

Optimal Investment for a Retirement Plan with Deferred Annuities

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We construct an optimal investment portfolio model with deferred annuities for an individual investor saving for retirement. Deferred annuities are insurance products that pay a fixed amount regularly during the individual's lifetime from the time of retirement. The objective function consists of power utility in terms of secured retirement income increments from the deferred annuity purchases, as well as bequest from remaining wealth invested in equity, bond, and cash funds. The asset universe is governed by a vector autoregressive model incorporating the Nelson-Siegel term structure and accumulated equity returns. We use multi-stage stochastic programming (MSP) to solve the optimization problem numerically with an efficient non-linear solver (MOSEK). Scenario trees are generated by an improved method based on [2]. Similar MSP models can be found in the retirement planning literature, eg. [1], but our model focuses on the accumulation phase, rather than the payout phase.

Our numerical results show that the availability of deferred annuity purchases changes significantly the portfolio of investors saving for retirement. Deferred annuity purchases are made continuously over the working lifetime of the investor, increasing particularly in the years before retirement. The investment strategy fully hedges price changes in deferred annuities, and bond holding and deferred annuity purchases increase when interest rates are high. They are consistent with previous studies, but also provide novel support for deferred annuities as a major source of retirement income.

References

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- [2] Pedersen, A.M., B, Weissensteiner, A., Poulsen, R.: Financial planning for young households. *Annals of Operations Research*, 205, pp. 55-76, 2013.