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Forward mortality rates in discrete time. II: Longevity risk and hedging strategies. (English)

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Summary: Longevity risk has emerged as an important risk in the early 21st century for the providers of pension benefits and annuities. Any changes in the assumptions for future mortality rates can have a major financial impact on the valuation of these liabilities and motivates many of the longevity-linked securities that have been proposed to hedge this risk. Using the framework developed in *A. Hunt* and *D. Blake* [N. Am. Actuar. J. 25, S482–S507 (2021; Zbl 1461.91246)], we investigate how these assumptions can change over a one-year period and the potential for hedging longevity risk in an illustrative annuity portfolio and find that relatively simple hedging strategies can significantly mitigate longevity risk over a one-year period.

For Part I, see [the authors, ibid. 25, Suppl. 1, S482–S507 (2021; Zbl 1461.91246)].

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References:

[1] Alai, D. H., Ignatieva, K., and Sherris., M.2013. Modelling longevity risk: Generalizations of the Olivier-Smith model. Tech. Rep., University of New South Wales.

[2] Barbarin, J., Heath-Jarrow-Morton modelling of longevity bonds and the risk minimization of life insurance portfolios, Insurance: Mathematics and Economics, 43, 1, 41-55 (2008) · Zbl 1140.91377

[3] Bauer, D.; Börger, M.; Ruß, J.; Zwiesler., H., The volatility of mortality, Asia-Pacific Journal of Risk and Insurance, 3, 10, 2153-92 (2008)· doi:10.2202/2153-3792.1035

[4] Blake, D.; Cairns, A. J.; Dowd., K., Living with mortality: Longevity bonds and other mortality-linked securities, British Actuarial Journal, 12, 1, 153-197 (2006)· doi:10.1017/S1357321700004736

[5] Cairns, A. J., 2007. A multifactor generalisation of the Olivier-Smith model for stochastic mortality. Tech. Rep., Heriot-Watt University, Edinburgh.

[6] Cairns, A. J.; Blake, D.; Dowd., K., Pricing death: Frameworks for the valuation and securitization of mortality risk, ASTIN Bulletin, 36, 1, 79-120 (2006) · Zbl 1162.91403 · doi:10.1017/S0515036100014410

[7] Cairns, A. J. G.; Blake, D.; Dowd, K.; Kessler, A., Phantoms never die: Living with unreliable population data, Journal of the Royal Statistical Society: Series A (Statistics in Society) (2016)· doi:10.1111/rssa.12159

[8] Cairns, A. J.; Dowd, K.; Blake, D.; Coughlan., G. D., Longevity hedge effectiveness: A decomposition, Quantitative Finance, 14, 2, 217-35 (2013) · Zbl 1294.91072

[9] Coughlan, G. D., Epstein, D., Sinha, A., and Honig., P.2007. q-Forwards: Derivatives for transferring longevity and mortality risks. London: JPMorgan Pension Advisory Group, London.

[10] Cowley, A.; Cummins., J., Securitization of life insurance assets and liabilities, Journal of Risk and Insurance, 72, 2, 193-226 (2005)· doi:10.1111/j.1539-6975.2005.00121.x

[11] Cox, S. H.; Lin., Y., Natural hedging of life and annuity mortality risks, North American Actuarial Journal, 11, 3, 1-15 (2007)· doi:10.1080/10920277.2007.10597464

[12] Denuit, M. M., An index for longevity risk transfer, Journal of Computational and Applied Mathematics, 230, 2, 411-17 (2009) · Zbl 1173.91443

[13] Denuit, M. M.; Goderniaux, A.-M., Closing and projecting life tables using log-linear models, Bulletin of the Swiss Association of Actuaries, 1, 29-49 (2005) · Zbl 1333.62251

[14] Dhaene, J.; Kukush, A.; Luciano, E.; Schoutens, W.; Stassen., B., On the (in-)dependence between financial and actuarial risks, Insurance: Mathematics and Economics, 52, 3, 522-31 (2013) · Zbl 1284.91226

[15] Dowd, K., Survivor bonds: A comment on Blake and Burrows, Journal of Risk and Insurance, 70, 2, 339-48 (2003)· doi:10.1111/1539-6975.00063

[16] Hobcraft, J.; Menken, J.; Preston, S. H., Age, period and cohort effects in demography: A review, Population Index, 48, 1, 4-43 (1982)· doi:10.2307/2736356

[17] Hunt, A.; Blake, D., A general procedure for constructing mortality models, North American Actuarial Journal, 18, 1, 116-138 (2014) · Zbl 1412.91045

[18] Hunt, A., and Blake, D.. 2017. Modelling mortality for pension schemes. ASTIN Bulletin, 47 (2): 601-29. doi: · Zbl 1390.91189

[19] Hunt, A., and D. Blake. 2020a. On the structure and classification of mortality models. North American Actuarial Journal (forthcoming).

[20] Hunt, A., and D. Blake. 2020b. A Bayesian approach to modelling and projecting cohort effects. North American Actuarial Journal (forthcoming).

[21] Hunt, A., and D. Blake. 2020c. Forward mortality rates in discrete time I: Calibration and securities pricing. North American Actuarial Journal (forthcoming).

[22] Hunt, A., and D. Blake. 2020d. Identifiability in age/period mortality models. Annals of Actuarial Science (forthcoming).

[23] Hunt, A., and D. Blake. 2020e. Identifiability in age/period/cohort mortality models. Annals of Actuarial Science (forthcoming).

[24] Kaas, R.; Goovaerts, M.; Dhaene, J.; Denuit, M. M., Modern actuarial risk theory (2008) · Zbl 1148.91027

[25] Lee, R. D.; Carter, L. R., Modeling and forecasting U.S. mortality, Journal of the American Statistical Association, 87, 419, 659-671 (1992) · Zbl 1351.62186 · doi:10.1080/01621459.1992.10475265

[26] Li, J. S.-H.; Luo, A., Key q-duration: A framework for hedging longevity risk, ASTIN Bulletin, 42, 2, 413-452 (2012) · Zbl 1390.91194 · doi:10.1017/asb.2017.26

[27] Loeys, J.; Panigirtzoglou, N.; Ribeiro., R., Longevity: A market in the making (2007), London: JPMorgan Pension Advisory Group

[28] Michaelson, A.; Mulholland., J., Strategy for increasing the global capacity for longevity risk transfer: Developing transactions that attract capital markets investors, Journal of Alternative Investments, 17, 1, 18-27 (2014)· doi:10.3905/jai.2014.17.1.018

[29] Miltersen, K. R., and Persson, S.-A.. 2005. Is mortality dead? Stochastic forward force of mortality rate determined by no arbitrage. Tech. Rep., University of Ulm.

[30] Norberg, R., Forward mortality and other vital rates— Are they the way forward?, Insurance: Mathematics and Economics, 47, 2, 105-12 (2010) · Zbl 1231.91459

[31] Olivier, P.; Jeffrey., T. (2004)

[32] Richards, S. J., Detecting year-of-birth mortality patterns with limited data, Journal of the Royal Statistical Society: Series A (Statistics in Society), 171, 1, 279-98 (2008)

[33] Smith, A. (2005)

[34] Tan, C. I.; Li, J.; Li, J. S.-H.; Balasooriya, U., Parametric mortality indexes: From index construction to hedging strategies, Insurance: Mathematics and Economics, 59, 285-99 (2014) · Zbl 1306.91140

[35] Tappe, S.; Weber, S., Stochastic mortality models: An infinite-dimensional approach, Finance and Stochastics, 18, 1, 209-48 (2013)

[36] Villegas, A. M.; Haberman, S., On the modeling and forecasting of socioeconomic mortality differentials: An application to deprivation and mortality in England, North American Actuarial Journal, 18, 1, 168-93 (2014) · Zbl 1412.91057

[37] Zhu, N.; Bauer, D., Applications of forward mortality factor models in life insurance practice, Geneva Papers on Risk and Insurance Issues and Practice, 36, 567-94 (2011)

[38] Zhu, N., and Bauer, D.. 2011b. Coherent modeling of the risk in mortality projections: A semi parametric approach. Tech. Rep., Georgia State University.

[39] Zhu, N.; Bauer, D., A cautionary note on natural hedging of longevity risk, North American Actuarial Journal, 18, 1, 104-15 (2014) · Zbl 1412.91061