Modelling a Dutch Pension Fund's Capital Requirement for Longevity Risk

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Abstract

Longevity risk is the risk arising from uncertainty in the prediction of future mortality. This risk must be faced by pension funds. The legislation for Dutch pension funds prescribes that the pension funds need to keep in reserve a certain level of capital for this risk. De Nederlandsche Bank (DNB), the regulator of the legislation, suggests a method for calculating this capital requirement. In this paper an alternative method is developed, that provides a better insight in the current risk. Moreover, it turns out that the resulting capital requirement from our method is less than half of the capital requirement calculated using the method suggested by DNB.

Keywords:

Longevity risk, capital requirement for longevity risk, Dutch pension fund, stochastic mortality, Monte Carlo simulations

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Life expectancy in the Netherlands has increased considerably during the past years and is expected to continue to increase. People living longer puts pressure on the costs of pension funds. Pension systems can respond by requiring higher contributions or by raising the retirement age, which has been done in the Netherlands in 2014 by raising the retirement age from 65 to 67. So, this increasing life expectancy is challenging, but can be handled by anticipation. The real problem is the uncertainty surrounding these increases in life expectancy, resulting from the uncertainty in mortality projections. The uncertainty in mortality projections makes future pension payments uncertain and results in the risk that a pension fund does not have enough money at the moment to pay out the pension rights. More specifically, it results in the risk that future death probabilities fall faster than accounted for in reserving calculations. The risk associated with the uncertainty in mortality projections is called longevity risk.

Longevity risk is one of the risks that must be faced by pension funds. The legislation for Dutch pension funds prescribes that they need to keep in reserve a certain level of capital for this risk. This legislation is laid down in the new Financial Assessment Framework (nieuw Financieel Toetsingskader). The regulator of the legislation is De Nederlandsche Bank (DNB). To support the pension funds, DNB suggests a method for the calculation of the buffer capital for longevity risk. The capital requirement for longevity risk is calculated in terms of prescribed percentages of the provision for pension liabilities per age cohort. The provision for pension liabilities (PPL) is the amount of money needed at the moment to be able to pay out all the pension liabilities. The prescribed percentages for the pension type old-age pension are shown in Figure 1.

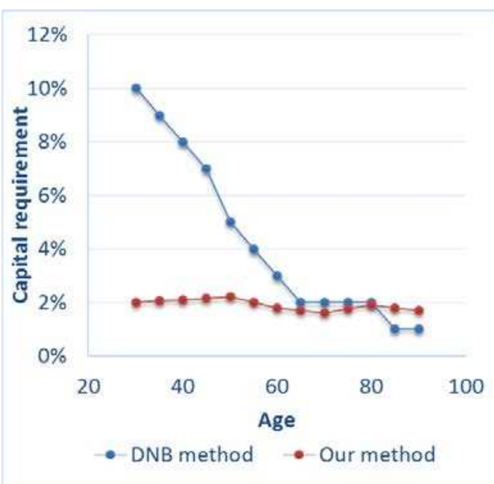

Figure 1: Capital requirement for longevity risk as percentage of the provision for pension liabilities per age cohort, for the pension type old-age pension.

A problem with the current DNB approach is that these prescribed percentages were never adapted since 2007, which implies that these percentages are outdated. In addition, no model is provided that results in the prescribed percentages, making the method non transparent. Therefore, in this paper an alternative approach is provided, that is based on recent advances in mortality modeling. In this way, a better insight in the current risk is achieved.

The analysis of longevity risk depends on how future mortality is modelled. The model used most often to forecast future mortality is the one of Lee and Carter [1]. In this paper, the model of Li and Lee [2] is employed, which is an extension of the Lee-Carter method. The Royal Dutch Actuarial Association also selected the Li-Lee model for Projection Table AG2014 [3] and Projection Table AG2016 [4]. The calibration of our model is done using data sets from 2016, i.e. the data available at the Human Mortality Database [5] and the database of Statistics Netherlands [6]. In this way, an up-to-date insight in the mortality is used.

Our modelling approach is based on a Monte Carlo method, which is applied, separately for males and females, as follows. Multiple (10.000) scenarios of future mortality probabilities are generated using the Li-Lee model. These can be seen as actual developments of mortality in the future, which fluctuate around the best estimate. For every scenario, the provision for a pension fund is calculated. Then, the capital requirement is determined by the 75th percentile of the simulated provisions minus the best estimate of the PPL [7]. The best estimate of the PPL is the PPL based on the best estimate projection of future mortality, i.e. the most probable development of future mortality probabilities. The underlying idea is shown in Figure 2. Adding the capital requirements for males and females results in the total capital requirement for longevity risk.

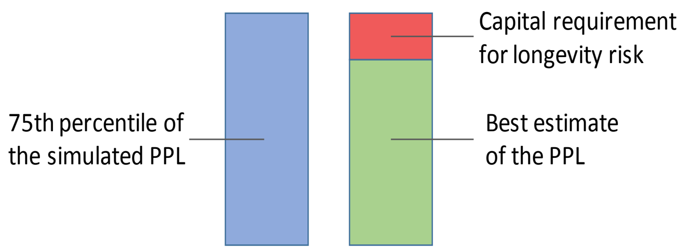

Figure 2: Graphical explanation of our calculation of the capital requirement for longevity risk.

For the pension type old-age pension the shares that account for the longevity risk for the specific age cohort are calculated by considering one age cohort in the model. The resulting capital requirements for longevity risk as percentage of the provision per age cohort are shown in Figure 1. As can be seen, the capital requirement by using our model is much lower than the method suggested by DNB.

As stated before, the current DNB approach is non transparent, since no supporting model is provided. Because of this lack of explanation of the DNB model the exact reason for the resulting reduction in capital requirement is unclear, however, it may be due to the more recent projection tables used in our model.

The impact of our model on the capital requirement for the risk factor related to longevity risk for a typical Dutch pension fund is demonstrated in Table 1. The provision for pension liabilities of this pension fund is around € 3000 million. From the table, it is clear that the capital requirement for longevity risk using our method is 60% lower than using the method suggested by DNB. For the sake of generality, it is assumed in our calculation that the mortality probabilities for the population of the pension fund are equal to the mortality probabilities for the whole Dutch population. So the characteristics of the population of the pension fund are not specifically taken into account.

Modelling approach	*Capital requirement for longevity risk (M€)*
Method suggested by DNB	134
Our method	54

Table 1. Capital requirement for longevity risk using both methods.

In conclusion, we have obtained an up-to-date transparent method to model longevity risk for pension funds that performs much more favorable than the method suggested by DNB. The resulting lower capital requirement for longevity risk by using our method results in a reduction of the required degree of coverage. This would especially be interesting for pension funds that need to submit a recovery plan to DNB, because of their low policy funding ratio.

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Authors

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Fabian M. Polman started in 2015 at RiskCo as an intern working on his M.Sc. Thesis. In 2016 he received his M.Sc. in Mathematical Sciences at Utrecht University and since then he is a Business Analyst at RiskCo in Utrecht. His research interests include forecasting methods and their applications. The work described in this paper is based on his thesis (see: http://dspace.library.uu.nl/handle/1874/337689).

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