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Feature Articles

Downside Risk Management of a Defined Benefit Plan Considering Longevity Basis Risk

Yijia Lin, Ken Seng Tan, Ruilin Tian & Jifeng Yu

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Abstract

To control downside risk of a defined benefit pension plan arising from unexpected mortality improvements and severe market turbulence, this article proposes an optimization model by imposing two conditional value at risk constraints to control tail risks of pension funding status and total pension costs. With this setup, we further examine two longevity risk hedging strategies subject to basis risk. While the existing literature suggests that the excess-risk hedging strategy is more attractive than the ground-up hedging strategy as the latter is more capital intensive and expensive, our numerical examples show that the excess-risk hedging strategy is much more vulnerable to longevity basis risk, which limits its applications for pension longevity risk management. Hence, our findings provide important insight on the effect of basis risk on longevity hedging strategies.

Notes

Normal contribution or service cost, C, is the cost of additional benefits earned by employees for their service each year, which depends on salary levels, employee turnover and mortality. However, the ultimate cost is usually uncertain. To measure this cost, in practice, pension firms often first estimate their future pension obligations using actuarial assumptions and then attribute these obligations to service years to derive an annual service cost (Competition Commission 2007). In our example, we calculate future pension obligations based on the retirement benefit B and then determine the optimal annual normal contribution C with our proposed model.

Available at http://www.mortality.org or http://www.humanmortality.de (data downloaded on November 22, 2011).

Withdrawals from DB pension plans are often not permitted, or if permitted are subject to excise taxes. As a robustness check, we resolve our optimization problems with and without hedging at a higher withdrawal penalty factor of ψ_2=0.5 that equals the prevailing excise tax rate in the United States. Overall, the results confirm the findings based on the withdrawal penalty factor of ψ_2=0.2 shown in this article. To conserve space, we do not report the results. The results are available upon request.

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