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Intergenerational risk sharing in closing pension funds☆

Tim J. Boonen [a,*], Anja De Waegenaere [b,c]

[a] Amsterdam School of Economics, University of Amsterdam, Netherlands
[b] Department of Accountancy, Tilburg University, CentER for Economic Research and Netspar, Netherlands
[c] Department of Econometrics and OR, Tilburg University, CentER for Economic Research and Netspar, Netherlands

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ABSTRACT

We model intergenerational risk sharing in closing funded pension plans. Specifically, we consider a setting in which in each period, the pension fund's investment and indexation policy is the outcome of a bargaining process between representatives of the then living generations. Because some generations might be under- or overrepresented in the board, we use the asymmetric Nash bargaining solution to allow for differences in bargaining powers. In a numerical study, we compare the welfare that the generations derive from the outcome of this repeated bargaining to the welfare that they would derive if a social planner's optimal policy would instead be implemented. We find that as compared to the social optimum, older generations benefit substantially from the repeated bargaining, even if all generations are equally well-represented in the board. If older generations are relatively over-represented, as is sometimes argued, these effects are attenuated.

1. Introduction

The combination of a severe financial crisis, unanticipated longevity shocks, and tighter regulation, has implied that many Defined Benefit (DB) pension funds have decided to change their pension plans to (collective) defined contribution plans. Existing participants can then no longer accrue new rights in the DB fund, new participants can no longer enter, and it needs to be decided how the assets that were accumulated in the past are divided over the remaining generations. In a DB fund, participants or generations typically do not "own" a share of the assets, and so there is no objective way to divide the accumulated assets over the different generations. Therefore, we model a setting in which the available assets stay in the DB fund, until full rundown. In each period it is decided whether and how accrued rights are indexed or cut, and how the remaining assets are invested.

There is a substantial amount of literature that deals with optimal payout and investment policies in collective pension funds or PAYG pension systems (see, e.g., Enders and Lapan, 1982; Gordon and Varian, 1988; Krueger and Kubler, 2002; Ball and Mankiw, 2007; Gollier, 2008; Cui et al., 2011). Our study differs from this literature in two ways. First, we consider a closing fund, which implies that risk can no longer be shared with the "unborn" generations. Second, whereas the existing literature typically takes a welfare perspective, we consider a case where a pension fund board consisting of representatives of different generations needs to decide on the payout and investment policies in each period. Because different generations have different horizons, they typically have different preferences regarding indexation and investment policies (see, e.g., Merton, 1971; Merton and Samuelson, 1974; Blake, 1998; Teulings and de Vries, 2006; Bovenberg et al., 2007; Hoevenaars and Ponds, 2008). Therefore, the investment and payout policies that are jointly determined by representatives of different generations will depend on how well each remaining generation is represented in the board. To take this into account, we use the *asymmetric* Nash bargaining solution to model the outcome of a bargaining process in which some generations may have more bargaining power than others. We ensure time consistency by using a "period-by-period" approach in which decisions are made

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* Corresponding author.
E-mail address: t.j.boonen@uva.nl (T.J. Boonen).

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for the current period only, while rationally anticipating future decisions.[1] We assume that for each generation, continued participation until decease (or full run-down of the assets) is mandatory, i.e., individuals do not have the option to leave the pension fund.[2] Instead, their rights are represented by representatives in the pension fund's board, and the task of the board of a pension fund is to design a pension policy that is perceived as "fair" by the participants of all generations.

In the first part of the paper, we present the model and derive the dynamic optimization problems that need to be solved in order to determine the investment and indexation policies that the pension board would take if, in every period, the representatives of the remaining generations bargain over the policy that will be implemented in that period. We then compare the investment and indexation policies that result from this repeated bargaining with the outcome that a social planner who cares about aggregate social welfare would prefer, as in Gollier (2008). We numerically analyze the welfare effects of the optimal policy for the different generations under both approaches. We find that, as compared to the social optimum, the elderly benefit substantially from bargaining. The result is robust to changes in the calibrated parameter values.

This paper is set out as follows. In Section 2, we present the characteristics of the DB fund, and discuss the setting that we consider. In Section 3, we model the pension fund's optimal investment and benefit policies as the outcome of a bargaining process by which the members of the pension board weigh the utility that each generation derives from a particular strategy. In Section 4, we numerically analyze the welfare effects of the optimal policy for the different generations. Finally, Section 5 concludes.

2. Model

In this section we first discuss the characteristics of the defined benefit (DB) fund that we consider. We then discuss our approach to determine optimal draw down strategies for the fund after it closes.

2.1. Characteristics of the DB fund

We let date $t = 0$ be the date at which the DB fund closes for new accruals and new participants. We assume that every participant works (or has worked) for three periods and is (or will be) in retirement in the one or two periods thereafter. Hence, on date zero there are five generations in the pension fund: three generations with active workers and two retired generations. Every generation is assigned a number from the set $\{0, 1, 2, 3, 4\}$. The generation with number τ then corresponds with the generation that is in its second retirement period at the beginning of period τ.

We introduce the following notation and assumptions:

- Participants in generation τ have entered the fund at the beginning of period $\tau-4$ and only leave the fund due to decease.
- Participants die either at the end of their first retirement period or at the end of their second retirement period.
- We allow for heterogeneous generations that may be different in size and life expectancy. Within a generation, all individuals are homogeneous with respect to accrued pension rights and survival rates. We use the following notation for generation $\tau \in \{0, \ldots, 4\}$:
  - $N_\tau > 0$: the number of participants in generation τ at the beginning of their first retirement period, i.e., on date $t = \tau - 1$.
  - $p_\tau \in (0, 1]$: the deterministic fraction of participants in generation τ that are still alive at the beginning of their second retirement period.
  - $\widetilde{L}_\tau > 0$: the accrued pension right for each participant belonging to generation τ in the pension fund. These accrued rights serve as *benchmark* for the pension payment that each participant in generation τ receives at the beginning of its first retirement period, and, if alive, at the beginning of its second retirement period. The actual payment can be different due to conditional indexation or cutting of pension rights.

Table 1
Balance sheet of the pension fund.

Assets	Liabilities
Risk-free assets	Benchmark liabilities L_0
Risky assets	Buffer
A_0	L_0 + buffer

The participants in generation τ have accrued pension rights $\widetilde{L}_\tau$ during their active life prior to date 0. The best-estimate value of the accrued pension rights is defined as the discounted expected pension payments, where the discount rate equals the deterministic risk-free rate, r^f. At the beginning of period 0, generation $\tau = 0$ is in its last period of the retirement. All other generations $\tau > 0$ are either still active or in their first period of retirement. Hence, the date-0 best-estimate value of the pension rights of an individual in generation $\tau \in \{0, \ldots, 4\}$ who is alive on date-0 is given by:

$$\begin{aligned} \widehat{L}_\tau &= \frac{\widetilde{L}_\tau}{(1+r^f)^{\tau-1}} + p_\tau \cdot \frac{\widetilde{L}_\tau}{(1+r^f)^{\tau}} \quad \text{if } \tau > 0, \\ &= \widetilde{L}_\tau, \qquad\qquad\qquad\qquad\quad \text{if } \tau = 0. \end{aligned}$$

We let L_0 denote the best-estimate value of the aggregate liabilities of all five generations on date 0. On date $t = 0$, there are $p_0 N_0$ participants in generation $\tau = 0$, and N_τ participants in generation τ for $\tau > 0$. Therefore, it holds that:

$$L_0 := p_0 \cdot N_0 \cdot \widehat{L}_0 + \sum_{\tau=1}^{4} N_\tau \cdot \widehat{L}_\tau. \tag{1}$$

The asset value of the pension fund at time $t = 0$, denoted by $A_0 > 0$, is the aggregated value of the risk-free and risky assets of the pension fund. Table 1 presents a schematic overview of the balance sheet of the pension fund at time $t = 0$.

2.2. Closing the DB fund

Because the DB fund closes on date $t = 0$, the participants no longer accrue new rights in the DB fund. However, the fund continues to exist, and the generations collectively need to agree on the investment and benefit policies until full run down of the assets. Shocks in investment returns can be shared by all generations alive, and so the generations can benefit from intergenerational risk sharing (Gollier, 2008; Goecke, 2013; Bonenkamp and Westerhout, 2014). Because the pension fund closes for new entrants, however, the degree of risk sharing is limited. Specifically, risk can no longer be shared with "unborn" generations. Moreover, different generations typically have different preferences regarding the indexation policy and the investment policy of the fund (see, e.g., Teulings and de Vries, 2006; Bovenberg et al., 2007). We model a case in which these decisions are made by the board of the pension fund, which consists of representatives of each of the

[1] It is well-known that in multi-period settings, the Nash bargaining solution is not time consistent for a broad class of differential games (Haurie, 1976). The importance of time consistency is shown by Pelsser and Stadje (2014) and Pelsser and Salahnejhad (2016).

[2] Ligon et al. (2002), Westerhout (2011) and Beetsma et al. (2012) show that when participation in risk sharing pools is voluntary, this generally limits the possibility to share risk efficiently.