21th International Scientific Conference AMSE
Applications of Mathematics and Statistics in Economics 2018
Kutná Hora, Czech Republic 29 August 2018 – 2 September 2018

WILL LIFE INSURANCE PRODUCTS MEET OUR EXPECTATIONS?

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Abstract

About fifteen to twenty years ago, funds invested in a life insurance in Slovakia were being valued by a guaranteed so-called technical interest rate of (5-6) % p.a. Gradually, this interest rate was declined to 0.7 % p.a. in 2016. Consequently, with the entry into force of the Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009, known as Solvency II, and the Directive 2014/51/EU of the European Parliament and of the Council of 16 April 2014, known as Omnibus II Directive, insurance companies should guarantee maximum returns on finance on the level of the yields of the risk-free bonds, traded in the eurozone. This paper offers a case study related to the amount of premium, the advantages or disadvantages of an insurance policy and of the selected insurance contracts. Based on our analysis, we recommend insurance as an actual risk coverage and not as an investment.

Key words: *insurance, yield, directive, term life insurance, endowment insurance*

JEL Codes: *G22, G28, C6, K20*

1. Introduction

We can look at insurance from two perspectives. First of all, an insurance contract should protect an insured or his/her relatives in a case of his/her death, accident or illness. This is the main subject of the insurance business. Therefore, life insurance should fulfill the essential role of an insurance and protect clients in the case of undesirable events. From a second point of view, the insurance contract should be concluded for a relatively long period to really represent a life insurance. In our personal opinion, the contract should be concluded for at least 15 years or more.

At present, insurance companies offer a variety of types of an insurance, such as a life insurance, which is the so-called risk life insurance. Risk life insurance secures the insured and his/her family in a case of death for any reason, as a result of an accident or illness. Insurance premium is paid in regular installments or on a one-off basis and it is agreed with fixed or decreasing sum insured. Temporary death-related insurance, known also as term life insurance, is signed for a fixed period. The sum insured will be paid in a case of death of insured to heirs or beneficiaries.

Credit insurance is also a risk life insurance with a decreasing sum insured in the event of death. The insurance amount decreases each year during the insurance period by copying the loan balance and at the same time the insurance premium is recalculated each year according to the so-called technical age (as if new age at entry) of the insured but with an ever-lower sum insured. This is the reason, why this insurance is more cost-effective than a classical term insurance in the case of death with a fixed sum insured.

Whole life insurance in the case of death is an insurance which in the event of death of the insured should provide an heir or beneficiaries with the financial coverage of the funeral costs. Insurance is terminated by the death of the insured, when the sum insured is paid to the beneficiaries. More information about term life insurance can be seen in Schreiber (2017).
The basic types of insurance also include so-called pure endowment insurance. Pure endowment benefits are conditional on the survival of the insured. In general, pure endowment is not sold as a stand-alone policy, but may be sold in conjunction with term life insurance to create the endowment insurance. However, this insurance does not cover the risk of death. If the insured dies during the insured period, the insurer will not pay anything to the entitled person or he only repays the current value of the insurance or insurance premium paid so far. This depends on the specific conditions stated in the insurance contract.
Investment life insurance is a combination of a term life insurance and a long-term investment of cash into mutual funds. Part of the insurance premium is used for risk and fees, the second part is invested in an agreed manner, on the basis of the chosen allocation ratio in one or more mutual funds. Yield is not guaranteed but with a reasonable adjustment and management of the investment, a higher return can be achieved than for endowment insurance. Purchased units can be moved between individual funds to achieve higher profits. Investment life insurance requires the client's ability to also accept the risk of potential loss.
There are many intermediaries in various financial institutions in Slovakia. Information about life insurance products provided by insurance agents is often insufficient. In many cases, they do not provide the clients with all the necessary information and knowingly mislead them for their own profit - it is a violation of good morals. Most often they will not tell them everything about the disadvantage to cancel the insurance in the first years of its existence. The redemption value of the life insurance policy is lower in the first years than the amount of money inserted into it. Although such intermediaries "bring money", on the other side they spoil the reputation of the insurance company. In addition, the insurance contract speaks against client. Because the client agreed to the insurance conditions by signing.
All insurance companies in the European Union must comply with the regulations laid down in the relevant national laws and, of course, the relevant European Union directives. In the Slovak Republic, the Act 39/2015 Coll. on insurance and amending certain laws is currently valid. On the level of the European Union, the Council Directive 2004/113/EC of 13 December 2004 implementing the principle of equal treatment between men and women in the access to and supply of goods and services, the Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II) and the Directive 2014/51/EU of the European Parliament and of the Council of 16 April 2014 amending Directives 2003/71/EC and 2009/138/EC and Regulations (EC) No 1060/2009, (EU) No 1094/2010 and (EU) No 1095/2010 in respect of the powers of the European Supervisory Authority (European Insurance and Occupational Pensions Authority) and the European Supervisory Authority (European Securities and Markets Authority) are in force. Basic requirements of these directives of the European Union are currently applied in research work, for instance, (Chen and Vigna 2017, Shao et al. 2017). An essential part of the research of probability of death or survival, respectively, is mortality modelling and longevity modelling, for more information see studies of the authors (Deprez *et al*. 2017, Chen and Vigna 2017, Konicz and Mulvey 2015).
This paper is organized as follows. In Section 2, we give the legislation concerning the life insurance, basic concepts related to the probabilities of death or survival and a determination

of risk-free interest rate term structure using the Svensson yield curve. In Section 3, we offer basic information about endowment insurance (term life insurance and pure endowment) and the case study which focuses on an analysis of the insurance premium amount which flows from the mentioned insurance policy. In Section 4, we give conclusions and considerations on life insurance products.

2. Preliminaries

In this section we give the legislation concerning life insurance, basic concepts and notations related to modelling of life insurance products.

2.1 Legislation in life insurance

Currently in Slovakia, life insurance legislation is governed by the Act 39/2015 Coll. on insurance and amending certain laws. Part three of this Act - Requirements for the performance of insurance and reinsurance activities, Title one - System of governance, Article 23 - General governance requirements, in item (2) declares, "Insurance and reinsurance undertakings, as well as branches of foreign insurance and reinsurance undertakings, shall have in place an effective system of governance which provides for sound and prudent management of the business. The system shall at least include an adequate transparent organizational structure with a clear allocation and appropriate segregation of responsibilities and an effective system for ensuring the transmission of information." Moreover, listed in item (3) is, "Insurance and reinsurance undertakings, as well as branches of foreign insurance and reinsurance undertakings, shall perform their activities in a prudent manner that:

(a) takes account of and mitigates the risks to which they are exposed;

(b) poses no threat to the interests of their clients;

(c) has no adverse effect on their financial situation."

Regarding to European legislation we pay attention to the Council Directive 2004/113/EC of 13 December 2004 implementing the principle of equal treatment between men and women in the access to and supply of goods and services which in paragraph (4) declares, "Equality between men and women is a fundamental principle of the European Union. Articles 21 and 23 of the Charter of Fundamental Rights of the European Union prohibit any discrimination on grounds of sex and require equality between men and women to be ensured in all areas." Therefore we use so-called unisex life tables which are published on the web page of the Statistical Office of the Slovak Republic (Mortality tables, 217). Moreover, in our models we implement requirements of the Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II). Article 77 of this directive - Calculation of technical provisions, paragraph 2, declares, "The best estimate shall correspond to the probability weighted average of future cash-flows, taking account of the time value of money (expected present value of future cash-flows), using the relevant risk-free interest rate term structure." Also we would like to put to the attention that the Solvency II Directive was amended by the Directive 2014/51/EU of the European Parliament and of the Council of 16 April 2014 (the so-called “Omnibus II Directive").

2.2 Basic probabilities

The basic building blocks in modelling of all life insurance products are the relevant survival and mortality probabilities which are given as follows:

- ${}_tp_x$ - the probability that individual at age x survives at least to age $x+t$,
- ${}_tq_x$ – the probability that individual at age x dies before age $x+t$,
- ${}_{r|t}q_x$ - the probability that individual at age x survives r years, and then dies in the subsequent t years, that is, between ages $x+r$ and $x+r+t$.

The probability ${}_{r|t}q_x$ is also called a deferred mortality probability, because it is the probability that death occurs in some interval following a deferred period. It can be calculated by formula

$$ {}_{r|t}q_x = {}_r p_x - {}_{r+t} p_x. \tag{1}$$

Because our model is based on monthly benefits and we have the annual probabilities of death, we also recall a fractional age assumption (Dickson *et al*., 2009) as follows.

Definition 1 *For integer x, provided the uniform distribution of deaths in every age interval* $[x, x+1[$*, and for* $0 \leq s < 1$*, assume that*

$$ {}_sq_x = s \times q_x. \tag{2}$$

For wider study of this issue we would like to refer to research study of authors Jones and Mereu (2000) and Dickson *et al*. (2011). Their study introduces a unifying family of fractional age assumptions whose members include the familiar uniform distribution of deaths, constant force, and Balducci assumptions. The family also includes a wide range of alternative assumptions that can be used when those mentioned above are inappropriate.

2.3 Svensson yield curve

In our modelling of the life insurance products we apply time value of money (recommendations of the Directive Solvency II) using the relevant risk-free interest rate term structure. On the basis of Technical notes of the European Central Bank (ECB) we give the formula of the Svensson yield curve (European Central Bank, 2017b).

Definition 2 *The Svensson yield curve is given by*

$$\begin{aligned} R(z) = \beta_0 \quad &+ \quad \beta_1 \times \frac{1-\exp\left(-\frac{z}{\tau_1}\right)}{\frac{z}{\tau_1}} + \beta_2 \times \left[\frac{1-\exp\left(-\frac{z}{\tau_1}\right)}{\frac{z}{\tau_1}} - \exp\left(-\frac{z}{\tau_1}\right)\right] + \\ &+ \quad \beta_3 \times \left[\frac{1-\exp\left(-\frac{z}{\tau_2}\right)}{\frac{z}{\tau_2}} - \exp\left(-\frac{z}{\tau_2}\right)\right], \end{aligned} \tag{3}$$

where

- $R(z)$ *– yield from a bond investment with continuous compounding (% p.a.),*

- z – *term to maturity,* $z \in]0, T_{max}]$,
- T_{max} – *maximum term to maturity,*
- $\beta_0, \beta_1, \beta_2, \beta_3, \tau_1, \tau_2$ – *parameters of the Svensson yield curve, where* β_0, τ_1 *and* τ_2 *must be positive.*

3. Endowment insurance

Endowment insurance is the most widespread type of insurance. Besides life insurance, the so-called insurance reserve is also created for the insured. The insurance reserve is like a personal account of the insured whose value cannot decrease but by further payments of the common premium gradually increases up to the amount of the agreed sum insured for the occasion of survival to a certain age. The insured pays the first part of the premium for saving, the second part is used for risk and fees. Premiums can be paid by the client in installments as regular premiums. The paid insurance premium is divided into two parts (in the insurance company), according to the exactly defined rules and actuarial formulas. A minor part of the client's money is consumed by the insurance company to cover expenses - fees, commissions, overheads and the greater part is transferred to technical provisions. Technical provisions are the money of clients which an insurance company manages separately from its assets and have been using to pay insurance benefits in case of death or in case of survival.
The money of the insured increases on yield, while the insurance company has been guaranteeing yields over the entire insurance period up to the amount of yields, which are determined by yield curves of risk-free bonds, traded in the eurozone. If the insurance company is able to increase on yield more than it guarantees, a surplus will be created. Every year, the part of the surplus will be added to the value of the insurance, by the insurance company. The insurance company is mandated to share the surplus (profit). In the insurance contract should be exactly specified what proportion of the potential surplus will have to be added by the insurance company to technical reserves of the client.

3.1 Modelling of the selected product - Endowment insurance

Regarding to actuarial terminology endowment insurance represents term life and pure endowment insurance. Firstly we recall the basic notations which are as follows:

- IS - sum insured as an absolute amount in monetary units (hereafter euros);
- i - technical interest rate as a % p.a.;
- $R(z)$ – yield from a risk-free bond investment with continuous compounding (% p.a.);
- $P(z)$ - discounting factor, where

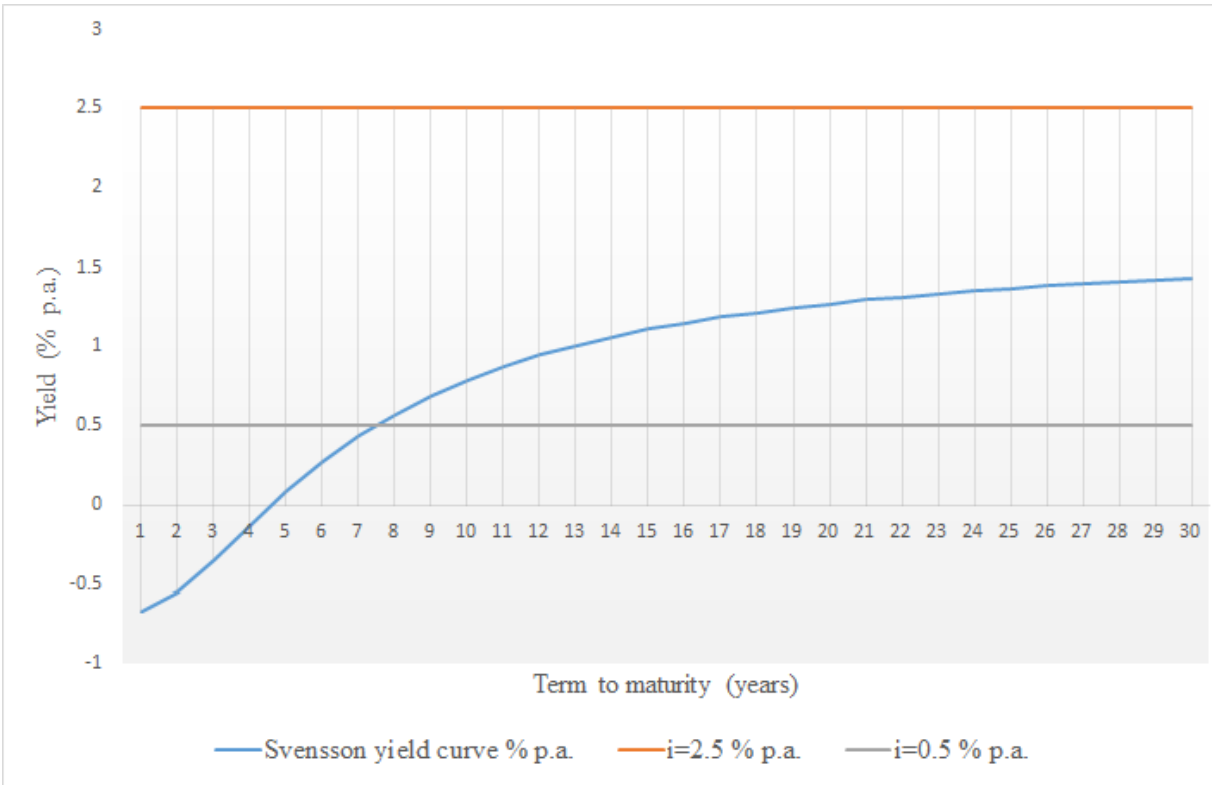
$$P(z) = \begin{cases} \frac{1}{(1+\frac{i}{100\%})^z} & \text{if } i \text{ is technical interest rate,} \\ \exp\{-\frac{R(z)}{100\%} \times z\} & \text{if } R(z) \text{ is yield from a bond investment;} \end{cases}$$

- x - age at entry;

- ω - maximum age to which a person can live to see (regarding used life tables is here $\omega = 105$ (Mortality tables, 2017);
- α - initial costs as a % from a sum insured;
- β - administrative expenditures as a % from a sum insured payable monthly in the amount of $\frac{1}{12} \times \beta$;
- γ - administrative expenditures as a % from the yearly gross premium;
- IC - initial costs as an absolute amount in monetary units independent on an accumulated sum.

For a simpler comparison of yields, we also provide Figure 1 showing the level of the used constant interest rates and the Svensson yield curve on 4 May 2018, for AAA rated bonds. Corresponding parameters are as follows: $\beta_0 = 1.659447$, $\beta_1 = -2.231370$, $\beta_2 = 24.027861$, $\beta_3 = -26.848539$, $\tau_1 = 2.301868$ and $\tau_2 = 2.272782$.

Figure 1: Yields with respect to constant technical interest rate i % p.a. and the Svensson yield curve $R(t)$ % p.a. continuous compounding, May 4^{th} 2018.



Source: The author's work, European Central Bank, 2017a.

3.1.1 Single premium

Under a term life insurance (TLI) policy, the death benefit is payable only if the insured dies within a fixed term of, say, n years. We consider the situation when a death benefit of 1

monetary unit is payable at the end of the month of death of the insured. The expected present value $A^{1(12)}_{x:\overline{n}|}$ of the benefit is given by

$$A^{1(12)}_{x:\overline{n}|} = \sum_{t=0}^{12\times n-1} {}_{\frac{t}{12}|\frac{1}{12}}q_x \times P\left(\frac{t+1}{12}\right). \tag{4}$$

Pure endowment (PE) benefit is conditional on the survival of the insured. In this case, a survivor benefit of 1 monetary unit will be paid out if the insured will be alive at age $x+n$. The expected present value $A_{x:\overline{n}|}{}^{1}$ of the mentioned benefit is as follows

$$A_{x:\overline{n}|}{}^{1} = {}_n p_x \times P(n). \tag{5}$$

An endowment insurance provides a combination of a term life insurance and a pure endowment insurance. The sum insured IS is payable in the case of the death of the insured within a fixed term n years, but if an insured survives for n years, an IS is payable at the end of the nth year. Therefore, we can give the expected present value of the corresponding benefits $A_{x:\overline{n}|}$ by formula

$$A_{x:\overline{n}|} = A^{1(12)}_{x:\overline{n}|} + A_{x:\overline{n}|}{}^{1}. \tag{6}$$

We use the concept *life annuity* to refer to the series of payments to an insurance company as long as an insured is alive on the payment date. Because we assume that our insured pays a premium at the beginning of the each month, it is obvious that the expected present value of the basic premium in the amount of 1/12 of monetary unit $\ddot{a}^{(12)}_{x:\overline{n}|}$ is given by

$$\ddot{a}^{(12)}_{x:\overline{n}|} = \frac{1}{12} \times \sum_{t=0}^{12\times n-1} {}_{\frac{t}{12}}p_x \times P\left(\frac{t}{12}\right). \tag{7}$$

3.1.2 Monthly premiums

On the basis of the previous formulas and explanations we can consecutively give formulas on the calculation of the amount of the monthly premium $(TLI)\ MP_{x:\overline{n}|}$ for term life insurance, and the monthly premium $(PE)\ MP_{x:\overline{n}|}$ for pure endowment and finally $MP_{x:\overline{n}|}$ for endowment insurance as follows

$$(TLI)\ MP_{x:\overline{n}|} = \frac{IS \times A^{1(12)}_{x:\overline{n}|}}{12 \times \ddot{a}^{(12)}_{x:\overline{n}|}}, \tag{8}$$

$$(PE)\ MP_{x:\overline{n}|} = \frac{IS \times A_{x:\overline{n}|}{}^{1}}{12 \times \ddot{a}^{(12)}_{x:\overline{n}|}}, \tag{9}$$

$$MP_{x:\overline{n}|} = \frac{IS \times \left(A^{1(12)}_{x:\overline{n}|} + A_{x:\overline{n}|}{}^{1}\right)}{12 \times \ddot{a}^{(12)}_{x:\overline{n}|}}. \tag{10}$$

Moreover, we also assume expense and profit loadings, therefore we built *gross monthly premiums* as follows. For simplicity, we used the same costs loadings in all cases. For endowment insurance, we counted them only once.

$$(TLI)\ GMP_{x:\overline{n}|} = \frac{IS \times \left(A^{1(12)}_{x:\overline{n}|} + \frac{\alpha}{100\,\%} + \frac{\beta}{100\,\%} \times \ddot{a}^{(12)}_{x:\overline{n}|}\right) + IC}{12 \times \ddot{a}^{(12)}_{x:\overline{n}|} \times (1 - \frac{\gamma}{100\,\%})}, \tag{11}$$

$$(PE)\ GMP_{x:\overline{n}|} = \frac{IS \times \left(A_{x:\overline{n}|}^{1} + \frac{\alpha}{100\,\%} + \frac{\beta}{100\,\%} \times \ddot{a}_{x:\overline{n}|}^{(12)}\right) + IC}{12 \times \ddot{a}_{x:\overline{n}|}^{(12)} \times (1 - \frac{\gamma}{100\,\%})}, \tag{12}$$

$$GMP_{x:\overline{n}|} = \frac{IS \times \left(A_{x:\overline{n}|}^{1(12)} + A_{x:\overline{n}|}^{1} + \frac{\alpha}{100\,\%} + \frac{\beta}{100\,\%} \times \ddot{a}_{x:\overline{n}|}^{(12)}\right) + IC}{12 \times \ddot{a}_{x:\overline{n}|}^{(12)} \times (1 - \frac{\gamma}{100\,\%})}. \tag{13}$$

3.2 Case study - Endowment insurance policy

Our case study offers the calculation and small analysis of the basic life insurance product - endowment insurance and its corresponding monthly premium which will be paid during the following 20 years for insured at age 47[1]. The sum insured IS in the amount of 3,100 euros will be paid out to heirs in a case the insured dies during the following twenty years or it will be paid out to the insured if she will be alive at age 76. On the basis of previous formulas we give monthly premiums for term life insurance and pure endowment.

Table 1: Monthly premium for Term and Pure Endowment insurance with different interest rate risk loading according to (8), (9) and (10)

Monthly premium (euros)	$i = 2.5\,\%$ p.a.	$R(z)$ p.a.	$i = 0.5\,\%$ p.a.
Term life insurance (8)	2.30	2.40	2.48
Pure Endowment insurance (9)	8.79	9.81	10.88
Endowment insurance (10)	11.09	12.21	13.37

The author's work.

On the basis of Table 1 it is obvious that the changes of the technical interest rate or yields of the risk-free bonds, respectively, cause price increase of the monthly premium. We would like to point out that pure endowment insurance is much more expensive than life insurance.
In our case study, the impact of the fall in interest rates from 2.5 % p.a. to 0.5 % p.a. will cause a price increase by 0.18 euros in term life insurance and by 2.09 euros in pure endowment insurance. We can also see that the amount of premium, calculated using technical interest rate 0.5 % p.a., is more expensive by 0.08 euros in a comparison with premium calculated using the Svensson yield curve. A much bigger difference is to be seen in the case of pure endowment - increase by 1.07 euros.
Regarding to cost loadings, corresponding premiums are written in Table 2. We applied initial costs α in the amount of 5 % from the sum insured, administrative expenditures $\beta = 0.1\,\%$ from the sum insured payable monthly in the amount of $\frac{1}{12} \times \beta$, administrative expenditures $\gamma = 1.5\,\%$ and initial costs IC in the amount of 300 euros.

[1]The insured is one of the co-authors. Calculations are made using so-called unisex life tables.

Table 2: Monthly premium for Term and Pure Endowment insurance with different interest rate risk loading and cost loading according to (11)

Monthly premium (euros)	$i = 2.5\,\%$ p.a.	$R(z)$ p.a.	$i = 0.5\,\%$ p.a.
Term life insurance (11)	4.95	4.63	4.70
Pure Endowment insurance (13)	11.64	12.15	13.37
Endowment insurance (12)	14.01	14.59	15.92

The author's work.

Remark 1 *We have chosen sum insured in the amount of* $3,100$ *euros because the unnamed insurance company offered us the insurance policy with the same sum insured. The amount resulting from the fact that the insurance company requires monthly insurance premiums to be higher than* 15 *euros. Unnamed insurance company offers returns of investment (technical interest rate)* 0.5 *% p.a. Our results with respect to these requirements are listed in Table 2, third column.*

On the basis of our small analysis, we would like to emphasize that insurance should serve to cover the real risk, but not as a saving or an investing. For instance, if the insured would save the amount of monthly premium of pure endowment insurance in the amount of 13.37 euros (from Table 2, she will be able to save for twenty years at least $3,208.25$ euros without any yields. If we would assume financial yields on the amounts of yields of technical interest rate 0.5 our insured would be obtain $3,373.02$ euros. In the case of the calculation of pure endowment premium using the Svensson yield curve (May 4^{th} 2018) without any yields our insured would obtain $2,916.38$ euros and with yields on the level of the Svensson yield curves in the amount of $3.150,34$ euros.

4. Conclusion

Slovak insurance companies should learn from crises in countries such as the Netherlands or the United Kingdom and take care of the quality of life insurance sales. The Ministry of Finance (MF) of the Slovak Republic indicates the increase of financial literacy in Slovakia as one of its priorities. It therefore cooperates with several organizations to improve the financial awareness of people. MF also supports the increase of financial literacy of the society as a possible tool for the elimination of the material distress and the poverty trap for the 2014-2020 programming period. The Ministry is also part of the Expert Group on Financial Literacy, which updated the National Standard of Financial Literacy with effect from the first of September, 2017.
Currently, the Ministry of Education implements systematic financial education in the basic curricula of primary and secondary schools as a cross-sectional theme. Several projects are being implemented to support the education of teachers in the field of financial literacy, in the form of financial education through lectures at schools. Clients should be better informed about financial products also through legislation. For example, since the amendment to the Act on Insurance, the Ministry of Finance promises to increase the transparency of the costs related

to the distribution of financial products. It also introduces an obligation for a financial agent and a financial adviser to provide the client with an information document before concluding a financial service contract with clear and comprehensible information about the main items, entering the premium.
We believe that the social pressure to provide complete and correct information to clients by insurance agents will become increasingly strong and insurance companies will place increased demands on the moral and knowledge profile of their intermediaries.

Acknowledgements

Petra Medveďová and Jana Špirková have been supported by the Slovak Scientific Grant Agency VEGA no. 1/0093/17 Identification of risk factors and their impact on products of the insurance and savings schemes.

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