A SEGMENTED ANALYSIS OF THE UNDERWRITING RESERVE AND ITS COVER IN A PENSION INSURANCE COMPANY

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ABSTRACT

In a pension insurance company the demands on solvency, liquidity and yield impose the following criteria on the investment activities depending on their duration:
long-term investments — minimize the risks,
medium-term investments — maintain the balance of the premium level,
short-term investments — optimize the yield.
The level of premiums is a recurrent problem in a statutory pensions scheme based partly on funding and partly on a pay-as-you-go system. The premiums are fixed annually as a result of negotiations between the labour market organizations and the supervising authorities. Pension benefits and age limits are likewise subject to a continuous process of revision.
The above-described method could be summed up as a very practical system, which nevertheless requires good actuarial knowledge and which provides those engaged in investment activities with rapid information of the future development of the underwriting reserve. It facilitates investment decisions and bridges the gap between investment experts and actuaries, a gap that has traditionally been quite broad in Finland.

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1. INTRODUCTION

The employment pensions scheme, which consists of old age pension, disability pension, unemployment pension and survivors' pension, forms a long-term economic relationship involving the pension institution that provides this pension cover and the employer as well as the insured employee.

The long intervals manifest themselves also in the funding of future pensions. An insurance premium collected by the pension institution is often paid out as a pension several decades later. In connection with survivors' pensions the interval between funding and payment of the final pension instalment may in rare cases be almost a hundred years.

The Finnish pensions scheme is partly based on funding and partly a pay-as-you-go system. Moreover, the funding involves certain regulations and exceptions concerning e.g. the pensionable age. Therefore the structure of the underwriting reserve is complicated and the maturity of its components variable.

In a pension insurance company the underwriting reserve should, however, match its cover in such a way that the operation of the company is based on optimum solvency, liquidity and yield.

For professional investors the task of dividing the investment assets into long-term, medium length and short-term investments is a well-known and traditional one.

Without actuarial skills it is, however, extremely difficult to divide even the existing underwriting reserve in this way. From the point of view of successful investment decisions, it is important to understand the future development of the underwriting reserve and its distribution in the long term. For this purpose actuarial skills are essential.

It is my intention to describe a system that backs up investment activities, a system by which a pension insurance company's existing and future underwriting reserve and the cover of the existing reserve are segmented into components of equal maturity. This system has been practised in a pension insurance company that operates in accordance with the Employees' Pensions Act (TEL) in Finland.
2. GENERAL FEATURES OF THE PENSIONS SCHEME

2.1. FORMS OF PENSION

The Employees' pensions scheme (TEL) consists of old age pension, disability pension, unemployment pension and survivors' pension for widows, widowers and orphans.

2.2. THE LEVEL OF THE PENSION COVER

The target pension level is 60 per cent of the pension-carrying income. It requires 40 years of employment, and the pensionable age is 65.

In cases of disability, unemployment and death the space of time from the occurrence of pension contingency to the above-mentioned pensionable age is included in the pension-carrying employment period.

An unemployment pension can be granted to an unemployed person aged 60–64 years. Early disability pension may be granted to an insured employee at the age of 55–64 years, on conditions that are somewhat less strict than those for the normal full disability pension.

There is no upper limit to the pension-carrying income. The pensions are index-linked.

2.3. FUNDING

As far as insured employees ages 23–54 are concerned, an amount of pension equivalent to 1.5 per cent of the income is funded annually to be used for old age pensions.

Disability pensions are funded at the occurrence of contingency, which applies to most of the survivors' pensions and half of the unemployment pensions as well.

Index increments, that part of the old age pensions which accrues at the age of 55–65 years, half of the unemployment pensions and part of the survivors' pensions are financed through a method for joint distribution of liability. This pay-as-you-go system is based on a pooled component of the insurance premium and, at present, 4 per cent of the interest yield from the technical reserves of the funding system.
2.4. INSURANCE PREMIUMS

The insurance premium contains components for each form of pension, components for administrative costs and premium losses and a pooled component for the pay-as-you-go system.

2.5. INVESTMENTS

Within the Finnish employment pensions scheme, policyholders are entitled to re-borrow 65 per cent of their premiums. The investment assets are therefore largely comprised of premium and investment loans, as shown by the following table:

- premium loans 57%
- investment loans 24%
- bonds and debentures 5%
- equity interests 5%
- real estate and equity in real estate 9%

3. A MODEL FOR ESTIMATING INSURANCE BUSINESS

Analysis and segmentation of the maturity of the underwriting reserve requires knowledge of its components and their development during a chosen period of time.

The model now to be presented calculates the state of the insurance business, including the components of the underwriting reserve at the end of each forecasted year. The model is based on the state of the insurance business at the end of the year preceding the first year to be forecasted.

One of the major criteria of the utility of this model is its great capacity to produce calculations based on alternative assumptions.

The pension scheme that forms the basis of our model is illustrated in figure 1.
Fig. 1 The pension scheme as a network

Not going into details, the operation of the model can be described as follows.

From the basic situation the model moves on to the next year, calculating the changes that have taken place during the year in the number of persons between the nodes. The probabilities of the changes are partly formulated on the basis of observations (e.g. becoming disabled or unemployed) and partly on the basis of general actuarial principles (e.g. mortality). Money quantities are shifted according to the alterations in the numbers from one node to another. At the turn of the year, also age and index changes are carried out. The final state of the first forecasted year forms the basic situation for the next year to be forecasted and so
The underwriting reserve, which is specified by form of pension, age and sex at the end of each forecasted year, forms the input data in the model for segmented analysis.

4. A MODEL FOR SEGMENTED ANALYSIS

As I have mentioned, the aim of the segmented analysis is to examine the correlation of the maturities of the underwriting reserve and its cover.

The underwriting reserve and its cover are divided into periods of chosen length, e.g. periods of 0–2, 2–5, 5–10, 10–20, 20–30 and over 30 years.

4.1. MODEL STRUCTURE

The model can be divided into four separate functions: segmented distribution of cover, calculation of the coefficients for the segmented distribution of the underwriting reserve, this distribution itself and graphic analysis of the results.

Besides the underwriting reserve, also its cover is used as input data in this model.

The segmentation of cover is carried out in accordance with the object of investment. The five categories of objects are premium loans, investment loans, bonds and debentures and equity interests and equity in real estate.

The coefficients are derived from the capital value coefficients used in the calculation of the underwriting reserve.

The segmentation of the underwriting reserve is based on a linkage of the reserve and the coefficients produced by the model for estimating insurance business.

The results are combined and analyzed with the help of the figures and diagrams. In the example shown in figure 2 the maturities of the cover and underwriting reserve segments are balanced in such a way that they strengthen the liquidity of the company.
A SEGMENTED ANALYSIS OF THE UNDERWRITING RESERVE AND ITS COVER

Fig. 2. A segmented analysis of the underwriting reserve and its cover.
4.2. SEGMENTATION OF COVER

The following rules of distribution are applied to each object of investment.

As a rule, real estate and equities are regarded as long-term investments.

Premium loans are divided into 14 categories according to the amount of the loan. Each category is studied individually.

Investment loans are divided into 9 categories according to the original loan period.

The distribution of the cover is checked at set intervals and used as model input data.

4.3. SEGMENTATION OF THE UNDERWRITING RESERVE

The starting point for the segmentation is a calculation of the underwriting reserve by multiplying the amount of the funded pension per annum with the capital value coefficient, which is dependent on age etc.

Based on the quantities calculated with capital value coefficients we can calculate the liability share of a chosen period of time, e.g. 0 to \( n \) years.

The following is an example of the segmentation of an old age pension in payment. A corresponding technique is applied on other pension forms as well.

The liability of an old age pension in payment is calculated with the formula

\[
\overline{V} = \overline{\alpha}_{x+1/2} \cdot E
\]

where \( E \) stands for the funded part of the annual pension.

The capital value coefficient is based on the following formula:

\[
\overline{\alpha}_{x+1/2} = \frac{\int_{x+1/2}^{\infty} D_t \cdot dt}{D_{x+1/2}}
\]

The period to be studied is expressed as \( n \) years. The liability proportion of the first \( n \) years is calculated by multiplying the funded pension with this coefficient:
\[
\frac{\int_{x+1/2}^{\infty} D_t \cdot dt - \int_{x+1/2+n}^{\infty} D_t \cdot dt}{D_{x+1/2}}
\]

\[-\frac{\bar{\alpha}_{x+1/2} - \frac{D_{x+1/2+n}}{D_{x+1/2}} \cdot \bar{\alpha}_{x+1/2+n}}{\bar{\alpha}_{x+1/2}}\]

In proportion to the total liabilities it corresponds to a quota of

\[
\frac{\bar{\alpha}_{x+1/2} - \frac{D_{x+1/2+n}}{D_{x+1/2}} \cdot \bar{\alpha}_{x+1/2+n}}{\bar{\alpha}_{x+1/2}} = 1 - \frac{D_{x+1/2+n}}{\bar{\alpha}_{x+1/2+n}}
\]
4.4. REALIZATION

Figure 3 shows the setting in which the system is put into practice.

The ADP environment

VAX

Microcomputers

Cover data

Estimated underwriting reserve

Diskette

Virtual disks

Network

Plotter

Network printer

GRAPHICS

Fig. 3 The ADP environment
BIBLIOGRAPHY


