control rights we examine relate to decisions on funding, asset allocation, and asset management. Under complete contracting, governance can be shown to be neutral: DC and DB plans differ only on risk allocation. If instead contracts are incomplete, a DB (DC) plan should: (1) Assign more vigilance responsibility to the sponsor (beneficiaries); (2) Rely

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less (more) on trustees; (3) Tend to employ trustees that are professional experts (caring insiders); (4) Assign asset allocation rights to the sponsor (beneficiaries); (5) have strict funding requirements.

1 Introduction

Until recently, most policy debates on pensions – especially in Europe – focused on public responsibilities and the difficulties that many publicly funded schemes have in meeting their obligations. However, recent events, not least declines in stock markets, have increased the salience of such issues in privately funded pensions. This has major implications for countries, such as the U.S. and U.K. which have already gone heavily down the private funding route. However, it may also affect the attractiveness of this option as an alternative to public funding. The Pension Benefit Guaranty Corporation (PBGC) estimates that US companies have accumulated pension deficits of around 300 billion dollars. In the UK, Morgan Stanley estimates that the aggregate pension deficit of the FTSE 100 companies in the end of 2002 is 65 billion pounds. Serious deficits are also reported in private occupational plans in Germany and the Netherlands.

It is tempting to view the woes of privately funded pensions as an exogenous event driven by the world-wide shift in investor confidence. However, this is at best an incomplete picture. It is clear cut that there is significant variation in the performance of pension plans subject to the same market conditions. Moreover, there has been an increasing focus on pension plans whose poor performance can be attributed to firms' excessive investment in own stock. When ENRON failed, its employees lost not only their job but also most of their pension assets, of which over 60% was invested in ENRON stocks. This suggests that a full understanding on the issues needs to understand the framework in which investment and funding decisions are made.

These issues should be in seen in the context of the shift from defined benefit (DB) to defined contribution (DC) pension plans (Poterba et al. [16]). In the US, contributions to 401(k) plans (the main form of DC scheme) amounted to 18% of total contributions in 1985. Today, they make up over 80% of the total. In the UK, this shift has been both more recent and more dramatic. Since 2001 scores of companies have closed down their DB plan to new entrants and, in some case, they have dismantled existing DB plans.

To their disappointment, employees have been offered DC plans instead.

This paper develops a framework which links these issues in the context of questions about the governance of pensions which links the nature of the pension contract (DC/DB) with investment performance and funding adequacy. To do so, we develop an approach to pension provision inspired by contract theory. The main focus is on governance. Paralleling the literature on corporate governance, we study the importance of residual claims and control rights in creating incentives for good performance. As in the theory of the firm, the starting point is the acknowledgment that contracts are incomplete. It is essential in pension plans to understand who owns the residual surplus or deficit (shareholders, creditors, employees, etc...) and who has the right to make decisions. Our results make plain the link between residual claim structure and control right allocation.[1]

In private pension governance, the key determinant of residual claim is the choice between DB and DC. In principle, surpluses and losses accrue to the sponsor in a DB plan and to the beneficiaries in a DC plan. In practice, things are complicated by several factors, such as the possible presence of other residual claimant like insurers, the legal difficulty for a sponsor to appropriate surpluses, or the risk for insolvency. We will examine some of those – extremely important – complications later in the text but our starting point is a stylized dichotomy between a DB plan in which the sponsor is the residual claimant and a DC plan in which the beneficiaries have residual claims.

We study the interaction between the DB/DC choice and three areas of control rights: funding decisions, asset allocation, and asset management. Funding decisions relate to the determination of the monetary flows into the pension fund. Asset allocation and asset management are two components of the plan's investment strategy. Asset allocation is a high-level longer-term decision on the classes of assets that the fund will invest in. For example, it includes the choice of how much to devote to fixed income and how much to devote to equity, or to whether to allow, or even encourage, investment in own stock. Asset management is instead the day-to-day determination of the investment portfolio within the broad classes identified in the asset allocation phase. While the distinction between asset allocation and asset management is one of degrees, in practice there is an important difference: in most plans asset management is outsourced to external fund managers

[1]See Tirole [21].

while asset allocation is not. Therefore, in the case of asset management, the important point is vigilance. Whoever is in charge of monitoring asset management must exert effort to evaluate the performance of fund managers and, if necessary, fire underperformers and hire promising managers.

The core contribution of this paper is to establish a connection between the residual claim structure of a pension fund and its optimal control right structure. The analysis is in many ways simple. However, it provides a first step towards identifying challenging theoretical questions and interesting empirical puzzles, suggesting directions for future research.

The players in our model are the sponsor (the employer or a group of employers), the beneficiaries (the workers who participate to the plan), and the fund manager. We will also consider another class of actors, who are supposed to monitor the pension fund on behalf of the beneficiaries. Following the common law term, we will refer to them as *trustees*.

We begin by analyzing a world of complete contracts. The sponsor and the beneficiaries can sign binding agreements on all the aspects of the pension plans. In particular they can contract on how much vigilance on the fund manager each party will exert and what asset allocation they will choose. In this context, we prove an irrelevance result. If both parties are risk-neutral a DB and a DC plan are equivalent, in that they produce the same equilibrium level of vigilance, the same allocation, and the same expected utility for both parties. If the parties are not risk-neutral, then the choice between DB and DC is only determined by which party is more risk averse.

The complete contract world constitutes a benchmark. In order to get interesting governance result, we need to consider contract incompleteness. For analytical clarity, we do this in steps. First, we consider non-contractible vigilance. This will, among other things, provide a role for trustees. We also examine the possibility that the contract between the beneficiaries and the trustees is, in turn, incomplete and we compare alternative incentive structures for trustees: either professional trustees motivated by career concerns or "caring laymen" driven by a stake in the pension fund. Second, we see what happens when asset allocation is non-contractible. While the analysis is general, we have in mind two areas of practical interest: purchase of own company stock and excessive risk taking. Finally, we remove the assumption that funding levels are contractible. We endogenize the possibility of default and we study the link between residual claimancy, risk of insolvency, and incentives for underfunding.

Each of the three steps is accompanied by a critical survey of existing

work, which is mostly of an empirical nature. Theoretical predictions are compared with available evidence. In some cases, interesting puzzles emerge, such as the underperformance of pension fund in comparison with mutual funds. In other cases, the theory helps us identify areas in which more empirical work could be particularly useful, such as in analyzing the personal characteristics and the incentive structures of pension fund trustees.

The structure of the paper is as follows. In the next section, we discuss the background to the analysis in the paper and related literature. In section 3, we introduce the model that we use throughout the paper. Section 4 then shows that governance issues are irrelevant in a world of complete contracts. In section 5, we focus in on incentives for vigilance in pension plans. We also discuss the role of trustees. In section 6 we discuss asset allocation in greater detail while in section 7 we look at underfunding. Section 8 concludes.

2 Background

The structure developed here is most appropriate for thinking about private occupational plans. We leave out state pensions and supplementary private pensions in which the employer plays no role. In occupational pensions, a key relationship is that between the pension sponsor (the employer or a set of employers) and the beneficiary (the employee, who will draw pension benefits upon retirement). They are collectively responsible for monitoring the way in which the pension assets are managed. In the basic model that we study, we discuss how the level of vigilance depends on the structure of the contract.[2]

There are a number of key players involved in pension fund management. At the heart of it all are the beneficiaries and the sponsor. The roles that they fulfil depend on the exact pension contract on offer. However, both are typically contributors to the pension fund and may play a role in checking that the fund is properly managed.

The assets in the plan are typically managed by a fund manager. The typical form of contract depends on size the funds under management. The main financial incentive therefore comes through increases the size of this i.e., not losing the contract. Also important can be the terms on which annuities are offered or purchased in the fund. The quality of annuities may

[2]For an excellent overview of private pension governance in several countries see OECD [12].

be a function of a good management, for example, appropriately matching assets and liabilities.[3]

There are two kinds of important "external" actors. Many funds rely on external audit and validation. The increasing importance of consulting actuaries is a key feature of pension fund governance in recent years. These can play an important role of pension fund management. However, recent accounting scandals in the United States have served as reminder that incentives matter in getting auditing done effectively – it is not merely an issue of mechanical checks.

The other key players are monitors. In common law countries, the pension scheme is typically set up as a trust and the monitoring role is taken up by trustees. In other legal systems,it can be a foundation with a foundation board (NL, CH), a mutual association with a board of directors (Germany), or a pension fund management company supervised by a control commission (Portugal and Spain). For simplicity, we refer to the person or body in charge of monitoring the plan as "the trustee". While we do not underestimate differences in legal systems, we choose to model the trustee in a stylized manner in order to provide an accessible discussion of general features of monitoring in pension plans.

From an economic point of view, pension funds are a network of overlapping contractual arrangements that specify obligations on the part of all of these key players. If all behavior were the subject of verifiable contractual arrangements and there were no information problems, the governance structure would be largely a veil – any incentives available under one governance structure could be replicated by another by appropriate choice of contracts. We argue that incompleteness of contracts is a key feature of pension fund governance and will imply the need to match the governance structure to the incentives of the various parties and the nature of the pension contract being used.

It should be remarked from the outset that the aim of the present analysis is not to provide a realistic description of pension fund governance, but rather to identify, in a simplified model, a few aspects of pension plans that appear to be crucial from a governance perspective.

[3]Annuitization is not discussed in this paper. For an analysis of the asymmetric information problems related to annuities, see Finkelstein and Poterba [3].

3 The Basic Model

There are three players: the beneficiary (subscript b), the sponsor (subscript s) and the asset manager. The asset manager produces a stochastic return $r \in [0, \infty)$. There are two kinds of actions which affect the pattern of returns which we call vigilance, denoted v and asset allocation denoted by a where $a \in A$. The cumulative distribution of return r is denoted by:

$$F(r|v, a),$$

where $F_v(r|v, a) \leq 0$ for all returns r: vigilance induces a first order stochastically dominating distribution of returns. The way in which returns depend on a need not be specified in general. However, the reader may prefer to think of asset allocation as a set of decisions that affect the riskiness of the distribution of returns while vigilance affects the mean.

By a, we mostly have in mind the possibility that a portion of the pension fund is used to purchase stocks in the sponsor company or in companies associated with the sponsor company. This is common practice for certain categories of pension plans in the US and it brings the sponsor two potential benefits: additional financing at rates that are lower than market rates and long-term performance-related incentives for the workforce. Mitchell and Utkus [8] provide a comprehensive analysis of investment in company stock in the United States.

The sponsor is assumed to be risk neutral, while the beneficiary may be risk averse. We suppose that this return can be responsive to vigilance by the beneficiary and sponsor. Total vigilance is $v = v_b + v_s$. Asset allocation is an indivisible decision and can only be controlled by one or other party.

We assume that the sponsor and the beneficiary strike a contract that specifies a series of contributions into a pension plan along with a constitution which specifies responsibility for vigilance and asset allocation. The sponsor and the beneficiaries face a cost from being vigilant denoted by $c_b(v_b)$ in the case of the beneficiaries and $c_s(v_s)$ for the sponsor. Asset allocation has no direct cost. However, we assume that the beneficiary may have preferences over which assets are held in their pension plan (for example as a means of bolstering demand for the firm's own stock). These considerations are captured by a function $d(a)$.

We consider two contractual structures for pension plans: defined benefits and defined contribution. For the purposes of this exercise the key distinction between the two is in terms of residual claimancy. In a DB plan, this is the

sponsor, while in the DC plan it is the beneficiary. The pension plan is bundled with an employment contract which we model very simply. The beneficiary receives a retirement plan and a monetary wage w.

To keep the model tractable, we assume that there are two periods. In the first period, the sponsor offers a wage and makes a unitary contribution to the pension fund.[4] In the second period, the fund return is realized, the beneficiary receives his benefit, and the sponsor may make an additional contribution or receive a distribution from the fund. For simplicity we assume that the sponsor and the beneficiary have the same discount rate and we normalize it to one. For simplicity, the utility function of the beneficiary is assumed to be separable and identical across the two periods. A beneficiary that receives wage w in period 1 and pension benefit p in period 2 has utility $U(w)+U(p)$. The function U has the usual properties including $U'>0$ and $U''\leq 0$.[5]

In a DB plan, the sponsor is the residual claimant. The beneficiary is promised a fixed pension p. Any difference between r and p accrues to the sponsor:

$$\begin{aligned} W_s^{DB}(w,v,a) &= -1+\int_{\underline{0}}^{\infty} r dF(r|v,a)-p+d(a)-w-c_s(v_s) \\ W_b^{DB}(w,v,a) &= U(w)+U(p)-c_b(v_b) \end{aligned}$$

By assuming that the sponsor always pays the promised pension p, we are excluding the possibility of default. We will examine the risk of insolvency in sections 6 and 7.

In a DC plan, the sponsor has no claims to the returns from the investment. Hence, she faces only monitoring costs. The beneficiary now bears the full risk from the investment returns. The payoffs now are, therefore,

$$\begin{aligned} W_s^{DC}(w,v,a) &= -1+d(a)-w-c_s(v_s) \\ W_b^{DC}(w,v,a) &= U(w)+\int_0^{\infty} U(r)\, dF(r|v,a)-c_b(v_b) \end{aligned}$$

[4]In this section, we simplify the problem by assuming an exogeneously given contribution to the pension plan (perhaps due to unmodeled tax reasons). In Section 7 we endogenize the sponsor's contribution and consider the possibility of over- and underfunding.

[5]The assumption that there are only two periods allows us to abstract from other – perhaps equally important – differences between DB and DC plans. For instance, in a truly dynamic model we would need to consider the differential effect of career risks on the two schemes.

Thus, in our stylized framework, the only difference between a DB and a DC plan is ownership of the return r. In a DC plan the beneficiary owns r, while in a DB plan the beneficiary owns p and the sponsor owns the difference $r-p$ (which can be negative or positive). In both plans, the sponsor contributes a unitary amount in period 1. As no assumption is made on p, we cannot say whether the expected benefit is higher under DC or DB.

4 Complete Contracts

Suppose now that vigilance and asset allocation can be contracted over perfectly in the sense that the two parties can sign binding contracts on how much vigilance each of them will exert and what the asset allocation will be (and they can make side-payments to each other). We assume that the sponsor is the one designing the scheme. She chooses between DB and DC and she selects vigilance v_s and v_b and allocation a. We also assume that, in order to persuade the beneficiary to accept a job at the sponsor company, the sponsor must offer a total level of utility u (equal to an unmodeled outside option).[6]

First, assume that both parties are risk neutral. We shall prove an irrelevance result: the optimal governance structure is the same in a DB or DC plan.

The sponsor must provide utility u. In a DB plan this means

$$w + p - c_b(v_b) = u,$$

while in a DC plan it implies

$$w + \int_0^\infty r dF(r|v,a) - c_b(v_b) = u$$

Then, substituting w into the sponsor's payoff, we see that a sponsor who must provide her risk-neutral beneficiary with expected utility u obtains the same profit, whether it is a DB or a DC plan:

$$W_b^j(u,v,a) = -1 + \int_{\underline{0}}^\infty r dF(r|v,a) + d(a) - u - c_b(v_b) - c_s(v_s) \qquad j \in \{DB, DC\}.$$

[6]The assumption that it is the sponsor who designs the the scheme is not driving the results. The two propositions of this section would hold as stated if the scheme were designed by the beneficiary under the constraint that it provides a certain expected payoff to the sponsor.

This means that, for any u, the optimal vigilance and allocation do not depend on whether the plan is DB or DC. Moreover, the sponsor's expected payoff is the same irrespective of who the residual claimant is. Thus,

Proposition 1 *With complete contracting and a risk-neutral beneficiary, the optimal vigilance v_s and v_b and allocation a do not depend on whether the plan is DB or DC. Moreover, the sponsor and the beneficiary are indifferent between DB and DC.*

The result is intuitive. The sponsor and the beneficiary agree on what an efficient plan is, i.e. the one that solves

$$\max_{v_s,v_b,a} \int_{\underline{0}}^{\infty} r dF\left(r|v,a\right) + d\left(a\right) - c_b\left(v_b\right) - c_s\left(v_s\right).$$

Whether the residual claimant is the sponsor or the beneficiary, they will implement the efficient vigilance and asset allocation. The choice between DB and DC determines only the allocation of risk, but that is inconsequential because both parties are risk neutral.

Next, suppose – perhaps more realistically – that the beneficiary is risk-averse. We can show

Proposition 2 *With complete contracts, a risk averse beneficiary, and a risk neutral sponsor, a DB plan is always optimal.*[7]

Proof. As before, fix a level of utility u and assume that the sponsor must provide the beneficiary with u. In a DB plan this means

$$U\left(w\right) + U\left(p\right) - c_b\left(v_b\right) = u,$$

while in a DC plan it implies

$$U\left(w\right) + \int_0^{\infty} U\left(r\right) dF\left(r|v,a\right) - c_b\left(v_b\right) = u$$

Hence,

$$U\left(p\right) = \int_0^{\infty} U\left(r\right) dF\left(r|v,a\right).$$

[7]The converse holds if the beneficiary is risk neutral and the sponsor is risk averse. A DC plan is optimal.

But then, by concavity of U, we have

$$p < \int_0^\infty r dF\left(r|v,a\right).$$

Hence, for any possible v_s, v_b, and a, it is cheaper for the sponsor to provide utility u through a DB plan rather than a DC plan. ■

With complete contracting, pension governance and risk allocation are essentially orthogonal. If both parties are risk-neutral, it does not matter who the residual claimant is. If one party is risk-averse and the other risk-neutral, then the residual claimant should be the latter. As it is reasonable to assume that the beneficiary is more risk-averse than the sponsor, this result speaks in favor of DB plans.

One should emphasize that DB optimality is not a general result. We have dispelled with other risks such as labor market and human capital risk which can be more important in a DB than a DC plan. Notwithstanding, there is a general point here – that *under complete contracting the choice between a DC and DB plan should reflect only the optimal allocation of risk bearing between the sponsor and the beneficiary and not the incentives for monitoring.*

In the rest of the paper, we drop the assumption of complete contracting. As we wish to focus on pure governance issues rather than risk allocation, we assume that both parties are risk neutral. Thus, Proposition 1 provides a benchmark against which we can compare all the other results. Our strategy will be to consider the issues one dimension at a time. We begin with the study of vigilance.

5 Vigilance

We now depart from the complete contracting benchmark by assuming that vigilance is non-contractible. This is realistic since the kinds of prudential activities that are demanded for the successful management of a plan are very difficult to write down in a contract. To study the non-contractability of vigilance in isolation, we assume that $d\left(a\right) = 0$ and suppress all reference to a in what follows.[8]

[8]The present analysis does not allow for interactions between vigilance and asset allocation. However, less common types of investment – like emerging markets or hedge funds – might require more vigilance. One might conjecture that plans that provide strong vig-

Any vigilance in a pension plan now has to be incentive compatible, i.e., in the interest of the vigilant party to carry it out. Thus we need to consider vigilance levels $(\hat{v}_s, \hat{v}_b)$ that form a Nash equilibrium between the sponsor and the beneficiary, i.e., satisfy:

$$\begin{aligned} \hat{v}_s &\in \arg\max_{v_s \geq 0} W_s^j (v_s + \hat{v}_b) - c_s (v_s) \\ \hat{v}_b &\in \arg\max_{v_b \geq 0} W_b^j (\hat{v}_s + v_b) - c_b (v_b) . \end{aligned}$$

It is immediate to see that only the residual claimant has an incentive to exert vigilance. One of the two parties, the beneficiary in DB and the sponsor in DC, will shirk completely.

Proposition 3 *Suppose that vigilance is not contractible. In a DC plan* $\hat{v}_s = 0$ *and*

$$\hat{v}_b \in \arg\max_{v \geq 0} \int_0^\infty u (r) \, dF (r|v) - c_b (v) .$$

In a DB plan, $\hat{v}_b = 0$ *and*

$$\hat{v}_s \in \arg\max_{v \geq 0} \int_0^\infty r dF (r|v) - c_s (v) .$$

This stands in marked contrast to the complete contracting situation. There is no guarantee that the party with the comparative advantage in being vigilant is responsible for doing so.

This finding breaks the indifference between DB and DC plans which we found under complete contracting. In fact, the allocation of residual claims now rests exclusively on comparative advantage in exercising vigilance. We will work with an example which parametrizes the marginal cost of monitoring in a simple way. Specifically, let $c_b (v_b) = \frac{1}{2} \kappa_b v_i^2$. The sponsor has vigilance cost $c_s (v_s) = \frac{1}{2} \kappa_s v_s^2$, where, typically, $c < 1$. Suppose again that the sponsor is in charge of designing the pension plan and she must provide the beneficiary with expected payoff u.

It is easy to see that, for any u, the optimal plan gives residual claimancy to the party with the lower vigilance cost:

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ilance incentives will also make investments in assets with a higher moral hazard danger. This potentially interesting problem is left for future research.

Proposition 4 *If $\kappa_s < \kappa_b$ ($\kappa_s > \kappa_b$), then the sponsor will offer a DB (DC) plan.*

This result endogenizes the choice between DB and DC. One might think that the sponsor has more resources than beneficiaries. This would provide a powerful argument in favor of DB plans. In the end of this section we will contrast this result with the available empirical evidence.

5.1 Trustees

The previous analysis rested on the existence of a unitary beneficiary. However, beneficiaries are typically a large dispersed group while the sponsor may be a more concentrated interest. The present section identifies a free-riding problem among beneficiaries and introduces trustees as way of solving the free-riding problem.

Suppose that there are n identical beneficiaries, each of which has vigilance cost $c_i(v_i) = \frac{1}{2}\kappa_b v_i^2$. The sponsor has vigilance cost $c_s(v_s) = \frac{1}{2}\kappa_s v_s^2$. Suppose also that beneficiaries are risk neutral and that the expected return given total vigilance $v = v_s + \sum_{i=1}^{n} v_i$ is simply

$$E(r|v) = v.$$

It is easy to see that the efficient level of vigilance is $v_s = \frac{1}{\kappa_s}$ and $v_i = \frac{1}{\kappa_b}$ for every beneficiary i. The expected return is then $\left(\frac{1}{\kappa_s} + n\frac{1}{\kappa_b}\right)$.

However, in a DB plan, the equilibrium vigilance is $v_s = \frac{1}{\kappa_s}$ with no vigilance on the part of beneficiaries. The expected return in this case $\frac{1}{\kappa_s}$. In a DC scheme is $v_s = 0$ and $v_i = \frac{1}{n\kappa_b}$ for each beneficiary (and $\frac{1}{\kappa_b}$ in total), with expected return $\frac{1}{\kappa_b}$.

In both types of schemes we have the familiar problem that the party who has no residual claim exerts no vigilance. But in a DC scheme there is an additional issue. The beneficiaries have a joint residual claim and each of them does not internalize the full benefit of additional vigilance. This free-riding problem leads to a level of vigilance, $\frac{1}{\kappa_b}$, which is lower than the level that is collectively optimal – $\frac{n}{\kappa_b}$. This is due to the fact that vigilance is public good and beneficiaries free ride on the vigilance exerted by others.

Suppose that $\frac{\kappa_b}{n} < \kappa_s < \kappa_b$. Then, if the beneficiaries could agree on a common vigilance level, a DC plan would be better than a DC plan, while

if there is a free-riding problem, a DB beats DC. We summarize the above with

Proposition 5 *The presence of multiple beneficiaries rather than a unitary beneficiary creates a free-riding problem in beneficiary vigilance. This reduces the attractiveness of DC plans vis-à-vis DB plans.*

The appointment of a trustee can be thought of as a means of overcoming this free-rider problem. The next subsection will delve deeper into the issue of what motivates trustees. For now, let us assume that the trustee acts perfectly in the beneficiaries' interest when exercising vigilance in a DC plan and has a cost of monitoring is: $c_t(v_t) = \frac{1}{2}\kappa_t v_t^2$. Then in a DC plan, the equilibrium level of vigilance is $v_t = \frac{1}{\kappa_t}$. We thus draw the following lessons:

Proposition 6 *Trustees provide a possible solution to free riding among beneficiaries. A DC (DB) plan is optimal if the beneficiaries' trustee has a lower (higher) cost of vigilance than the sponsor.*

The lesson of this section is that the presence of a third-party monitor is particularly useful when the party with residual claim rights faces a free riding problem. As this is more likely to happen for beneficiaries, a strong and motivated board of trustees should be viewed as an essential ingredient, especially of DC plans.[9]

5.2 Evidence on Performance

The main message of the model with non-contractible vigilance is that the performance of a fund depends on the capacity of the residual claimant to exert effort. The normative lesson is that we should give residual claim to the party with better monitoring skills. It is instructive to benchmark some of these theoretical findings against available empirical evidence.

In practice most people would argue that the sponsor has a double advantage over beneficiaries. First, being a unitary player she does not face a free-riding problem. Second, she might draw on in-house expertise to ensure proper monitoring. If this is true, DB plans should display a better performance than DC plans, and this would provide a strong argument in favor of

[9]Free rider problems could also afflict DB plans with multiple sponsors – for example a scheme that is industry wide with sponsors being specific firms in the industry. Similar logic would then apply to the role of trustees in DB plans.

DB. To evaluate this statement, note that performance has two components: returns and costs.

With regards to cost, there is a large body of literature comparing administrative charges (any cost incurred in running the pension plan, from distribution costs to management fees) across countries and types of funds. These charges turn out be quite high: Murthi, Orszag, and Orszag [9] estimate that in the UK administrative costs take away 25% of the pension value (accumulation ratio) of a typical individual account pension. Whitehouse [22] reports extensive international evidence that individual plans (in which each beneficiary is responsible for choosing and monitoring his asset manager) have higher fees than institutional plans. For instance, charges for Australia's individual accounts are more than twice as high those of Australia's institutional accounts. Whitehouse ascribes the charge difference to the complexity of understanding the fee structure of pension funds. Clearly, overcoming this complexity is feasible for an professional investor but harder for an individual investor. These facts are consistent with the idea that decentralized beneficiary monitoring leads to lower levels of vigilance and hence worse performance.

With regards to returns, the theory predicts that professional investors obtain larger returns than retail investors because, having a lower cost of monitoring, they exercise more vigilance in equilibrium. This, however, is in contrast with the findings of Lakonishok, Shleifer, and Vishny [6]. The analyze a large database of US all-equity pension funds from 1983 to 1989. They find that (the equity-invested component of) the average pension funds underperforms the S&P 500 index. This is true for pre-fee returns and holds a fortiori once fees are taken into account. Virtually no money manager in the sample produces a long-term post-fee return above the S&P 500. Even more interestingly, pension funds appear to mutual funds. This is in clear contradiction with our prediction that professional investors (who are the purchasers of pension funds) should do better than retail investor (who buy mutual funds).[10]

Theory predicts that asset managers that are monitored by large professional investors (pension funds) should perform better than asset managers that are monitored by individual and relatively inexpert investors (mutual funds). It is therefore surprising to find that such performance differential is not observed in practice – an possibly the opposite is. One possibility

[10]Del Guercio and Tkac [2] also study pension fund returns.

is that, because all the funds in the sample are DC schemes, there is actually a lack of vigilance from trustees, who are mostly related to the sponsor. An agency-theoretic explanation is advanced by Lakonishok et al. [6], who suggest that the additional monitoring activity of pension trustees may actually be the cause of the lower returns. While retail investors pick funds almost exclusively on the basis of past performance, pension trustees also use other information, such as the stated fund strategy. The reliance on non-performance information may encourage fund managers to focus their energy on "looking good" with the pension trustees, for instance by presenting a consistent story, to the possible detriment of performance.

Prat [17] provides a formalization of the argument put forward by Lakonishok et al. [6]. There is a pool of investors and a fund manager may be good or bad. A good fund manager is better at predicting changes in asset prices. The fund manager is driven by career concerns: he wants to persuade investors that he is good because he will attract more funds in the future. Investors are rational and evaluate the fund manager's ability based on all available information. The investors always observe the return generated by the fund manager. The question is whether it is in their interest to observe also the composition of the portfolio chosen by the manager. It turns out that it may be optimal for investors to commit not to observe the composition. If the fund manager knows that he is evaluated only on observed return, he has an incentive to maximize expected return. If he knows that he is also evaluated on the portfolio he chooses, he has an incentive to choose the portfolio that maximizes his chance to be perceived as good. This creates an incentive to behave in a conformist way, to the detriment of expected return. In practice, portfolio composition is not observable in mutual funds (in which individually-managed accounts are typically invested) but it is observed in pension funds. This difference may explain the apparent lackluster returns of DB pension funds.

5.3 Professional Experts or Caring Laymen?

There is a great deal of variation in the background and motivation of trustees. A recent survey by Robinson and Kakabadse [18] reports that only 7% of UK trustees have specific investment qualifications and only 22.5% have professional accounting qualifications. Over 50% have no specific qualification. Is there an optimal trustee profile? Does it depend on the type of environment and/or the type of scheme?

In the previous section, the issue was whether or not a trustee was an expert in the sense of being skilled at exercising vigilance. But this said nothing about what kind of trustee would provide the best incentives to monitor. Here, we contrast two stylized models: *inside trustees* and *outside trustees*. The outsiders are experts, who have the potential of exercising very effective vigilance. However, the outsiders have no direct stake in the pension scheme, so they must be driven by external incentives (career concerns). According to this view, an outside trustees who is perceived to be capable will get future rewards in the form of more lucrative or prestigious jobs in the future.[11] In contrast, we model insiders as having less investment expertise, but a greater intrinsic commitment to the beneficiaries. This could be because they are beneficiaries themselves or because they feel a bond with the other beneficiaries who are co-workers, friends etc.. While, our distinction between insiders and outsiders is a rough and ready, it seems like a sensible starting point to think about trustees. In particular, the competent but career oriented trustee may be a useful way of capturing the professional cadre of pension fund trustee that was suggested by the Myners report [10]. However, it is clear that, in reality, some insiders have great technical competence while some outsiders can feel a strong sense of duty to the fund beneficiaries. Still, we feel that this distinction reflects an important trade-off that may arise in the selection of trustees.

Consider first the insider. His vigilance cost is $c(v) = \frac{1}{2}\kappa v^2$, and he maximizes the expected return of the pension scheme minus the vigilance cost:

$$v - \frac{1}{2}\kappa v^2.$$

Then, as we saw above, he chooses

$$v_I = \frac{1}{\kappa}.$$

For modelling outside trustees we follow (a simplified version of) Holmstrom's [4] career concerns model. The outsider trustee has the same vigilance cost of the insider: $c(v) = \frac{1}{2}\kappa v^2$, but the effect of vigilance on returns depends on his type θ, which is distributed as a normal with mean m and

[11] We need not assume that outsiders are necessarily motivated by money; they may strive for prestige or status. The crucial point is that their goals can only be achieved through external recognition rather than intrinsic satisfaction.

precision h_θ (the precision is 1/variance).[12] An outsider of type θ who exerts vigilance v obtains a return

$$r = \theta + v + \epsilon,$$

where ϵ is distributed as a normal with mean 0 and precision h_ϵ. The outsider does not know his own type. His future reward depends on the posterior on his type that is assessed (by a market for potential employees) based on the observed return. Let $\hat{\theta}(r)$ be the posterior evaluated by the market using Bayes rule. The trustee's payoff is

$$\beta\hat{\theta}(r) - \frac{1}{2}\kappa v^2,$$

where β is a positive constant that captures the strength of career concerns. Following Holmstrom [4], it is possible to obtain:

Proposition 7 *An outside trustee selects vigilance level*

$$v^* = \frac{\beta h_\varepsilon}{\kappa(h_\theta + h_\varepsilon)}.$$

Proof. Suppose the market for potential employees expects the trustee to choose vigilance v^*. Then, by Bayes' theorem, the market uses posterior

$$\hat{\theta}(r) = \frac{h_\theta m + h_\varepsilon(r - v^*)}{h_\theta + h_\varepsilon}$$

The trustee solves

$$\max_v \beta E\left[\hat{\theta}(r)|v\right] - \frac{1}{2}\kappa v^2$$

which can be rewritten as

$$\max_v \beta\frac{h_\theta m + h_\varepsilon(m + v - v^*)}{h_\theta + h_\varepsilon} - \frac{1}{2}\kappa v^2$$

yielding first order condition

$$\kappa v = \frac{\beta h_\varepsilon}{h_\theta + h_\varepsilon}$$

[12] His type is unknown to him and to outsiders.

In equilibrium

$$v = v^* = \frac{\beta h_\varepsilon}{\beta \left(h_\theta + h_\varepsilon \right)}.$$

■

The key observation for our purpose is that effort is *decreasing* in the variance of the noise component ε. The higher σ_ϵ, the more difficult it is, given the observed performance, to separate luck from ability or effort. A good return is more likely to be due to the ε component than to $\theta + v$. Therefore, a good return has less effect on the trustee's posterior. This in turn reduces the trustee's incentive to exert effort.

To fix ideas, it is useful to examine the two extreme cases where $h_\epsilon \to \infty$ and $h_\epsilon = 0$. In the former, the equilibrium vigilance level is $\frac{a}{c}$. Assuming that the career concern strength is above a certain threshold ($\beta > 1$), then an outsider trustee supplies a better expected performance than an insider. If instead, $h_\epsilon = 0$, it is immediate to see that the outsider puts no effort, and an insider produces a better expected return. To summarize:

Proposition 8 *An outside trustee performs better than an insider when the market provides strong career concerns (β is high) and the link between vigilance and return is direct (h_ϵ is high). An inside trustees perform better when career concerns are weak and the vigilance-return link is noisy.*

The proposition reflects some of the determinants of the trade-off between using professional experts or relying on internal laymen. In principle, outside experts can provide excellent vigilance, but they must be motivated to do so by the prospect of external rewards, which requires two conditions. First, there must be an established mechanism through which trustees that are perceived to be capable are rewarded. This may happen through other job offers or perhaps the enjoyment of wide reputation. Second, there should be a clear link between vigilance and return. It is not enough that this link exists *in expected value* (which is what counts from a welfare point of view). In order to provide the trustee with career concerns incentives, the link should also be relatively noise-free. It would be important to know whether these two conditions are met in practice.

The above discussion makes no intrinsic distinction between trusteeship in DB and DC schemes. This would depend on whether insider motivation is higher in one case of another. To this end, one possibility is that inside

trustees have stronger intrinsic motivation when they know that their fellow workers are the residual claimants. Then the conclusion would be as follows:

Proposition 9 *DC plans should rely more on self-motivated insiders while DB plans should be overseen by professional experts.*

The analysis has focused so far on incentives of pension fund trustees. However, it also suggests reasons why selection can be important. Indeed, trustee selection may be important dimension of pension fund governance. One issue is whether the beneficiaries should be given some direct input in this or whether the task of trustee selection is delegated to the sponsor. In DC plans, the sponsor would have little incentive to scrutinize potential trustees in order to optimally resolve the trade-off in this section. Thus, we would expect that the beneficiaries (suitably informed) to be given the right to select trustees in DC plans. We would similarly expect beneficiary input in trustee selection to be less important in DB plans.[13]

6 Asset Allocation

We now switch to concerns in pension governance that relate to asset allocation. As discussed in the introduction, by "asset allocation" we mean a high-level decision on broad classes on investment instruments, which is not the responsibility of fund managers. A typical fund manager operates within a well-defined investment class, such as domestic stocks or fixed income.

This section deals with a potential moral hazard problem that arises when the sponsor has some control on asset allocation. The degree of control varies a lot according to the type of plan. In some old-fashioned DB plans, the sponsor makes asset allocation decisions directly. However, in most collective plans asset allocation is the responsibility of trustees. The question then arises of how much control the sponsor has over the trustees. While trustees are nominally acting on behalf of beneficiaries, it is commonly believed that the sponsor has considerable influence on the nomination process and, more in general, on the decision-making of trustees.

A very interesting issue is how much control over asset allocation sponsors have in individually-managed retirement plans. This issue is particularly debated in the US with regards to 401(k) plans (Mitchell and Utkus [8, p. 4] and

[13] An exception (discussed further below) would be in distressed pension, i.e., those which are close to insolvency.

Poterba [15]). The asset allocation decision rests with the beneficiary, who selects among several investment options. However, the investment menu is assembled by the employer and it may include the employer's stock. The employer has thus several way to influence asset allocation, from restricting investment options to offering additional benefits for own stock purchases. Moreover, Mitchell and Utkus [8, p. 4] suggest behavioral explanations. There is evidence that framing effects and other forms of psychological pressure have powerful effects on individual financial decisions.

In the following, we assume that the sponsor has some control – whether direct or indirect – on asset allocation. We mostly think about investment in own stock, which is a widespread phenomenon in the US. The much publicized ENRON case is far from unique. Mitchell and Utkus [8, p. 4] report that over 5 million American workers have a DC plan in which more than 60% of the funds are held in their employer's stock.

The sponsor selects an asset allocation a from a set of feasible allocations A. The range of the feasible set is determined by the ability of the sponsor to control allocation. Each allocation a creates a direct benefit or cost $d(a)$. While the model is general, we mostly think of the benefit as arising from investment in own stock.

In a DB plan, the sponsor chooses portfolio allocation

$$\hat{a}_{DB} \in \arg\max_{a} \int_{\underline{0}}^{\infty} r dF(r|a) + d(a);$$

while in a DC plan she chooses

$$\hat{a}_{DC} \in \arg\max_{a} d(a).$$

Clearly, $\hat{a}_{DB}$ is efficient while $\hat{a}_{DC}$ is typically not. Given a DC plan the efficient allocation (attained under complete contracts) would be:

$$a^*_{DC} \in \arg\max_{a} \int_{0}^{\infty} r dF(r|a) + d(a)$$

which is identical to the level of monitoring achieved in a DB plan.

Thus we have:

Proposition 10 *Sponsor determined asset allocation is efficient in a DB plan but not in a DC plan. Thus, if the sponsor controls asset allocation, a DB plan is preferable.*

The fact that the sponsor is not a residual claimant under a DC plan means that he will not weight the effect of his asset allocation decision on the expected returns of beneficiaries. He is driven purely by any private motives that he has. This clearly has implications for the transition from DB to DC plans where the sponsor retains a significant role in asset allocation decisions.[14]

The result is consistent with the evidence in Meulbroek's [7] study. They argue that DC plans in the US are highly undiversified and they provide a quantification of the undiversification cost: under reasonable assumptions, a DC plan beneficiary who has half of his wealth in a pension plan which invests half of his assets in company stock values company stock 42% less than its market value. Meulbroek's cost estimate is a lower bound because it does not consider the possibility of a positive covariance between the employee's salary and the company stock price.

These issues are even more pressing in a situation where the a plan may become insolvent and the sponsor is protected by limited liability. Suppose that the sponsor's net worth (disregarding the pension scheme) is N. Also, assume that pension benefits are the most senior claim. Then, the promised pension p is paid in full only if it is lower than the combined value of the pension fund and the sponsor's net worth:

$$p \leq N + r.$$

Otherwise, the beneficiary becomes the residual claimant. The payoffs in a DB plan become:

$$\begin{aligned} W_s^{DB}(a) &= -1 + d(a) + \int_{p-N}^{\infty} (r - (p-N))\, dF(r|a) - w \\ W_b^{DB}(a) &= p + \int_0^{p-N} (r - p + N)\, dF(r|a) + w \end{aligned}$$

For $N \geq p$, we recover the unlimited liability case analyzed so far.

Now, it becomes clear that even in a DB plan the sponsor does not necessarily choose the efficient a. Given that she holds the equivalent of a call

[14]The optimality of a DB plan with sponsor controlled asset allocation holds up even the possibility of beneficiary controled allocation is considered. A beneficiary has no direct interest in asset allocation in a DB plan and would choose asset allocation to maximize the expected return in a DB plan under our current assumptions. In neither case is the asset allocation efficient except when $d(a) = 0$, in which case DB and DC plans with asset allocation controled by their residual claimants are equally good.

option on the fund return, she has an incentive to increase the variance of the return, which can be achieved by lack of diversification.[15]

Proposition 11 *If insolvency is possible and the sponsor controls asset allocation, then even under DB the resulting allocation is inefficient, in the sense that it is too risky. This problem is worse, the smaller is N relative to p.*

Intuitively, this is driven by the fact that the sponsor cares only about the states in which the pension plan is solvent. The tendency towards excessive risk taking embodies the usual problem of "gambling for resurrection" which occurs when there is limited liability.[16]

It should be noted that, since ERISA was passed in 1974, in the US the risk of insolvency for DB plans is not borne by beneficiaries but by a federal agency: the Pension Benefit Guarantee Corporation. One of the provisions of ERISA is that no DB plan can invest more than 10% of its funds in company stock. As Mitchell and Utkus [8, p. 4] note, "Congress instituted the 10% limit to avoid the moral hazard problem of plan sponsors investing pension plans heavily in their own stock and leaving pension liabilities to the federal government in the case of bankruptcy." It is interesting that no limit is imposed on DC plans despite the fact that they face the same moral hazard problem.

7 Choice of a Funding Level

The analysis so far has abtracted from underfunding issues by holding fixed the contribution level of the sponsor. In DC plans, this is a reasonable assumption because employer contributions are typically a component of employment contracts. However, in DB plans, this is not necessarily the case. Most often, there is some kind of a requirement that the fund assets are sufficient to cover future liabilities. However, the terms "sufficient" and "future liabilities" are open to interpretation as recent events have brought

[15] See Blake [1] for a general way of representing pension schemes as options on pension fund assets.

[16] Beneficiary controled asset allocation may now be optimal. Indeed, if $d(a) = 0$, a DC plan with asset allocation under the control of the beneficiary is optimal. In general there is a trade-off between DC/DB and sponsor versus beneficiary controled asset allocation depending on $d(a)$ and the size of N.

into sharp relief. Given that asset returns are not entirely predictable, the "sufficient" part is subject to market risk. The "future liabilities" are also uncertain because they depend on wages and job separations. It is the job of trustees, assisted by actuaries, to express an opinion on whether the funding requirement is satisfied. Clearly, this opinion is subjective. Several methods are consistent with accepted actuarial practices. In as much as the sponsor nominates and supervises trustees, we should expect the trustees' opinions to be influenced by the sponsor's preferences.

Underfunding of DB plans has recently come to the fore in the UK following the adoption of a new accounting standard, FRS 17, which requires pension fund assets to be measured using market value. This new requirement, combined with a fall in stock prices, has generated fears that many of the leading UK DB pension plans will display severe underfunding. As a result, either the plans will be closed or the sponsors will have to make additional contributions. A recent Financial Times article [20] estimates that in a sample of large DB plans the current funding level is 87%.[17]

We formalize the issue as follows. Suppose that a DB plan has a funding level $\theta \leq 1$. The upper bound is assumed to be set by the tax system. To simplify matters, we hold fixed the vigilance level and the investment policy, so that the return distribution is simply $F(r)$. The level of benefits specified in the contract are funded if $r\theta \geq p$. Hence, there is a critical level of the return: p/θ such that the commitment can be honored if and only if the return exceeds this level. Now consider the choice of funding level by the sponsor in a DB plan.

$$\begin{aligned} W_s^{DB}(\theta) &= -\theta + \theta \int_{p/\theta}^{\infty} \left(r - \frac{p}{\theta}\right) dF(r) - w \\ W_b^{DB}(\theta) &= p + \int_0^{p/\theta} \left(r - \frac{p}{\theta}\right) dF(r) + w. \end{aligned}$$

It is straightforward, to see that the efficient level of funding (that maximizes the joint payoff of the sponsor and beneficiary) which would be chosen under complete contracts is $\theta = 1$ as long as pension investments are worthwhile at all, i.e. $\int_0^{\infty} r dF(r) > 1$. Now consider what happens when the funding level is not contractible. In this case, the sponsor will choose:

[17] In the case of overfunding, the sponsor does not necessarily have access to the excess portion of the fund. Petersen [14] studies the phenomenon of pension plan reversions in the United States, that is, the termination of overfunded pension plans.

$$\theta_{DB}^{s} = \arg\max_{\theta \leq 1} \left\{ \theta \int_{p/\theta}^{\infty} \left(r - \frac{p}{\theta} \right) dF(r) - \theta \right\}.$$

It is straightforward to check that the payoff function is convex in θ. Hence, it will either be optimal for the sponsor to put in no resources ($\theta = 0$) or the full amount ($\theta = 1$). A sufficient condition for full funding is $\int_{p}^{\infty} r dF(r) > 1$. This says essentially that stock market returns above the level of the benefit commitment needs to be attractive to the sponsor. This is a stricter condition for full funding than required in the efficient solution.

Proposition 12 *In DB plans with the possibility of insolvency, sponsors may have an incentive to shirk on their contributions. In this case, a DC plan is optimal.*

This result can help us to understand the current move towards DC plans in a world where underfunding is a serious issue. The fact that stock market returns have fallen can imply that funding DB commitments is no longer optimal ($\theta_{DB}^{s} = 0$).

The analysis makes clear why controlling θ by imposing some minimum funding $\underline{\theta}$ is important in the context of sponsor incentives. This raises the more general issue of the extent to which funding can be contracted upon and monitored. The recent debate in the UK about FRS 17 illustrates the issues vividly. FRS 17 requires pension fund assets to be measured using market value. While FRS 17 does not modify the funding requirement $\underline{\theta}$ per se, it forces greater transparency. With the new rules, several pension schemes appear to be severely underfunded. In this sense, the introduction of FRS 17 is not dissimilar from a statutory increase in $\underline{\theta}$. The shift that we are seeing towards DC should be seen as a response to the difficulties to finding ways of undoing incentives of sponsors to underfund their pension plans when market returns to investing are low.

Another solution suggested by the model is to have more direct input by beneficiaries into determining contribution levels as a means of encouraging efficient funding levels. One possibility is to give power to trustees to coerce sponsors. However, this clearly leads to issues of corporate governance which go beyond the scope of this paper.

8 Conclusions

This paper is a first step toward an analysis of pension fund governance from a contract-theoretic perspective. While we hope that future research will explore this approach further, and perhaps complement it with other methodologies, it is useful at this point to summarize the main results:

1. If the sponsor and the beneficiary have complete contracting ability, the allocation of residual claim rights becomes irrelevant from a governance point of view. The party who is less risk-averse – typically the sponsor – should be the residual claimant. This argument goes in favor of DB plans.

2. With incomplete contracts, residual claimancy matters for governance. If we focus on vigilance, we should make the party with a lower vigilance cost the residual claimant.

3. If beneficiaries are disperses and disorganized, DC plans face a free-riding problem that reduces vigilance. The presence of a strong and motivated board of trustees may provide a solution.

4. The choice between professional outsiders or caring insiders depends on whether career incentives to outsiders are expected to function effectively. This depends on the existence of a well-defined job market for trustees and of a relatively noiseless link between trustees' behavior and fund performance. We should expect DB plans to make more use of outsiders and DC plans to rely more on insiders.

5. If the sponsor is responsible for asset allocation, the risk of mis-allocation is an issue especially in DC plans because the sponsor's allocation objectives are not aligned with the goal of efficient allocation. The problem is present also in DB plans if there is a possibility of insolvency.

6. Underfunding is not an issue in DC plans, but it can be a problem in DB plans if there is a possibility of insolvency.

Throughout the paper, we have tried to compare the predictions that come from our theory with available empirical evidence. Point 3 is consistent with the observation that administrative costs are generally higher in DC plans. However, the complementary prediction that returns too should be

higher in DB plans does not appear to receive empirical support. Regarding point 5, the case of US 401k plans appear to be consistent with the prediction that there could be lack of asset diversification in sponsor-controlled DC plans. Point 6 suggests that underfunding could be an issue in DB plans unless strict regulation is in place – a prediction that could be consistent with recent developments in UK DB plans.

The paper suggests some possible areas for future research. First, besides Robinson and Kakabadse's [18] survey, we do not have much information on trustees. Point 4 suggests that trustee profiles in DB and DC plans should display systematic differences. More generally, we expect the trustees' ability and willingness to monitor the fund to depend on their backgrounds and their environment. In turn, monitoring should reflect on plan performance. It would then be useful to collect evidence on the link between institutional features of trustee boards and performance of the plans that they oversee.

Second, it would useful to have more evidence on the performance of pension funds in comparison to the performance of mutual funds, along the lines of Lakonishok et al. [6]. Their alleged ability to generate better performance through more professional monitoring is a strong selling point of DB plans. It would be important to verify or disprove this claim.

Third, in practice the distinction between DB and DC is not entirely clear. Often in DB plans, the sponsor has some leeway in re-defining the "defined" benefits over time. Future theoretical research in this field could study more general claim structures and how governance plays a role in determining these.

Fourth, it would be important to evaluate the extent of sponsor moral hazard in the recent DB underfunding crisis. More knowledge in this area is essential to to assess proposed regulatory changes. In particular, moral hazard considerations should lead to some re-thinking of pension claim seniority in the UK.

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