UTILITY FUNCTION WITH BEQUEST MOTIVE IN THE SLOVAK SECOND PENSION PILLAR SCHEME

MAROŠ MALÍČEK
Matej Bel University in Banská Bystrica, Faculty of Economics
Department of Public Economics and Regional Development Systems
Tajovského 10, Banská Bystrica, Slovakia
e-mail: maros.malicek@umb.sk

JANA SOKOLOVÁ
Matej Bel University in Banská Bystrica, Faculty of Economics
Department of Tourism
Tajovského 10, Banská Bystrica, Slovakia
e-mail: jana.sokolova@umb.sk

Abstract

The main goal of this paper is to investigate whether it is economically advantageous to immediately annuitize pension savings at the moment of reaching the retirement age or whether an individual should opt for a programmed withdrawal with subsequent annuitization, taking the bequest motive into account. In order to compare the outlined two options we perform simulations using historical data on financial assets performance and calculate the expected pay-off from annuity and a programmed withdrawal with the bequest motive under the legislative framework of pillar 1bis in the Slovak pension system.

Key words: *1bis pension pillar, annuity, programmed withdrawal, bequest motive.*

1. Introduction

Slovak pension system in general have moved from only state operated system to multi-pillar scheme. After more than 10 years of its existence, defined contribution (DC) part of the pension system was a subject of major payout phase redesign, where the immediate annuitization became the only option for more than 90% of retirees from the 1bis pension pillar.

When discussing design of private defined contribution schemes pay-out phase, the key point of the debate is the selection of suitable products for retirees. If more than one option is available to the savers, decision on the retirement strategy is required, which in general means the decision on the combination of various products and the timing of their purchase. Buying annuity at any time is viewed as a sub-optimal choice (di Giacinto and Vigna, 2012). On the other hand, postponing the annuitization requires having an alternative product to finance the expenses. If only two different products are allowed: annuity and programmed withdrawal, then the decision starts to be more complicated. Not only the annuity risk emerges, but additional risk should be recognized – risk of ruin (probability of outliving accumulated wealth before buying an annuity). Dus et al. (2005) discuss the consequences of postponing the annuity purchase, which is often motivated by the existence of bequest.

The main motivation of our research is to evaluate the expected pay-off of retirement strategy consisting from the combination of two pension products: annuity and programmed withdrawal, where the timing of annuity purchase and bequest motive are considered.

2. Research Methodology

First step of our research includes the creation of an individual economic agent who faces the retirement decision where only two products are available: annuity and programmed withdrawal. We built our methodology on the previous work of Šebo and Šebová (2016), who tested the suitability of immediate annuitization under the 1bis pension pillar pay-out regime in Slovakia. However, they focused on the probability of ruin and potential bequest when opting for programmed withdrawal. Their conclusions suggest that opting only for the programmed withdrawal is not the optimal solution and one should investigate the stopping function ("point of no return"), where the programmed withdrawal become too risky (from the point of probability of ruin) and annuitization should be considered. Therefore, we try to go one step further and construct the retirement strategy where an individual opts for a programmed withdrawal for the first year and then adjust his/her decision based on the price of an annuity and remaining wealth. In order to investigate the optimal product mix of programmed withdrawal and annuity purchase timing, several formulas for pricing annuity and defining withdrawal strategy has to be defined. Than we define parameters for technical reserves´ returns (in case of annuity) and investment portfolio (in case of programmed withdrawal) returns using historical returns of equities and bonds. Finally, we compare the expected pay-off of both products during the retirement path of an individual.

We assume an individual who reaches the retirement age at 62 in 2016. His accumulated pension pot in 1bis pension pillar is set at 20 000 Eur. Our retirement strategy is built on the assumption, that an individual decides to buy a programmed withdrawal for the first year in retirement with initial pay-off set at the level of the annuity offered at the moment of retirement. Subsequent decisions during the retirement are driven on a monthly basis where an individual compares the utility of both products. If the utility from the annuity prevails, remaining pension wealth is used to buy an annuity, otherwise he continues with programmed withdrawal. Finally, we evaluate the economic value of our retirement strategy by calculating the expected benefits of our retirement strategy and annuity during the life-expectancy of an individual and compare the results. Decision tool was designed on monthly basis. Another assumption is that all savings are invested in bonds and there is no change of investment strategy in pay-out phase.

Gross monthly returns of bonds are generated using US historical data from FRED since January 1919 till 2015.[1] Benefit under the programmed withdrawal was designed according to Šebo and Šebová (2016) using the sustainable retirement income (SRI) approach of Milevsky (2001) and Milevsky et al. (1997). Withdrawal rate is based on historical 2-year average annualized returns ($r^{s;b}$) of a bond pension fund (DGDF) used for continuing investment of remaining wealth *(W)* adjusted for volatility of bond pension fund returns (δ_t^2) calculated for the last 2 years and a intensity of death under remaining life expectancy of a retiree ($\ln(2)/e_x$) at moment of making the decision on withdrawal rate. The equation for withdrawal rate (c_t^{SRI}) is then:

$$c_t^{SRI} = r_t^{s;b} - \delta_t^2 + \frac{\ln(2)}{e_x} \tag{1}$$

[1] The data from the Federal Reserve Bank of St, Louis were downloaded from http://research.stlouisfed.org/fred-addin/ (accessed 19-08-2016).

We assume an individual who reaches the retirement age at 62 in 2016. His accumulated pension pot $W(0)$ in 1bis pension pillar is set at 20 000 Eur. Individual withdraws each month a certain level of benefits (B_t) which is calculated as a withdrawal rate (c_t^{SRI}) of remaining wealth from previous month (W_{t-1}). Initial and each additional monthly benefit ratio from programmed withdrawal is then:

$$B_t = c_t^{SRI} W_{t-1}. \tag{2}$$

The value of pension wealth after the withdrawal is then subject of market returns. However, an individual values also the remaining wealth and not only the paid benefits. Therefore, we can express the utility of a bequest that can be paid in case an individual dies during the year. Utility of programmed withdrawal including the bequest can be expressed as follows:

$$U(PW) = \frac{\sum_{t=1}^{n} B_t}{12} + (1 + {}_k p_x) \times W_t - ({}_k p_x \times e_x \times B_t), \tag{3}$$

where ${}_k p_x$ represents the probability that an individual at age x survives k years and e_x is the life expectancy of an individual aged x. Other factors are known from previous formulas included in this paper.

The same procedure is required for the valuation of a nominal annuity. For defining the monthly nominal benefit from annuity purchase under the existence of 7 year pay-off guarantee stipulated by Slovak legislation on 1bis pillar annuities (A_m), we use actuarial formula and associated conditions presented by Szücs (2015):

$$A_m \approx \frac{1}{12} \times \frac{(1-\gamma)P}{(1+\beta)\left(\ddot{a}_x - \frac{13}{24}\right) + \alpha + (1-\varepsilon)M} \tag{3}$$

where $\alpha; \beta; \gamma; \varepsilon$ are the charges (initial costs for the first year of the contract; on-going monthly administration fees; one-off collection fee and guarantee payment costs); M represent the uncertain value of 7-year guarantee paid to the beneficiaries in case of policyholder´s death with the first 7 years of annuity purchase; and P stands for the value of savings (wealth) at the end of saving phase.

We can simplify this formula if only on-going monthly administration fees are used. Thus, the annuity rate, which basically represents the benefit ratio of an annuity, can be expressed as follows:

$$AR = (1-\beta) \times \left(\frac{\ln(2)}{e_x} + r^{s;b} \right) \tag{4}$$

We set the on-going monthly administration fees at 0,1. Then the monthly nominal annuity $\ddot{a}_x$ can be expressed as:

$$\ddot{a}_x = W_t \times \frac{AR}{12}. \tag{5}$$

As mentioned earlier, Slovak 1bis pension scheme legislature recognized the existence of 7-year pay-out guarantee on nominal annuities purchased. Therefore, an individual´s utility should take into account the existence of such bequest. Utility from purchasing the nominal annuity with 7-year pay-out guarantee (bequest) will be rising as an individual's age increases. The utility from annuity purchase can be expressed also in other ways that are not presented here.

The utility function from annuity was also calculated by bequest motive included using this formula:

$$U(A) = \ddot{a}_t + q_x \times (84 \times \ddot{a}_t), \tag{6}$$

where q_x is the probability of death at age *x*. Eighty-four monthly annuity payments represent the bequest motive of an annuity purchase.

Retirement strategy (*RS*) tries to avoid the probability of ruin by using remaining wealth to buy an annuity. As mentioned earlier, the retirement strategy (*RS*) is based on a stopping function, which recommends switching from programmed withdrawal (*PW*) into annuity (*A*) if utility from programmed withdrawal falls below the utility from annuity.

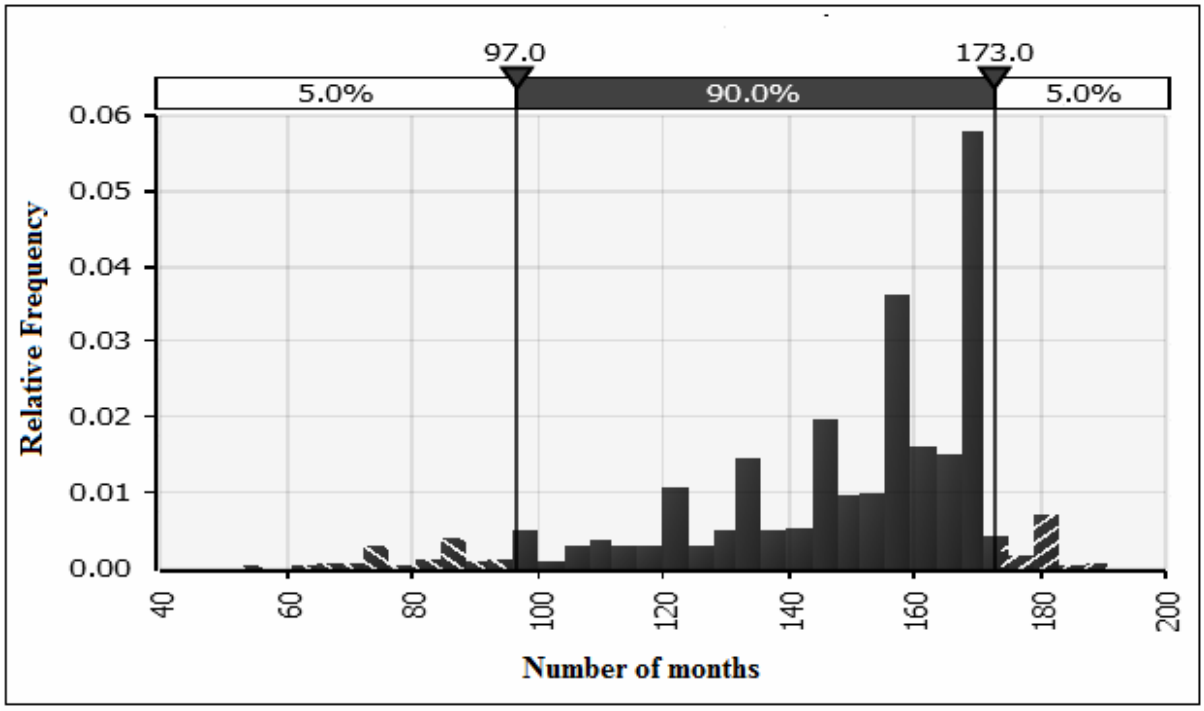
$$RS = \begin{cases} PW, & if\ U(PW) \geq U(A), \\ A, & otherwise. \end{cases} \tag{7}$$

Having the retirement strategy in place, we can compare the amount of benefits received under the retirement strategy compared to the immediate annuitization. Comparing the received cumulative benefits of both alternatives, we can assess whether an individual receives additional premium from taking the longevity risk earlier in his retirement.

3. Results and Discussion

We have performed 3200 simulations using the @RISK software, where various scenarios of bond market performance were generated. In 90 % of cases (dependent on period in which is individual economic agent retires), annuitization is economically suitable at age 70 up to the age of 75. Our retirement strategy recommended buying annuity after 191 months of receiving benefits through programed withdrawal. Results representing the distribution of withdrawal period during which an individual received benefits via programmed withdrawal and then switched into annuity are shown in Figure 1.

Figure 1: Number of months of receiving programmed withdrawal

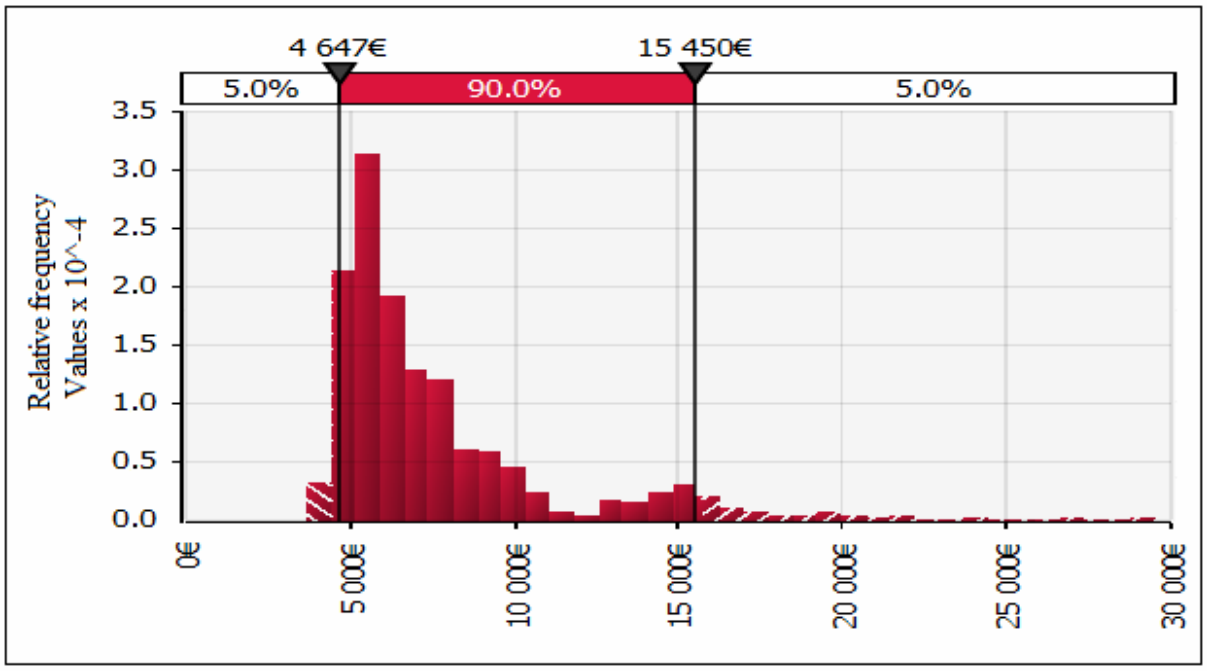


Source: the authors.

The second part of our research focuses on the assessment of the price of annuity. We can conclude that in 90 % of cases, the value of remaining wealth, under which the strategy recommended purchasing an annuity, ranges from 4647 € to 15450 €. The minimum amount of the savings at which the annuity should be purchased is 3,691.55 €, while the maximum value, which has been recommended for purchase an annuity, is quite high at 29,566.04 €. However, this situation occurs in less than 1% of cases.

When inspecting the cumulative benefits received under the retirement strategy, earlier conclusions are mixed. In 90% of cases cumulative benefits received by applying the retirement strategy varied from 15,048 € to 25,007 €. The minimum amount was 10,972.66 € and the maximum is 31,209 €. However, if no retirement strategy is applied, there is a considerable risk of ruin and average cumulative benefits withdrawn under no retirement strategy stood at the level of 19,285.35 €. We can conclude that if there is no retirement strategy, programmed withdrawal increases the risk of ruin and cumulative benefits received are significantly lower than the immediate annuitization as well as when applying the retirement strategy. The results are illustrated in Figure 3.

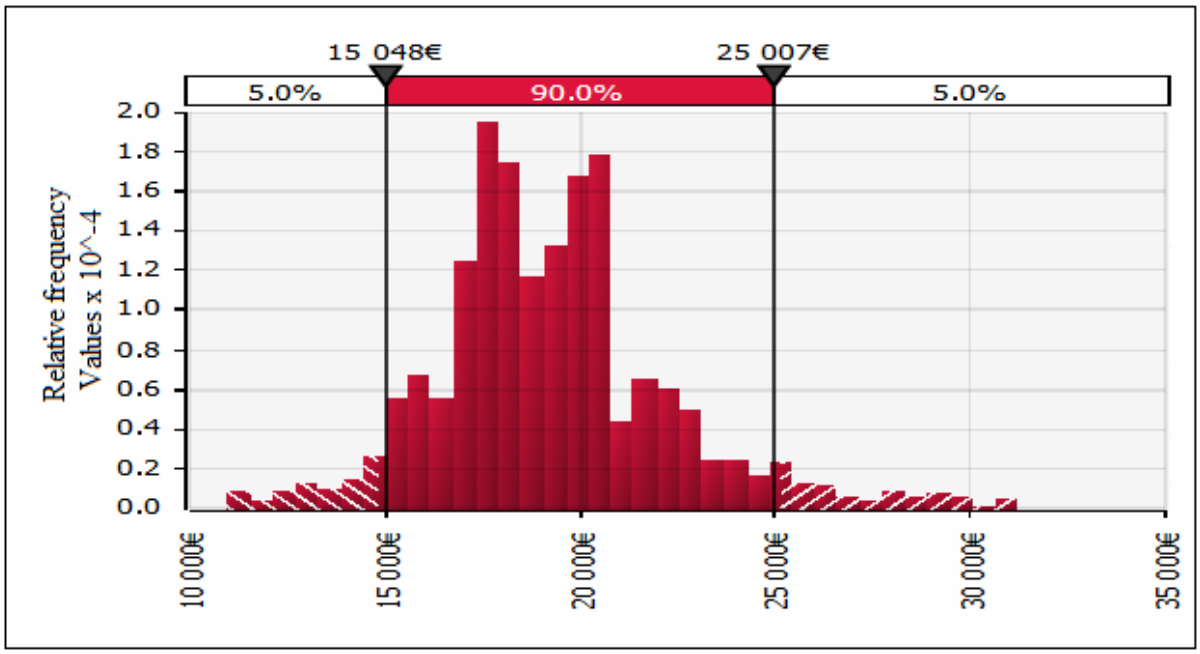
Figure 2 The amount of savings needed to buy an annuity by the strategy DGDF



Source: the authors.

The risk of ruin is significantly lower, when using retirement strategy. According to the results, in 90 % of cases, annuitization should take place until an individual receives 254 monthly benefits from programmed withdrawal. The savings would be ruined only in 9.31% of cases. The results show that the risk of ruin increases significantly after 206th month of, i.e. at the age of 79. Based on these results we can say that if an individual decides contrary to what the retirement strategy recommends, he exposes the pension wealth to the increasing longevity risk (risk of ruin).

Figure 3 Cumulative benefits from programmed withdrawal till the annuitization



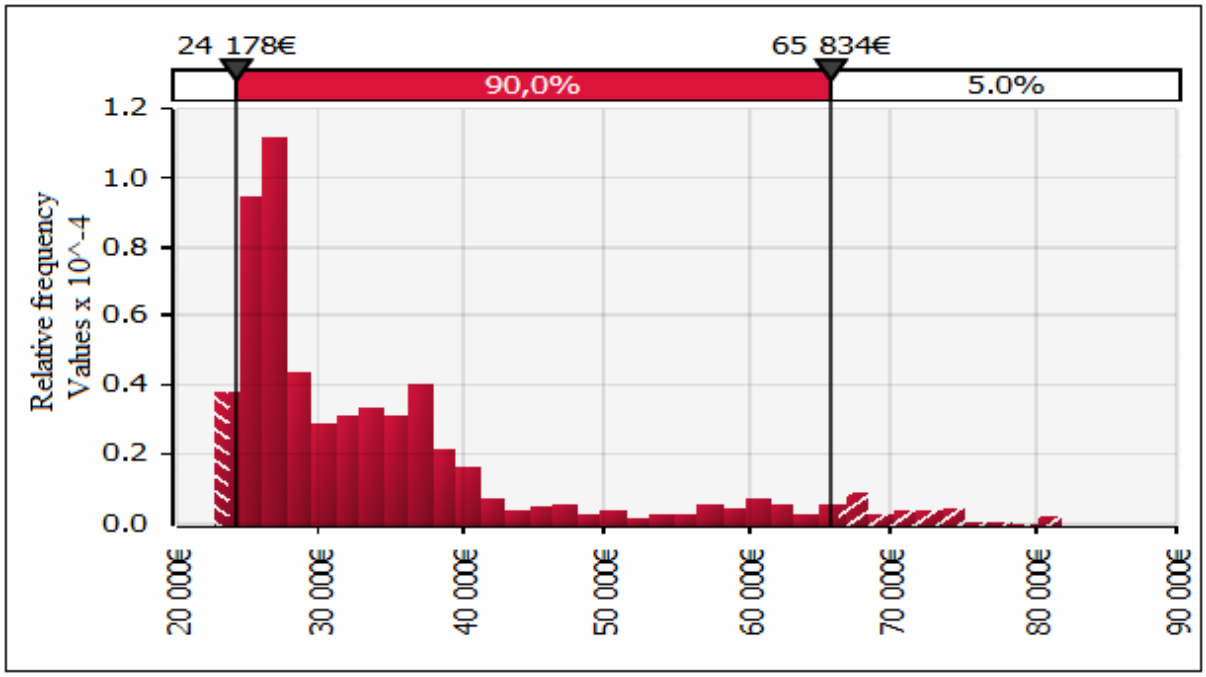
Source: the authors.

If we focus on inspecting how much would an individual withdraw until the average life expectancy cumulatively when using retirement strategy approach. We found that the strategy brings better results than immediate annuitization and delivers better results when investing the remaining wealth into bond pension fund. In 90 % of cases, this amount ranges from 24,178 € to 65,834 €. The minimum value is at the level of 22,657.65 €. In practice this means that in all cases the retirement strategy would provide an individual with higher cumulative benefits compared to the initial wealth and is able to cope with the longevity risk (risk of ruin). On average, an individual who manages the retirement wealth using our retirement strategy can expect to receive cumulative benefits of 34,632.57 €, while the most frequent (expected) value is at 24,451.86 €. The results on distribution of cumulative benefits under the retirement strategy are shown in Figure 4.

The final step was to compare the cumulative benefits received from the retirement strategy against the immediate annuitization The red columns in Figure 5 show the situation where the cumulative amount received from the immediate annuitization is greater than the amount pumped through programmed withdrawal and subsequent annuity purchase.

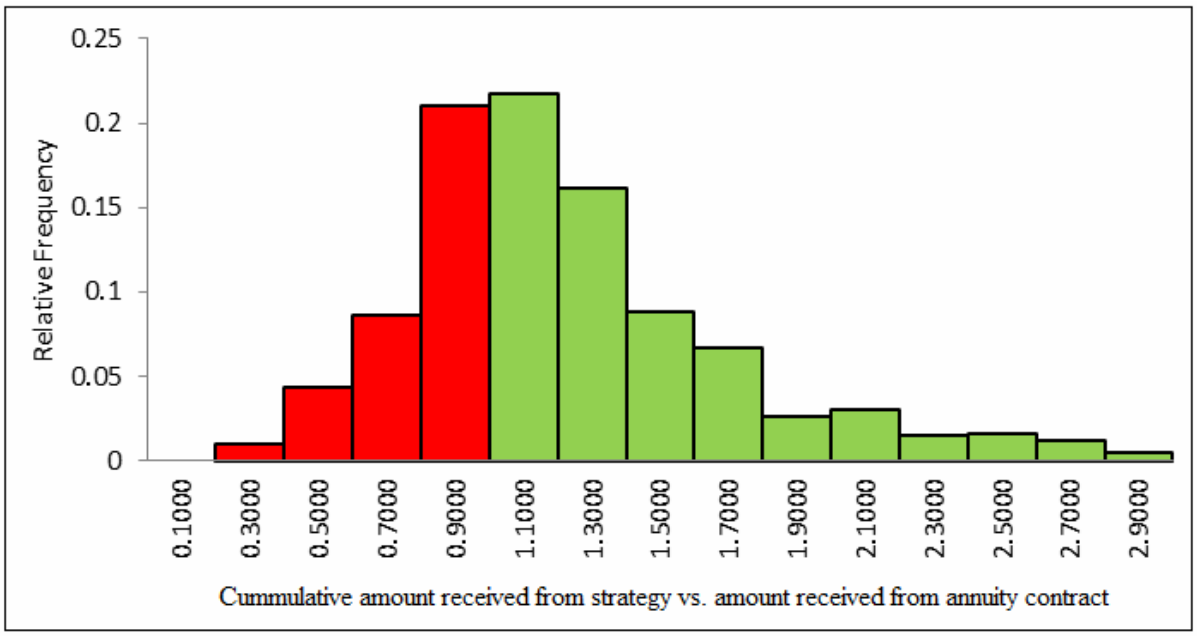
Comparing the cumulative benefits from the retirement strategy and immediate annuitization, we can say that in 56.75% cases, an individual would receive a higher amount of benefits when applying the retirement strategy, while the remaining cases would favor immediate annuitization. We can conclude that only 35% of the cases are those, when it is better for the individual to receive an annuity rather than programmed withdrawal with subsequent annuity purchase, however, without considering the bequest motive

Figure 4 Cumulative benefits received from the retirement strategy



Source: the authors.

Figure 5 Histogram of the cumulative benefits from the retirement strategy vs. the immediate annuitization



Source: the authors.

4. Conclusions

A programmed withdrawal using a dynamic withdrawal rate that corresponds to the past returns and adjust the paid benefits on an annual basis helps avoiding the risk of running out of money, since benefits fluctuate in tandem with the pension fund's returns. We came close to the conclusions drawn by Dus et al. (2005), i.e. that an immediate annuitization can be

viewed suboptimal in general and also in individual circumstances. We have also shown that opting only for a programmed withdrawal does not state the optimal strategy either. However, using the stopping function to define the retirement strategy that opts for the annuity if the utility from the ongoing programmed withdrawal including the bequest is lower that the utility from the annuity purchase seems to be a better option. Using our retirement strategy, retiring individual can better manage retirement savings and maximize the utility function while minimizing probability of ruin due to the individual longevity risk and ability to maximize utility from the existence of a bequest.

Acknowledgements

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0465-12.

References

[1] DI GIACINTO, M., VIGNA, E. 2012. On the sub-optimality cost of immediate annuitization in DC pension funds. In Central European Journal of Operations Research, 2012, vol. 20, no. 3, pp. 497-527.

[2] DUS, I., MAURER, R., MITCHELL, O. S. 2005. Betting on death and capital markets in retirement : A shortfall risk analysis of life annuities versus phased withdrawal plans. NBER Working Paper No. 11271, 2005, http://www.nber.org/papers/w11271.

[3] MILEVSKY, M., HO, K., ROBINSON, C. 1997. Asset allocation via the conditional first exit time or how to avoid outliving your money. In Review of Quantitative Finance and Accounting, 2016. vol. 9, iss. 1, pp. 53-70.

[4] MILEVSKY, M. 2001. Optimal annuitization policies : Analysis of the options. In North American Actuarial Journal, 2001, vol. 5, no. 1, pp. 57-69.

[5] SZÜCS, G. 2015. Stochastické modely úrokových mier v poisťovníctve. Dissertation thesis defended at the Faculty of Matemathics, Physics and Informatiocs of Comenius University in Bratislava. Bratislava, 2015.

[6] ŠEBO, J., ŠEBOVÁ, Ľ. 2016. Suboptimality of immediate annuitization in private pension schemes. In Ekonomický časopis, 2016, vol. 64, no. 2, pp. 169-190.