The investment management for a downside-protected equity-linked annuity under interest rate risk

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ABSTRACT

In this paper, we investigate the optimal asset allocation in the distribution phase for an equity-linked annuity scheme of a DC pension plan. We extend previous research to consider the interest rate risk. To prevent a shortfall on the annuity payment in case of poor investment performances, a minimum guarantee on the annuity payment is included in our model. We show that the optimal asset allocation could be represented by a weighted average of two portfolios. The first portfolio is the so-called growth optimal portfolio, which maximizes the expected growth of annuity payment over the planning horizon. The second portfolio is the replicating portfolio, which replicates the returns on a level life annuity. The optimal portfolio weights on these two parts are decided by the coverage ratio of the fund size to the present value of guaranteed annuity payments. Numerical examples show that a high level of guarantee effectively reduces the uncertainty of future annuity payments but loses the opportunities for fund growth. The demand for stocks decreases with the level of guarantee, while the demand for bonds is insensitive to the level of guarantee.

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1. Introduction

In many countries, there is a trend to shift pension schemes from defined-benefit (DB) schemes to defined-contribution (DC) schemes in recent decades. Due to demographic evolution, many DC pension plans involve an annuitization of the accumulated pension wealth at retirement to prevent ever running out of the retiree's wealth before death. As pointed out in the seminal work of Yaari (1965), individuals with no bequest motives should transform all their wealth into a life annuity under uncertain lifetime because (1) life annuity is the only safe asset that pays periodically until the annuitant's death; and (2) returns on life annuity are higher than the riskfree rates because the survived annuitants can receive a survival credit from the mortality risk-sharing implicit in the annuity.

There are two types of annuity plan available to DC scheme members in the distribution phase: the conventional fixed annuity plan and the investment-linked annuity plan. The advantage of the fixed annuity plan is that it provides annuitants with a level pension income without risk until death. However, there are some drawbacks inherent in its nature. First, retired members may receive a pension income lower than expected due to a high annuity price at retirement. Second, the purchasing power of the level pension income would be eroded by inflation in the long run, especially since people are more longevous than before.

In contrast to the fixed annuity plans, investment-linked annuity plans offer the annuitants an opportunity to benefit from the financial market growth. Since the pension income varies to reflect changes in the value of investments, the annuitants face the same financial risk in the distribution phase as they do in the accumulation phase; as a result, an optimal investment strategy in the distribution phase is critical to members of investment-linked annuity plans.

The optimal investment strategy for DC pension plans has drawn much attention in the academic field in recent years. The research on optimal investment strategy for DC pension plans in the accumulation phase is quite rich. Recent literature includes Battocchio and Menoncin (2004), Boulier et al. (2001), Cairns et al. (2006), Deelstra et al. (2003), Emms (2012), Gao (2008), Haberman and Vigna (2002), and Han and Hung (2012). The optimal investment strategy in the accumulation phase aims at maximizing the utility of the pension wealth at retirement subject to continuous cash inflows contributed by the sponsors and/or the active scheme members.

The financial risk and optimal investment policy in the distribution phase have been studied in Albrecht and Maurer (2002), Blake et al. (2003), Charupat and Milevsky (2002), Emms and Haberman (2008), Gerrard et al. (2004), Gerrard et al. (2006), Milevsky and Young (2007), and He and Liang (2013). In the distribution phase of DC pension plans, the sponsors and the scheme members stop contributing to the pension fund. The optimal investment strategy is subject to continuous cash outflows and aims at maximizing the retiree's well-being from the distributed pension income after retirement.

Blake et al. (2003) compare two different investment-liked distribution schemes with the conventional level life annuity. The two types of investment-linked distribution schemes are the equity-linked annuity (ELA) and the equity-linked income-drawdown (ELID). In the ELA scheme, the fund assets are held in a portfolio of stocks and bonds. To protect the annuitants from outliving their pensions before death, the distributions are linked to the fund size as well as the expected survival time of the annuitant. Besides, there is no residual fund paid to the annuitant's heirs as a bequest in the case of early death. Therefore, the survived annuitants receive an actuarial fair survival credit from the implicit mortality risk-sharing. This means that the profits created by the early death are shared among the survived annuitants. At some prescribed age after retirement say, age 75 in the research of Blake et al. (2003), the survived annuitants are forced to transform their remaining pension wealth into a level annuity.

As to the ELID scheme, it differs from the ELA schemes in three aspects: (1) the annuitants can decide how much of the fund to withdraw during the period between retirement and the compulsory purchase of a level annuity; (2) the annuitants receive no survival credit and therefore (3) the residual fund of the annuitants who die early would be paid to their heirs as bequests. In fact, since the annuitants can decide both the amount to withdraw and the investment strategy, the optimization