The Impact of Some Risk Factors on the Amount of Pension from the Third Pillar Pension[1]

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Abstract

*This paper brings an analysis of the impact of banning the use of gender in insurance, with special focus on supplementary pension saving called also third pillar pension, according to the requirements of the European Court of Justice. By means of actuarial formulas of m-*thly *paid annuities and also mortality tables, it models and analyzes the amounts of pension annuities in the designed products of the third pillar pension.*

Keywords*: annuity, gender, premium, pension*

JEL Classification: G22, G28

1. Introduction

Supplementary pension saving constitutes the third pillar pension in Slovakia, based on an optional basis. Supplementary pension saving represents a voluntary pillar of the pension system in which funds are managed by private companies. A Supplementary Pension asset Management company (Doplnková dôchodková sporiteľňa – DDS) is a limited liability company established on the territory of the Slovak Republic which is run under the conditions stipulated by law on the basis of a license issued by the National Bank of Slovakia (NBS). Each DDS is required to create and manage a payout supplementary pension fund and at least one contributory supplementary pension fund. The area of supplementary pension saving is regulated by Act 650/2004 Z. z.[2] on supplementary pension saving

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[2] Z. Z. – Zbierka zákonov Slovenskej republiky [Collection of Laws of the Slovak Republic].

and amendments to other related acts. The most significant changes to supplementary pension saving were enacted by the following amendments: Act 555/2007 Z. z., Act 449/2008 Z. z. which amends and supplements Act 461/2003 Z. z. on social insurance, as amended, and on amendments, and by Act 557/2009 Z. z., which amends and supplements Act 650/2004 Z. z. on supplementary pension saving and amendments to other related acts. The most important changes in these amendments are – increased protection of property in supplementary pension funds and increased investment security through detailed arrangements of risk management, possibility of payment of a lump sum in cases where the saved amount is lower than the prescribed amount for payment of pension. Act 557/2009 Z. z. reduces the upper limit of the amount of the fixed fee for operating a supplementary pension fund and introduces a new variable type of retribution – retribution for the appreciation of property in a supplementary pension fund as an incentive for saving appreciation of supplementary pension companies. In addition to this main objective, this law liberalizes transfers between supplementary pension companies, cancels fees for transfer to another pension company after more than three years of saving, which will lead to a stronger competition in this area. For more information, see, for example the webpage of the Ministry of Labour, Social Affairs and Family of SR (2013).

In the recent time, a lot of attention is paid to investment strategies, but only little attention is paid to future products of the third pillar pension. The way of calculation of future pensions is different in different companies. In the future, DDS companies will offer four possibilities – whole life pension annuities, term life pension annuities, lump sum payment (in the amount of 100% of the saved amount if the client is eligible to get a pension) and termination settlement (in the amount of 80% of the saved amount if the client does not fulfill the conditions for a pension). In our paper, we propose so-called products by which it would be possible to determine the amount of pension on the basis of future pensioner's own choice. Moreover, we analyze the amount of future pensions with respect to some risk factors, such as gender and interest rate.

The European Union (EU) Gender Directive (Council Directive 2004/113/EC) guarantees equal treatment between men and women in the access and supply of goods and services. However, the Directive does not prohibit insurers from using gender in the calculation of premiums and benefits, as it contains an exemption to this rule: under Article 5(2), Member States can opt out from banning the use of gender and can allow ´proportionate differences´ in insurance premiums and benefits, where the use of gender is a determining factor in the assessment of risk based on the relevant and accurate actuarial and statistical data, provided that Member States ensure that such data is ´compiled, published and regularly

updated´. All European national legislative assemblies chose to use the opt-out for life products – including life insurance and pension annuities. However, on March, 1 2011, the European Court of Justice (ECJ) ruled that this time-unlimited opt-out provision from the EU Gender Directive was inconsistent with the European Charter (Test-Achats ruling[3]).

The ECJ ruled that the (time-unlimited) exemption is invalid but allowed for a transition period for implementation up to December, 212012. National governments of Member States have been obliged to change their laws accordingly by this date.

Not only the risk factors – gender and regulation of ECJ, but also trends in the development of technical interest rate can affect the amount of pension annuities.

Premiums on insurance, mortgage payments, payments of rent, payments on installment purchases, dividends and pensions are all annuities. The net annual premium of whole life annuities and also other actuarial functions are usually evaluated for integer ages and terms, assuming that cash flows are payable annually. However, annuities are very often paid more frequently than annually, namely monthly, quarterly, but also semi-yearly. We can find in various sources well known formulas on the evaluation of certain and expected annuities which are paid more frequently than annually (Neill, 1992; Cipra, 2010, MacDonald, 2004; Dickson, Hardy and Waters, 2009).

This paper is divided into five parts. In the first part, we mention two factors which impact the amount of future pension annuities – EU Gender Directive and actuarial model of the expected present values of annuities payable annually and m-thly per year. In the second part, we pay attention to formulas for m-thly annuities payable in advance. Moreover, we discuss the life expectancy in Slovakia. In the third part, we apply the mentioned formulas for m-thly paid annuities to calculation of pension annuities of six possible products of the third pillar pension. The fourth part contains analysis of the mentioned products. At the end, in the fifth part, we give conclusions and some remarks and schemes of our next investigation.

2. Preliminaries

At the beginning we give the basic notations which are used in the evaluation of the mentioned products. They are:

[3] The ruling arose from a legal challenge from the Association Belge des Consommateurs test – Achats ASBL, a Belgian consumer association, about whether the exemption is compatible with the prohibition on discrimination on the grounds of gender.

i – technical interest rate;
q – accumulated factor, $q = 1 + i$;
v – discounting factor, $v = 1 / q$;
m – number of paid, or paid out annuities within one year;
x – retirement age;
n – number of years of term pension,
l_x – number of the living at age x;
d_x – number of deaths at age x;
ω – maximum age to which a person can live to see (regarding used life tables is here $\omega = 100$;
p – programed withdrawal from an accumulated value at the beginning of retirement time (in percent);
z – quotient of the m-thly paid out pensions within t years (in percent);
t – number of years of payment of a quotient of the certain pensions.

In individual formulas for evaluation of different possibilities of pension payments, the expected present value of annuities payable m times per year or in other words, the expected present value of m-thly paid annuities, is very important.

2.1. Annuities Payable *m* Times per Year[4]

Following the authors Neill (1992), MacDonald (2004), Dickson, Hardy and Waters (2009), and Cipra (2010), we point to a well-known approximation (1) which represents the expected present value of the whole life annuities of one monetary unit per year, payable to the entry aged x with $\frac{1}{m}$ at the beginning of each m-thly period and which has the following form

$$\ddot{a}_x^{(m)} \approx \ddot{a}_x - \frac{m-1}{2m} \tag{1}$$

where $\ddot{a}_x$ is the present value of whole life yearly annuities in the amount of one monetary unit, $\ddot{a}_x = \sum_{t=0}^{\omega - x} {}_t p_x \cdot v^t$ or by the commutation functions $\ddot{a}_x = \frac{N_x}{D_x}$, where $D_x = l_x \cdot v^x$, $N_x = \sum_{i=0}^{\omega - x} D_{x+i}$.

The present value of temporary expected annuities $\ddot{a}_{x,\overline{n}|}^{(m)}$ of $\frac{1}{m}$ monetary unit which are payable in advance m-thly per year during n years is given by

[4] All values were calculated by VBA, MS Office Excel 2010 system.

$$\ddot{a}_{x,\overline{n}|}^{(m)} \approx \ddot{a}_{x,\overline{n}|} - \frac{m-1}{2m} \cdot \left(1 - {}_nE_x\right) \tag{2}$$

where $\ddot{a}_{x,\overline{n}|} = \frac{N_x - N_{x+n}}{D_x}$ and ${}_nE_x = \frac{D_{x+n}}{D_x}$.

Note that in the case of positive cash-flows the present value with payments paid *m*thly is less than the corresponding yearly present value.

***Remark* 1**: There exist also extended formulas of (1) and (2) which are very interesting from mathematical point of view, but for low interest rates they have not a significant effect. For more information see Cipra (2010) and Špirková and Urbaníková (2012).

The present value of temporary *m*-thly paid certain annuities $\ddot{a}_{\overline{n}|}^{(m)}$ in the amount of $\frac{1}{m}$ monetary unit over duration time *n* is as follows

$$\ddot{a}_{\overline{n}|}^{(m)} = \frac{1}{m} \cdot q^{\frac{1}{m}} \cdot \frac{1 - q^{-n}}{q^{\frac{1}{m}} - 1} \tag{3}$$

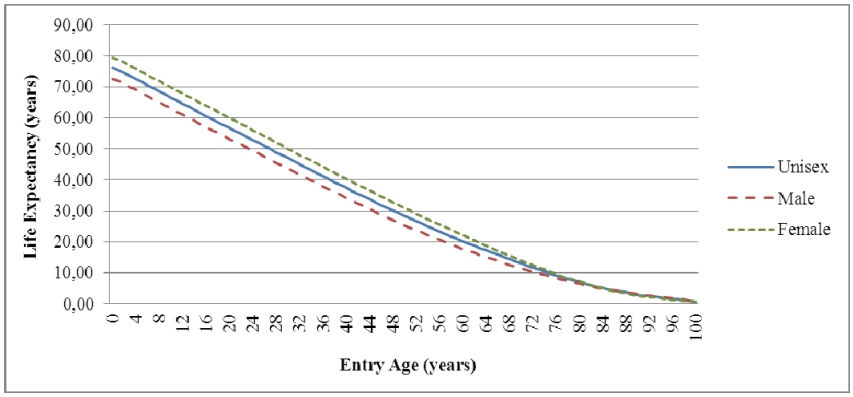
For more information, see for example Urbaníková (2008).

2.2. Life Expectancy

Life expectancy equals the average number of years a person born in a given country would live if mortality rates at each age were to remain constant in the future. According to the World Health Organization (WHO), women on average live longer than men nearly in all countries.

Graph 1

Life Expectancy According to Death Probability in 2012 in the Slovak Republic



Source: Authors.

In 2012, the life expectancy in the Slovak Republic was 72.47 for men and 79.45 years for women. On the basis of OXERA (2012),[5] life expectancy will increase, and moreover, for women it will increase faster than for men.

On Graph 1 shows the life expectancy in the Slovak Republic separately for males and females, as well as combined, so-called unisex. At first sight, it is clear that the risk factor – gender is a significant factor in life insurance pricing.

3. Products of the Third Pillar Pension

In this part, we deal with products which could be offered to a client retiring at age x who has savings in an amount S.

Product 1

Product 1 offers the client a possibility to get m-thly paid pension annuities in an amount $NP_{x1}^{(m)}$ during the whole life. This m-thly paid out pension can be calculated as follows

$$NP_{x1}^{(m)} = \frac{S}{m \cdot \ddot{a}_x^{(m)}} \tag{4}$$

Net technical provisions ${}_rNV_{x1}$ at the beginning of r-th year for this product are given by formula

$${}_rNV_{x1} = m \cdot NP_{x1}^{(m)} \cdot \ddot{a}_{x+r}^{(m)} \tag{5}$$

Product 2

Product 2 is the same as Product 1, but in this case to the pensioner will be paid term life m-thly paid pension annuities as long as he lives, but for a maximum of n year.

Formula (6) expresses m-thly paid out pension $NP_{xn2}^{(m)}$ to the client as long as he lives, but, for a maximum of n years:

$$NP_{xn2}^{(m)} = \frac{S}{m \cdot \ddot{a}_{x,\overline{n}|}^{(m)}} \tag{6}$$

[5] OXERA is one of Europe´s foremost independent economics consultancies, which was established in 1982 and it has built a reputation for providing critical economic insight to an international list of clients including governments, regulators and major companies.

Net technical provisions at the beginning of *r*-th year are as follows

$$ {}_{r}NV_{xn2} = m \cdot NP_{xn2}^{(m)} \cdot \ddot{a}_{\overline{x+r,n-r|}}^{(m)} \tag{7} $$

Product 3

The third product represents whole life *m*-thly paid out pension annuities with the first higher pension in an amount *p*-% of the accumulated sum *S*. Then *m*-thly paid out pension annuity $NP_{x3}^{(m)}$ from, Product 3 is given by

$$ NP_{x3}^{(m)} = \frac{S \cdot (1-p)}{m \cdot \ddot{a}_{x}^{(m)}} \tag{8} $$

and the corresponding net technical provisions at the beginning of *r*-th year are as follows

$$ {}_{r}NV_{x3} = m \cdot NP_{x3}^{(m)} \cdot \ddot{a}_{x+r}^{(m)} \tag{9} $$

Product 4

Product 4 is an extension of term life *m*-thly paid out pension annuities during *n* years with the first higher pension in an amount *p*-% of the accumulated sum *S*. The formula

$$ NP_{xn4}^{(m)} = \frac{S \cdot (1-p)}{m \cdot \ddot{a}_{\overline{x,n|}}^{(m)}} \tag{10} $$

expresses the amount of *m*-thly paid out pension for a maximum of *n* years, and formula

$$ {}_{r}NV_{xn4} = m \;.\, NP_{xn4}^{(m)} \;.\, \ddot{a}_{\overline{x+r,n-r|}}^{(m)} \tag{11} $$

expresses the corresponding net technical provisions at the beginning of *r*-th year of pension time.

Product 5

On the basis of formula (12) we can calculate the amount of whole life *m*-thly paid out pension annuities, and moreover, with *z*-% of *S* as term certain *m*-thly paid pension annuities during *t* years for an authorized person after death of the pensioner. Pension $NP_{x5}^{(m)}$ from Product 5 paid out *m*thly per year is given by

$$ NP_{x5}^{(m)} = \frac{S}{m \;.\; \left(\ddot{a}_{x}^{(m)} + z \;.\; \ddot{a}_{\overline{t|}}^{(m)} \;.\; A_x \right)} \tag{12} $$

and the corresponding net technical provisions at the beginning of *r*-th year of pension time are as follows

$$ {}_rNV_{x5} = m \cdot NP_{x5}^{(m)} \cdot \left(\ddot{a}_{x+r}^{(m)} + z \cdot A_{x+r} \cdot a_{\overline{t}|}^{(m)} \right) \tag{13} $$

Product 6

Product 6 practically expresses a general formula for evaluation of whole life *m*-thly paid pension annuities with the first higher pension in an amount *p*-% of the accumulated sum *S* and *z*-% of *S* as survivor pension certain annuities during *t* years for an authorized person.

The amount of pension annuity $NP_{x6}^{(m)}$ is given by formula

$$ NP_{x6}^{(m)} = \frac{S \cdot (1-p)}{m \cdot \left(\ddot{a}_{x}^{(m)} + z \cdot \ddot{a}_{\overline{t}|}^{(m)} \cdot A_x \right)} \tag{14} $$

and the corresponding amount of net technical provisions at the beginning of *r*-th year of pension time is given by

$$ {}_rNV_{x6} = m \cdot NP_{x6}^{(m)} \cdot \left(\ddot{a}_{x+r}^{(m)} + z \cdot A_{x+r} \cdot a_{\overline{t}|}^{(m)} \right) \tag{15} $$

4. Analysis of the amount of Monthly Pension

For analysis of the above mentioned offered products we used mortality tables (Mortality tables, 2013) from web page of the Statistical Office of the Slovak Republic, corresponding formulas (1) – (15) and currently valid technical interest rate 1.9% p. a.[6] For more information about the construction of so-called unisex life tables see, for example Smetana and Cipra (2005).

Monthly pensions for all proposed products are evaluated for unisex mortality tables, retirement age $x = 60$ years and saved accumulated sum $S = 1\,000$ euros, term period $n = 25$ years, certain term period $t = 5$ years, the first higher pension in an amount $p = 30\%$ of S (which is the maximum for the first higher pension stated by DDSs in the Slovak Republic), survivor's pension in an amount $z = 20\%$ of the original pension. Monthly pensions can be found in Table 1 below.

Remark 2: Some supplementary pension companies in the Slovak Republic require in their payment plan $n \geq 6$ years, $t = 2$ years and $p \leq 30\%$.

[6] The order of the National Bank of Slovakia of June, 25 2013 on the maximum amount of technical interest rate states the maximum amount of technical interest rate at 1.9%. This order have been come into effect on January, 1 2014; source: <http://www.nbs.sk/_img/Documents/_Legislativa/_Vestnik/ciastka23V-2013.pdf>.

According to OXERA, the most immediate effect of banning the use of a relevant risk factor on insurance pricing is through redistribution of premium from the high risk group to the low risk group. Redistribution effects suggest that unisex pricing will result in significant increases in premiums for retiring men buying pension annuities, for all women buying life insurance.

T a b l e 1

Pensions and Technical Provisions for Unisex and Retirement Age 60 Years

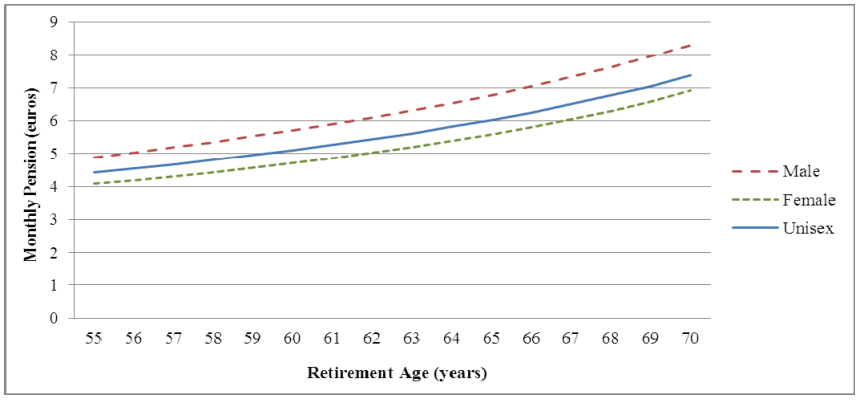
	Product 1	***Product 2***	***Product 3***	***Product 4***	***Product 5***	***Product 6***
Monthly Pension (euros)	**5.10**	**5.42**	**3.57**	**3.80**	**4.91**	**3.43**
	Net provisions (euros)					
Year of the Pension	***Product 1***	***Product 2***	***Product 3***	***Product 4***	***Product 5***	***Product 6***
0	1 000.00	1 000.00	700.00	700.00	1 000.00	700.00
1	969.05	965.15	678.34	675.61	970.78	679.54
2	938.34	930.40	656.84	651.28	941.77	659.24
3	907.66	895.55	635.36	626.89	912.81	638.97
4	877.39	860.95	614.18	602.66	884.23	618.96
5	846.97	826.01	592.88	578.21	855.50	598.85
6	816.17	790.52	571.32	553.36	826.42	578.49
7	785.07	754.51	549.55	528.15	797.05	557.93
8	754.00	718.30	527.80	502.81	767.72	537.40
9	723.24	682.10	506.27	477.47	738.67	517.07
10	692.22	645.35	484.56	451.75	709.38	496.57
11	661.10	608.15	462.77	425.71	679.99	475.99
12	629.66	570.27	440.76	399.19	650.30	455.21
13	598.65	532.31	419.06	372.62	621.03	434.72
14	568.32	494.41	397.82	346.08	592.38	414.67
15	538.52	456.31	376.96	319.41	564.24	394.97
16	509.16	417.80	356.41	292.46	536.52	375.57
17	480.38	378.81	336.27	265.17	509.35	356.54
18	452.02	339.00	316.42	237.30	482.57	337.80
19	423.90	297.94	296.73	208.56	456.01	319.21
20	396.38	255.54	277.46	178.87	430.02	301.02
21	369.90	211.55	258.93	148.08	405.02	283.51
22	344.66	165.33	241.26	115.73	381.19	266.83
23	320.35	115.68	224.24	80.98	358.23	250.76
24	297.02	61.23	207.91	42.86	336.20	235.34
25	274.71	0.00	192.30	0.00	315.14	220.59
26	253.45		177.41		295.06	206.54
27	233.27		163.29		276.01	193.21
28	214.19		149.93		257.99	180.59
29	196.21		137.35		241.01	168.71
30	179.34		125.53		225.08	157.56
31	163.55		114.48		210.17	147.12
32	148.83		104.18		196.27	137.39
33	135.12		94.58		183.33	128.33
34	122.36		85.65		171.28	119.90
35	110.43		77.30		160.01	112.01
36	99.08		69.36		149.30	104.51
37	87.87		61.51		138.71	97.10
38	75.73		53.01		127.24	89.07
39	59.98		41.99		112.38	78.66
40	33.16		23.21		87.06	60.94

Source: Authors.

The corresponding monthly pension annuities according to retirement age and gender w.r.t. Product 1 are illustrated on Graph 2.

Graph 2

The amount of Monthly Whole Life Pension Annuities (Product 1) According to Retirement age with an Accumulated Sum 1 000 Euros and Technical Interest Rate 1.9% p. a.



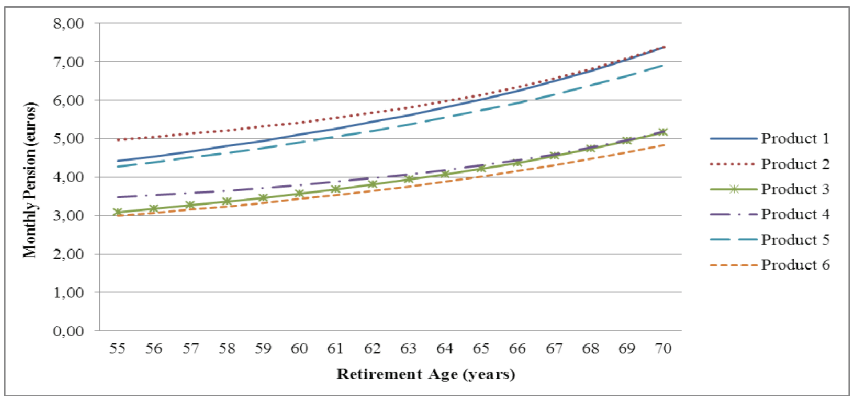
Source: Authors.

Based on the data available for the Slovak Republic, with technical interest rate 1.9% p. a. men (aged 55 and more) could see a reduction in pension income from pension annuities of around 12% on average; women (aged 55 and more) could see a pension income rise by around 7% on average.

Graph 3 illustrates the development of monthly pension annuities of all proposed products and unisex life tables with current technical interest rate 1.9% p. a.

Graph 3

The amount of Monthly Pension Annuities for all Proposed Products According to Retirement Age with an Accumulated Sum 1 000 Euros, Unisex Life Tables and Technical Interest rate 1.9% p. a.

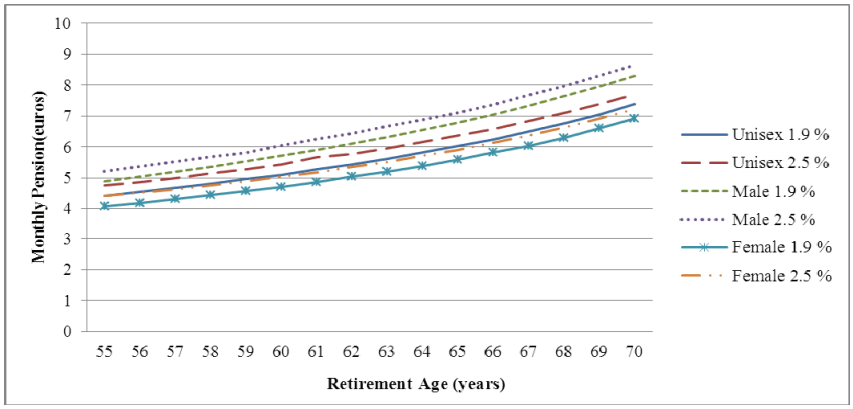


Source: Authors.

Graph 4 illustrates the amount of monthly pension of the first product according to retirement age, gender and technical interest rates (current and previous).

G r a p h 4

The amount of Monthly Pension Annuity According to Retirement Age Gender and Technical Interest Rate



Source: Authors.

The change in technical interest rate from 2.5% to 1.9% has caused a decrease of 6% on average for all products with respect to male, female and unisex life tables.

In terms of profit and loss of supplementary pension companies, in our personal opinion pension companies will seek to attract more men, and moreover, regarding individual products they will seek to offer products without payments of the first higher pension and without survivor's pension for authorized persons.

Moreover, additional costs could arise to insurers applying a gender mix risk premium due to the risk of adverse selection. There could also be additional marketing costs due to a ban on the use of gender.

Conclusion

For life insurance, premiums are currently determined based on age, gender, health conditions and smoking habits. Some of the mentioned aspects have been already analyzed, for instance, in Cipra (2012). In a few cases insurance firms use the policy-holder´s postcode as an indicator of socio-economic status, but this is not common practice in Europe. Importantly, insurers need to use indicators of risk that are relatively stable over time and easy to measure. Trying to use lifestyle factors to replace gender as a risk-based pricing factor could create additional costs. They would not necessarily be a stable indicator of risk over time,

and they would require additional verification, which could be annoying for policy-holders. This paper offers suitable products for payments of pension annuities from supplementary pension savings, which could be a basis for all pension companies.

In our future investigation, we plan to model technical interest rate and mortality tables by stochastic models on the basis of Cipra (2012) and other sources.

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