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Sustainability of participation in collective pension schemes: An option pricing approach☆

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ABSTRACT

This paper contributes to the discussion about mandatory participation in collective funded pension schemes. It explores under what circumstances individual participants exercise the option to exit such a scheme if participation is voluntary. We begin by showing how the willingness to participate increases if the period over which the option is valid becomes longer. Then, we demonstrate how the pension fund's set of policy instruments can be deployed to minimize the likelihood that any cohort exits the pension scheme. The instruments consist of contribution and indexation policies. Recovery of the funding ratio, i.e. the ratio of assets over liabilities, to its regulatory target level may be based on uniform contributions or age-dependent contributions. Specifically, while the value of the exit option deters younger workers from exiting the pension fund, a uniform contribution policy encourages older workers to stay in the pension scheme.

1. Introduction

This paper explores the sustainability of a collective funded pension scheme when participation in such a scheme is voluntary. It also explores how regulatory policies can be designed so as to induce pension fund participants not to exit the scheme, which would be an alternative to making participation mandatory if participation is deemed desirable.

Participation in collective pension schemes can be either mandatory or voluntary. Many countries feature pension arrangements with mandatory participation. Examples are the sub-national civil servants' pension schemes in the US and most occupational pension arrangements in the Netherlands and Denmark. The funded pension schemes in Australia, Chile, Iceland, Norway, Sweden and Switzerland, among others, are mandatory for all employees or even all wage earners (OECD, 2013). Mandatory participation in collective pension schemes may be beneficial for several reasons. First, and most important, individuals are protected against the consequences of their own myopia, which deters them from saving enough for their retirement. Second, it allows for intergenerational risk-sharing. This is *ex-ante* welfare enhancing as it allows shocks to be distributed over a large group of subsequent cohorts. Consequently, shocks have less impact on the disposable income of participants in a collective pension scheme compared to participants in individual schemes (Gordon and Varian, 1988; Shiller, 1999; Ball and Mankiw, 2007; Gollier, 2008; Cui et al., 2011;

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Chen et al., 2016). Finally, a collective scheme may operate at lower costs, because of economies of scale, while the obligation to participate avoids expenditures on marketing activities.

Despite these advantages, mandatory participation in collective pension schemes is under pressure. Increasing labour market mobility and self employment require more flexible pension arrangements (Chen and Beetsma, 2015). Furthermore, the potential benefit of intergenerational risk sharing may become smaller due to population ageing. Also the quest for more individual choice has increased. We analyse one aspect of more individual choice by allowing continued participation of the collective pension scheme to be voluntary. The question is what this additional choice flexibility implies for the sustainability of the collective scheme and, thereby, for the possibilities to continue to reap the benefits from participation. In the case of large collective schemes sustainability may also be systemically important, because a run on the assets of a large pension fund may have profound consequences for the financial markets in which it has invested.

This paper applies option pricing techniques to analyse the decision to continue to participate in or to exit a collective funded pension scheme. We also investigate how a pension fund can deploy its policy instruments to reduce the likelihood that a cohort wants to leave the pension fund. Hence, our analysis explores leads for meeting the quest for more individual freedom of choice (Bovenberg et al., 2007; Beetsma et al., 2012; Beetsma and Romp, 2013), while maintaining the sustainability of pension schemes. We analyse a participant's decision to exit the collective pension scheme under the assumption that all the other participants decide to stay in the fund. Hence, we assume that participants are myopic in their beliefs about how other participants may react. Like the assumption of full rationality, under which each participant takes account of the optimal decisions of all the other current and future participants, and what consequences these have for the financial situation of the pension fund, the assumption of myopia is not meant to fully capture how the real world operates. However, the average pension fund participant certainly features some degree of myopia, simply because it is too difficult or time consuming to see through the optimal decisions of all the other participants, and, hence, our assumption of myopia may serve as a useful starting point for more refined assumptions about the participants' beliefs.

We consider different degrees of flexibility to exit, ranging from a "European" option with a single pre-specified exit age to an "American" option that allows for the possibility to exit at any moment until the option expires. An example of the first type is when (only) at the moment of retirement the participant can choose between taking out his accumulated balance or receiving an annuity payment until death. This is the case for Australia, Chile, Denmark, Sweden and Switzerland.[1] By contrast, in the UK participants have the option to withdraw their entire balance at any moment after the age of 55, while in the US this option exists during the entire working career. An intermediate case is the "Bermudan option", which allows for a finite number of exercise dates. An example concerns the recent introduction in the UK of the obligation of employers to automatically enrol employees every three years into an occupational pension scheme. Participants can withdraw their contributions within a month after enrolment. Thereafter, contributions are locked in the pension scheme until the age of 55. Depending on the pension scheme one might be able to reduce or increase the level of contributions. In particular, the non-profit "NEST" pension scheme, which was set up as part of the government's workplace pension reforms, allows for a "contribution holiday". The participant can keep his retirement pot and start contributing again at a later date.

We set up a model with multiple overlapping generations, in which participants have the option to stay in their pension fund or to once-and-for-all exit it. Exiting the fund may be optimal when the funding ratio, i.e. the value of the fund's assets over its liabilities, is low. By exiting the participant does not share in the future recovery burden. Investment risks affect the financial position of the pension fund, which can deploy two instruments, the contribution and the indexation rate, to restore its financial position. This recovery is required by regulation in our model and can be spread out over a shorter or longer period. The types of pension contracts we consider range from collective defined-benefit (DB), in which all the adjustments take place through the contributions, to a collective defined-contribution (CDC) scheme, in which all adjustments occur through indexation. We also analyse hybrid contracts, with adjustments along both dimensions. In all contract specifications the accrual and indexation rates are uniform for all participants. The considered contribution policies, however, range from a uniform contribution policy, which is common in many collective pension arrangements throughout the world, to one in which the contribution is increasing with age. We also consider a compromise between these two contribution policies. To obtain our numerical results, we apply the explicit finite difference method in the case of a DB scheme and the Least Squares Monte Carlo (LSMC) approach, as proposed by Longstaff and Schwartz (2001), in the case of a CDC or hybrid scheme. By now, several other studies have applied the LSMC approach to pensions and life insurance products, e.g. Pelsser et al. (2007), Bernard and Lemieux (2008), Cathcart and Morrison (2009) and Boyer and Stentoft (2013).

Our key findings are the following. Ceteris paribus, young workers are more inclined to continue participation than older workers, since for the young the period over which the exit option can be exercised is longer. In combination with the uniform accrual rate, a uniform contribution is relatively beneficial to the elderly workers, because they are implicitly subsidized by the young cohorts: the newly accrued pension entitlements associated with an additional year of working are more valuable for older than for younger working cohorts, because the ensuing benefits of the older workers are discounted over a shorter period. For different settings of the policy instruments we explore the sustainability of the pension scheme in terms of the participants' willingness not to exit the scheme. In particular, if recovery relies more on the indexation policy, older workers are more likely to exit. In that case, a uniform contribution policy is conducive to keeping all the cohorts in the fund: young workers are reluctant to exit because the recovery relies relatively heavily on participants with large pension entitlements, i.e. the elderly workers, while the latter benefit from the subsidy implicit in the uniform contribution policy. This "pay-as-you-go effect" is present in many collective funded public sector pension plans, such as those in Australia, Canada, Germany, the Netherlands, Norway, Switzerland, the UK and the sub-national civil servants' plans in the US (Ponds et al., 2011). Moreover, we find that a reduction in investment risk enhances the sustainability of the pension scheme. Only when investment risk is low, is a longer smoothing period conducive to sustainability.

The existing cohorts effectively pay for the entry cohort's exit option. The option value typically varies between one to three times the annual wage. Under the DB pension scheme young cohorts are most likely to exit. Hence, under policy parameter settings for which the sustainability of the DB pension scheme is high (i.e., all working cohorts are more likely to continue participating) the option value to entry cohorts is low, as they are unlikely to exercise their option. By contrast, for the hybrid and CDC pension schemes the exit option is typically more valuable under policy parameter settings that are conducive to the sustainability of the pension arrangement.

[1] In Chile, the latter possibility only exists if the annuity exceeds some mandatory minimum. In Sweden, the participant may choose between an annuity until death or an annuity with a fixed maturity of at least five years.