

REBALANCING OF INVESTMENT PORTFOLIOS OF INSURERS UNDER SOLVENCY II¹

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Realokácia investičných portfólií poisťovní v rámci systému Solvency II

Abstract: *The investment policy of insurance companies is a very important area in the current environment of the new regulatory system, Solvency II. The Directive introduces a new method of measurement and management of all risks affecting the business of insurance companies. The aim of this paper is to quantify the differences in risk-adjusted returns, resulting from investments in selected asset classes and the creation of efficient portfolios. Another aim is to point out to the potential rebalancing of portfolios of insurance companies, due to the implementation of the new regulatory regime and the current situation on the financial market. The results presented are limited by three investment instruments, namely: a portfolio of government bonds, stock index and real estate index.*

Keywords: *Solvency II, rebalancing, investment instruments, market risk, RAROC*

JEL Classification: G 22

Introduction

The investment policy of insurance companies is a very important area, and in particular in the current environment of the new regulatory system, Solvency II. The Directive introduces a new method of measurement and management of all risks affecting the business of the insurance. One of them

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is the market risk. For this, Solvency II provides a different calibration of capital requirements (SCR – Solvency capital ratio) in the standard formula for each class of assets. Its introduction is a response to the shocks in the global financial system and follow-up to the need to modernise the European insurance regulation in order to increase the stability of both the insurance and financial markets. European insurance companies are among the largest institutional investors in the world. The volume of funds invested by them amounted, according to the institution Insurance Europe [15], at the end of 2015 about 9800 billion €, i.e. 60% of the GDP of the European Union. Solvency II sets out for each asset class different capital requirements, which in a certain way try to predefine optimal investment portfolios of insurance companies. In the context of the standard formula of the new regulatory regime, insurance companies will need to find an appropriate mix of risk and return on its investment portfolio. An important attribute in selecting investment instruments and their potential rebalancing will be their duration. It is a determining parameter for the reconciliation of cash flow arising from the assets needed to cover liabilities – ALM (Asset liability matching), which is a prerequisite for the safe functioning of the insurance company. The main parameter is the allocation of funds of insurance companies, which affects the SCR and the return of the portfolio.

The aim of the present paper is to quantify the differences in risk-adjusted returns, resulting from investments in selected asset classes and the creation of efficient portfolios. Further, we will point out to potential rebalancing of portfolios of insurance companies, due to the implementation of a new regulatory regime as well as the current situation on the financial market. The results presented are limited by three investment instruments, namely: a portfolio of government bonds, stock index and real estate index. Equity and real estate indices represent a higher return and risk level, government bonds again creating lower capital requirements associated with a lower rate of return.

The structure of the paper corresponds to this goal. It is divided into four parts. In the first part, we deal with a brief characterisation of the Solvency II project and the method of calculating capital requirements for limited market risk module within the standard formula. The second part is devoted to the impact of the calibration this module on the asset allocation of insurance companies. The third part contains the definition of the aim and the chosen research methodology, as well as the limits of the real environment, which lead to the simplification of our calculations. Achieved results of the research include the final, fourth part.

Project Solvency II

Solvency II is a new legislative framework that regulates the insurance industry in the European Union. The Directive was implemented on 1 January 2016. The new system brings a change in the perception of regulation, from rules-based system (Solvency I) to a system based on principles. In the context of the investment policy of insurance companies, this means that the regulator does not set a strict limit to the asset allocation of insurance companies, but recognizes same “freedom of investment activity” [4].

The new legislative regulation addresses a number of significant deficiencies of the previous regulation (Solvency I). One of the major changes is a realistic view of the risks of the company and their active management. Solvency I required a prudent valuation of assets and insurance liabilities. Solvency II focuses on the use of market-to-market or mark-to model and therefore, the market valuation of insurer’s balance sheet items (excluding technical reserves). The requirements is consistent with realistic valuations in order to show real economic value of assets and liabilities and the application of the so-called comprehensive approach to the balance – take into account all the risks that the insurance company is exposed to [17].

Solvency II is based on a three-pillar structure, similar to Basel II. In our research, we are working with the first pillar, which provides, inter alia, conditions for calculation of the Solvency Capital Requirement (SCR – Solvency capital ratio). It is designed to absorb unexpected losses arising from the height and nature of risks that affect the insurance company.

The role of the SCR is to ensure a low probability of default of the insurance company. Solvency capital requirement is in the one-year horizon calibrated on a confidence level 99.5% VaR (Value at Risk) of basic own funds (BOF) – the difference between assets and liabilities which excludes subordinated debt [11].

The SCR is based on specific stress situation (scenario) for individual sub-modules. Stress scenarios are dynamic models that test the impact of various factors on the value of the assets or liabilities, i.e. exploring the net current value of the cash flows of the assets (or liabilities) under the different scenarios that could occur [2]. These have an impact on the change of BOF, which can be calculated in several ways. In our paper, we focus on the standard formula calculation. According to this formula, the SCR is

composed of the capital requirement for operational risk, the ability of technical provisions and deferred taxes to absorb losses and BSCR (Basic solvency capital requirement), which is composed of six risk modules.⁴ One of them is the market risk module, and it is the very subject of our research. This module is sub-divided into six sub-modules: interest rate risk, equity risk, property risk, currency risk, credit spread risk, and concentration risk. Sub-modules are aggregated for the purpose of diversification through correlation matrix (Tab. 1) like BSCR.

The values of correlation coefficients vary depending on the selected stress scenario in the interest rate risk sub-module. For the upward shock, there are used coefficients, which are in the first place within a cell in the table, in the case of the downward shock in the second one. In our paper, we will focus on four sub-modules: interest rate risk, equity risk, property risk and currency risk.

Table 1

The correlation matrix of market risk sub-module

	SCR _{IR}	SCR _{EQ}	SCR _{PR}	SCR _{FX}	SCR _{SPREAD}	SCR _{CONC}
SCR _{IR}	1	↑0/0.5↓	↑0/0.5↓	0.25	↑0/0.5↓	0
SCR _{EQ}	↑0/0.5↓	1	0.75	0.25	0.75	0
SCR _{PR}	↑0/0.5↓	0.75	1	0.25	0.5	0
SCR _{FX}	0.25	0.25	0.25	1	0.25	0
SCR _{SPREAD}	↑0/0.5↓	0.75	0.5	0.25	1	0
SCR _{CONC}	0	0	0	0	0	1

Source: Own processing based on [13].

Size of the capital charge for a particular instrument determined by EIOPA [11] within the standard formula for the examined sub-modules as follows (Tab. 2):

⁴ BSCR is composed of six risk modules: market risk, counterparty default risk, underwriting risk in life, non-life and health insurance and risk modules of intangible assets, whose values are aggregated (excluding risk module of intangible assets) for the purpose of calculation of that requirement.

Table 2

The calibration of the market risk module

Risk sub-module	The methodology for the calculation of the SCR																																																																																																																	
Interest rate	<p>Interest rate risk arises from the sensitivity of assets and liabilities that respond sensitively to changes in interest rates (such as fixed income instruments). SCR_{IR} represents change of BOF caused by the increase (upward shock) or decrease (downward shock) of the risk-free rate curve (RFR). Shocks values depend on the duration of assets and liabilities, these are shown in Tab. 3.</p> <p style="text-align: right;">Table 3</p> <p style="text-align: center;">The stress scenarios in the interest rate sub-module</p> <table border="1"> <thead> <tr> <th>Tenor (year)</th> <th>Upward</th> <th></th> <th>Tenor (year)</th> <th>Upward</th> <th>Downward</th> </tr> </thead> <tbody> <tr><td>1</td><td>70.0%</td><td>-75.0%</td><td>18</td><td>29.0%</td><td>-29.0%</td></tr> <tr><td>2</td><td>70.0%</td><td>-65.0%</td><td>19</td><td>27.0%</td><td>-29.0%</td></tr> <tr><td>3</td><td>64.0%</td><td>-56.0%</td><td>20</td><td>26.0%</td><td>-29.0%</td></tr> <tr><td>4</td><td>59.0%</td><td>-50.0%</td><td>25</td><td>25.6%</td><td>-28.4%</td></tr> <tr><td>5</td><td>55.0%</td><td>-46.0%</td><td>30</td><td>25.1%</td><td>-27.7%</td></tr> <tr><td>6</td><td>52.0%</td><td>-42.0%</td><td>35</td><td>24.7%</td><td>-27.1%</td></tr> <tr><td>7</td><td>49.0%</td><td>-39.0%</td><td>40</td><td>24.3%</td><td>-26.4%</td></tr> <tr><td>8</td><td>47.0%</td><td>-36.0%</td><td>45</td><td>23.9%</td><td>-25.8%</td></tr> <tr><td>9</td><td>44.0%</td><td>-33.0%</td><td>50</td><td>23.4%</td><td>-25.1%</td></tr> <tr><td>10</td><td>42.0%</td><td>-31.0%</td><td>55</td><td>23.0%</td><td>-24.5%</td></tr> <tr><td>11</td><td>39.0%</td><td>-30.0%</td><td>60</td><td>22.6%</td><td>-23.9%</td></tr> <tr><td>12</td><td>37.0%</td><td>-29.0%</td><td>65</td><td>22.1%</td><td>-23.2%</td></tr> <tr><td>13</td><td>35.0%</td><td>-28.0%</td><td>70</td><td>21.7%</td><td>-22.6%</td></tr> <tr><td>14</td><td>34.0%</td><td>-28.0%</td><td>75</td><td>21.3%</td><td>-21.9%</td></tr> <tr><td>15</td><td>33.0%</td><td>-27.0%</td><td>80</td><td>20.9%</td><td>-21.3%</td></tr> <tr><td>16</td><td>31.0%</td><td>-28.0%</td><td>85</td><td>20.4%</td><td>-20.6%</td></tr> <tr><td>17</td><td>30.0%</td><td>-28.0%</td><td>90</td><td>20.0%</td><td>-20.0%</td></tr> </tbody> </table> <p>Source: [12] Shocks are applied to the RFR as follows [8].</p> $RFRt \cdot (1 + S_{upt}) \text{ for upward shock} \quad (1)$ $RFRt \cdot (1 + S_{down}) \text{ for downward shock} \quad (2)$ <p>$S_{upt;down}$ is the upward or downward shock for a specific duration of assets or liabilities. The insurance company used to calculate the SCR shock, which requires more capital to cover risk [18].</p>						Tenor (year)	Upward		Tenor (year)	Upward	Downward	1	70.0%	-75.0%	18	29.0%	-29.0%	2	70.0%	-65.0%	19	27.0%	-29.0%	3	64.0%	-56.0%	20	26.0%	-29.0%	4	59.0%	-50.0%	25	25.6%	-28.4%	5	55.0%	-46.0%	30	25.1%	-27.7%	6	52.0%	-42.0%	35	24.7%	-27.1%	7	49.0%	-39.0%	40	24.3%	-26.4%	8	47.0%	-36.0%	45	23.9%	-25.8%	9	44.0%	-33.0%	50	23.4%	-25.1%	10	42.0%	-31.0%	55	23.0%	-24.5%	11	39.0%	-30.0%	60	22.6%	-23.9%	12	37.0%	-29.0%	65	22.1%	-23.2%	13	35.0%	-28.0%	70	21.7%	-22.6%	14	34.0%	-28.0%	75	21.3%	-21.9%	15	33.0%	-27.0%	80	20.9%	-21.3%	16	31.0%	-28.0%	85	20.4%	-20.6%	17	30.0%	-28.0%	90	20.0%	-20.0%
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Equity risk	<p>SCR_{EQ} is created to cover the volatility in equity prices, which affects the change of BOF. It applies only to the downward stress scenario. SCR_{EQ} is divided into two types:</p> <p>$SCR_{EQ-TYPE 1}$ – stress scenario at level of 39% of equities which are listed on the regulated markets of the EEA or OECD. Reduced factors: 22% of the value of strategic interests; 22% of the equity risk</p>																																																																																																																	

	<p>with an investment horizon longer than 12 years, on the condition of supervisory approval for undertakings offering pension insurance products.</p> <p>SCR_{EQ-TYPE 2} – stress scenario 49% of equities, which are listed outside the EEA countries and the OECD, non-listed equities, hedge funds, commodities, and other alternative investments.</p> <p>Both basic capital requirements are modified by symmetric adjustment mechanism (SA – symmetric adjustment), the value of which increases or reduces the SCR by a maximum +/-10%. SA is based on the assumption of mean reverting behaviour⁵ of equities.</p> <p>SCR_{EQ} for both types of equities are then aggregated using a correlation matrix, with a fixed correlation index 0,75, using the following formula:</p> $SCR_{EQ} = \sqrt{SCR_{sq1}^2 + SCR_{sq2}^2 + CorrIndex^{sq} \cdot SCR_{sq1} \cdot SCR_{sq2}} \quad (3)$
Property risk	SCR _{PR} covers risks arising from the sensitivity of assets, liabilities and financial investments on the level and volatility of market prices of real estate. The basic stress scenario within the mediated changes of BOF is set to decline in real estate investments by 25%.
Currency risk	Risks resulting from investments denominated in a currency other than EUR. SCR _{FX} is made up of 25% of the value of those instruments.

Source: Own processing based on [11].

Individual partial SCR, in our case SCR_{IR}, SCR_{EQ}, SCR_{PR} and SCR_{FX} are aggregated via correlation coefficients (Tab. 1) and the following formula No. 4:

$$SCR_{MKT} = \sqrt{\sum_{r,c} CorrMkt_{r,c} \cdot SCR_r \cdot SCR_c} \quad (4)$$

Impact of the market risk module calibration on the asset allocation of insurers

As already mentioned above, through the calibration of the capital requirements for the various asset classes, Solvency II tries in a certain way to predefine optimal investment portfolios of the insurance companies. They will probably seek assets with maximum return and maximum compliance with the duration of liabilities. They will try to minimise the size of individual SCR that are calibrated differently for each asset class. According to the insurance company AXA [1], a new regulatory regime favours the allocation of funds to the so-called “govies”, government bonds and corporate bonds in the investment grade with a short duration. In our paper, however, we abstracted from the credit spread sub-module, which serves, among other things, for the calculation of the SCR for corporate bonds. For

⁵Symmetric adjustment mechanism is closer defined in [5].

the sake of simplification, we will devote only the allocation of assets to the government bonds of EU countries. They are exempted from the credit spread risk and concentration risk inside the market risk module. Analysts of the rating agency Fitch Ratings [14] expect that the implementation of the new regulation will lead to an increase in the demand for bonds (mainly government bonds of EU countries). On the contrary, Solvency II will cause a decline in the demand of insurance companies for more risky assets – equities, real estates and other alternative investments. Calibration of the standard formula placed government bonds of EU countries in terms of the creation of the SCR, in spite of a little difference in risk, which is individual for each of the instruments, in the same group. Solvency II considered these as a “safe” investment, given its return that is close to zero, but their revenues may not be sufficient for the fulfilment of long-term liabilities. Thus, insurance companies will have to diversify their portfolios and seek more profitable assets such as shares, which will increase their overall SCR [19]. The positive effects of investments in the equities are also provided by KPMG [16]. They argue that equities are burdened with the highest SCR, but given the diversification benefits are marginal capital costs of adding these instruments into the portfolio much lower and their expected rate of return much higher than in other financial instruments. In the following sections of the paper, we will focus, in the context of the current discussions and developments on the financial markets, on the calculation of risk-adjusted returns arising from the various asset classes. We will also create efficient portfolios and examine the possible reallocation of assets of insurance companies due to the calibration of the standard formula of the Solvency II.

The Aim and Methodology of Research

The aim of the present contribution is to quantify the differences in risk-adjusted returns, resulting from investments in selected asset classes and the creation of efficient portfolios. Further, we will point out to potential rebalancing of portfolios of insurance companies, due to the implementation of the new regulatory regime as well as the current situation on the financial market. Our inspiration is primarily a methodology that used in its contribution Braun et al. [3]. In our paper, we use the standard formula of the Solvency II, which calibration was discussed in the previous sections. In order to determine the risk-adjusted returns of selected assets we will use RAROC (Risk-adjustment return of capital). RAROC is commonly used by the insurance companies and companies from different sectors to maximise

their market value. Indicator is the ratio of return and cost of capital [6]. Therefore, it enables the individual undertakings to identify profitable business lines or investments and unprofitable areas of their activities. For the purposes of their research aimed at investment portfolios of insurance companies, Braun et al. [3] used the following form of this indicator:

$$\text{RAROC} = E[r]/\text{SCR} \quad (5)$$

where SCR is the Solvency capital requirement, risk capital necessary to cover investments in various asset classes. $E[r]$ is the expected profit from the financial instrument or portfolio investments. The authors using the indicator created a set of efficient portfolios, which expected benefits exceeded risk capital (SCR) of a fictitious insurance company. They concluded that in the case of efficient portfolios, insurance companies, paradoxically, did not reach the maximum profits. The reason for this situation was the fact that the amount of RAROC was affected to a greater extent by the volume of risk capital and rather than of the return which each of the asset classes produced.

Given the scope and complexity of the research problems we will limit the environment and the actual standard formula for calculating capital requirements. We presume that the investment portfolio will consist of three asset classes (Tab. 4). These will affect the amount of risk in the four sub-modules: interest rate risk, equity risk, property risk and currency risk,

Table 4

The portfolio composition

Risk sub-module	Investment instrument	Weights
Interest rate risk	BONDS portfolio consisting of:	
	Germany 10 Y bond yield	0.16
	France 10 Y bond yield	0.44
	Italy 8 Y bond yield	0.40
Equity risk	EURO STOXX 50	
Property risk	MSCI Europe Real Estate	

Source: Own processing based on data from sites: www.yahoo.finance.com and www.investing.com

as the MSCI is denominated in USD. We will not deal with the credit spread risk (capture the risk associated with corporate bonds), and concentration risk (increases due to the lack of diversification of assets and excessive exposure to a single counterparty).

Selection of government bonds of countries and their weights in the BONDS portfolio is based on the EIOPA Insurance stress test [12]. It included the average duration of government bonds held by insurance companies 8.6 years. The average duration of our instruments is 9.2 years. Participating insurers have allocated at the time of testing their funds in individual bonds follows – GR – 8.64%, FR – 24.53%, ITA – 22.52%. Weights in our study are based on the assumption that insurance companies invest exclusively in these three debt instruments.

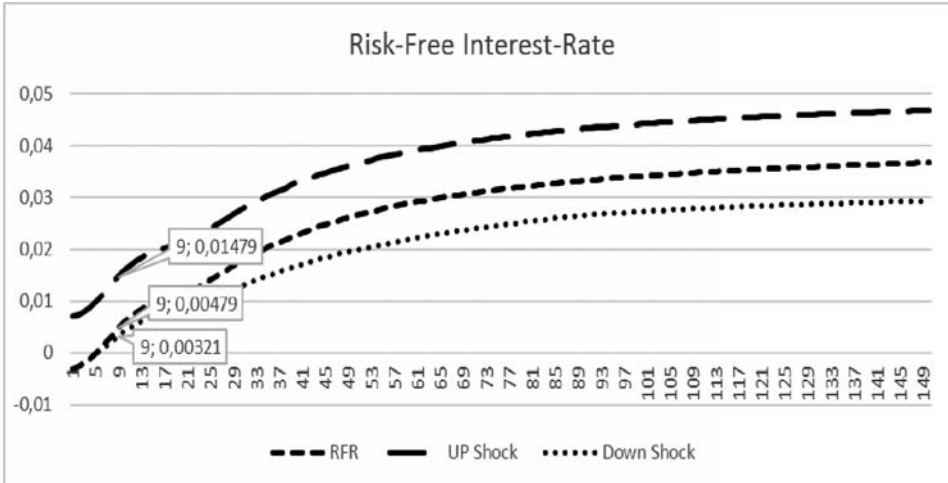
The structure of liabilities of our insurance company corresponds to the composition of the balance of the representative insurance company in QIS5 [7]. The share of liabilities (technical provisions and other liabilities) and the basic own funds are 87% and 13%, respectively. The median of duration of liabilities is nine years. This value was used in the calculations of EIOPA [10]. Size of balance of our insurance company is 10,000,000,000 €.

As we stated in the first part, duration of assets and liabilities is important in determining stress scenarios, which together with the development of RFR affect the value of both sides of the balance of the insurance company. In this paper, we work with a standard stress: +44% for the upward shock and -33% for the downward shock (Tab. 3). Standard shock is based on the average duration of assets and liabilities. The values of individual shocks applied to RFR are highlighted in Fig. 1. The RFR is published on a monthly basis by EIOPA.

Equity risk in our contribution represents the stock index EURO STOXX50, a benchmark of the European stock market. This includes 50 so-called “blue chips” – stocks of the fifty largest and most liquid European companies. The index is traded in EUR. Property risk is represented in the research by the MSCI Europe Real Estate, which is denominated in USD. Investments in it will be burdened with two partial SCR, standard SCR_{PR} and SCR_{FX} .

Figure 1

The development of risk-free interest rate



Source: EIOPA.

The research is based on the analysis of the historical annual data of selected asset classes over the time horizon of twenty years (1996-2016). Data sources are Internet portals finance.yahoo.com, ycharts.com, investing.com and eiopa.europa.com. One of the aims was to create an efficient portfolio that maximises the profit of the insurance company. For these purposes, we used EXCEL and its add-on - SOLVER.

The results of research

The aim of the Solvency II is a comprehensive management of all risks that affects the business of the insurance company. In the context of the new regulatory regime, the obligation arises for the insurance market participants to create the SCR to cover the risks. Size of the capital requirements depends on the calibrated stress scenario. Its definitive range is influenced by the deviation of the values of the investment instruments or factors that produce risk in a given risk module. The amount of stress scenarios is the maximum limit of changes in the value of BOF. Put simply, the value of BOF represents the maximum level of the SCR. Final Solvency capital requirements contain a large number of partial SCRs, which are principally divided into six basic modules. One of them is the market risk module. Its share of the total SCR was 69%, according to QIS5 [8]. As mentioned in the third part, within the maximum simplicity, we use the balance of the

insurance company from Tab. 5. The maximum limit of SCR to cover the risk of our portfolio will be 897,000,000 EUR (69% from 13% BOF).

Table 5

The balance of our insurance company

Assets	Liabilities	
10,000,000,000	BOF	1,300,000,000
	Liabilities	8,700,000,000

Source: Own processing on the basis of [10].

Our portfolio consists of three classes of investment instruments, which are in detail characterised in Tab. 6. The first asset class includes government bonds of EU countries. All of them are in the investment grade.

Table 6

The characteristic of investment instruments

Investment instrument	Asset class	Median	Standard deviation	Duration
BONDS portfolio	Government bonds	4.03%	1.40%	9,2
German 10-Year Bond Yield (AAA)	Government bonds	3.68%	1.66%	10
French 10-Year Bond Yield (AA)	Government bonds	3.69%	1.48%	10
Italian 8-Year Bond Yield (BBB-)	Government bonds	4.08%	1.38%	8
EUROSTOXX 50	Equity	6.46%	27.50%	-
MSCI Europe Real Estate	Property	6.89%	35.64%	-

Source: Own processing based on data from sites: www.yahoo.finance.com, www.investing.com and www.ycharts.com

We cannot say that it is a well-diversified portfolio of the debt instruments, but for the needs of our contribution, which does not specify the composition of passive items, it is sufficient to mention that the resulting duration of 9.2 years is higher than the median duration of liabilities nine years [9]. Therefore, our insurance company should not have problems with the meeting its obligations.

For the purpose of calculating risk-adjusted returns accruing from the investing in various asset classes, in our contribution crucial is the median that divides the returns of the instruments during the examined time horizon into two equal groups. The use of the median return for stocks and real

estate is not problematic, since these despite high volatility, demonstrated by standard deviation in the considered period, in absolute terms increased. It is problematic to use the median for the measurement of the actual return of the government bonds. Its use can be misleading because the returns of the bonds during the period was declining continuously and is now, in the case of debt instruments of many EU countries, close to zero or even in negative area.

The volume of risk charges which determines the size of RAROC depends on the stress scenario for the selected asset class and the choice of correlation coefficients (Tab. 1). Stress shocks are presented in Tab. 7.

Table 7

The SCR calibration for the individual asset classes

Sub-module	Shock
IR	8.71%/1.47%
EQ	39%
PR	25%
FX	25%

Source: Own processing based on EIOPA [10].

In the calculations, we used the upward shock within the interest rate module and version of the correlation matrix with increasing coefficients (Tab. 1). Size of stress scenario for assets sensitive to the interest rate is 8.71%. SCR for the remaining two instruments is consistent with the technical specifications of the Solvency II standard formula. In the calculation of the capital requirement to cover the equity risk, we do not count with the value of the symmetric adjustment mechanism (SA). Size of the mechanism depends on the development of the EIOPA equity index.

The SA subsequently raises or lowers the SCR. The resulting values of the capital requirements are shown in Tab. 8, which contains a summary of the results of our calculation. The main objective was to quantify the RAROC for individual investment instruments and efficient portfolios (EP) A and B, and point out to a possible rebalancing of investment portfolios of insurance companies.

Table 8

The specification of efficient portfolios and RAROC indicator for the selected asset classes

	BONDS portfolio	ESTXX50	MSCI	Efficient portfolio
Efficient portfolio A				
Weights	88.08%	8.90%	3.01%	100.00%
E[r]	4.03%	6.46%	6.89%	4.33%
SCR in %	8.71%	39.00%	50.00%	8.97%
SCR	767,192,924,38	347,229,138,71	150,741,875,08	897,000,000,00
Diversification in %			-10.47%	-27.25%
Diversification			- 31,565,348,64	- 343,238,976,43
RAROC	0.4627	0.1656	0.1743	0.4830
Efficient portfolio B				
Weights	87.99%	9.74%	2.27%	100.00%
E[r]	0.99%	6.46%	6.89%	1.66%
SCR in %	8.71%	39.00%	50.00%	8.97%
SCR	766,373,678,78	379,940,385,74	113,507,281,33	897,000,000,00
Diversification in %			-10.47%	-27.13%
Diversification			- 23,768,424,71	- 341,789,531,13
RAROC	0.1137	0.1656	0.1743	0.1847

Source: Own processing.

Creation of two EP is based on maximising the expected return and on the targeted value of SCR (897 000 000 EUR) to cover the market risk. Expected return of EP A is 4.33%. The share of debt instruments in this portfolio is 88.08%, the remaining 11.92% is accounted for alternative investments, in which dominates ESTXX50 with a share of 8.90%. As a consequence of the aggregation of risk sub-modules property and currency risk decreased SCR to cover the MSCI by 10.47%. Size of diversification in the case of EP A reached the level of 27.25%. SCR_{MKT} is thus, in comparison with the sum of the individual capital requirements, lower by 343,238,976.16 EUR.

Diversification effect was decisive in the calculation of RAROC for efficient portfolios. The value of risk-adjusted returns for the EP A was 0.4830, and thus every euro of created SCR will bring an insurance company 48 cents. The impact of declining of SCR on the value of RAROC is in our opinion very positive. Its value for the EP A is higher than the

highest risk-adjusted return for individual investment instrument, namely BONDS portfolio.

One of the objectives of our paper was to point out to a possible rebalancing of portfolios of insurance companies due to the introduction of a new regulatory regime. We tried to calculate the reallocation of investment resources by changing the values of returns, which currently provide “govies”. In the original EP A, we counted with the median return for the period of twenty years. In the design of the EP B, we replace it by current bond returns.

The aim was point out to the impact of low interest rates on the investment activities of insurance companies. The consequence of the application of current returns of debt instruments was a significant reduction in the expected return of the whole portfolio, since the profit-maximising weight of government bonds was 87.99%. The share decreased, compared to the original portfolio, by 0.09%. Changes in the proportions of the other two instruments were also insignificant, less than 1%. The reason for insignificant changes was the fact, that we used the original median income for the remaining two instruments. Expected return of EP B reached the level of 1.66%. It had a considerable influence on its RAROC, which compared to the EP A has declined sharply to 0.1847.

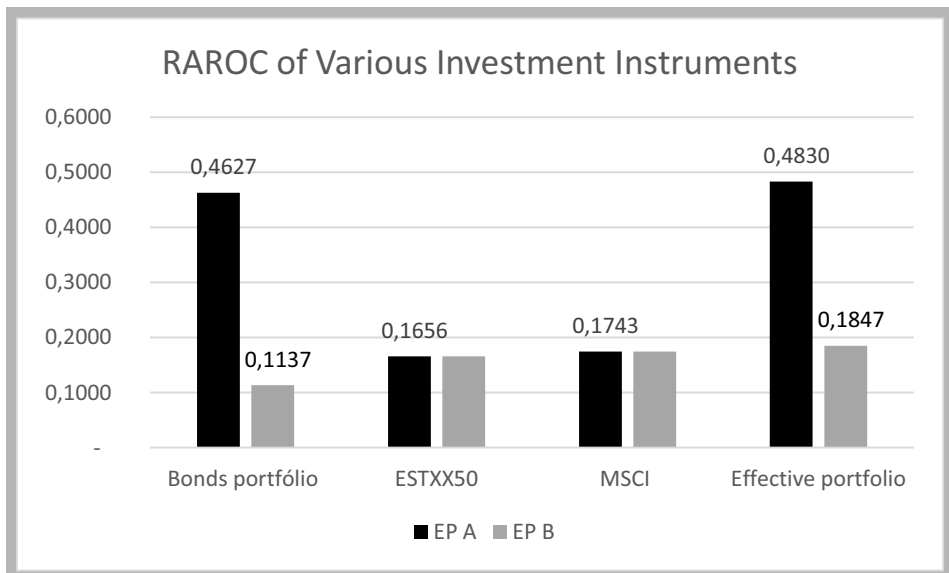
We can conclude that the application of current returns of debt instruments leads to the production of insufficient returns. Insurance companies in order to increase the return on your portfolio will, in our opinion, forced to seek more profitable assets. The implementation of Solvency II will be a limited impact on the allocation of the assets of insurance companies and will lead to rebalancing of their investment portfolios.

Demonstration of the inadequacy of investment returns of certain investment instruments is Fig. 2, which is a graphical representation of RAROC for each class of assets and efficient portfolios. Values of the indicator are significantly lower in comparison with the results of Braun et al. [3]. The authors considered it appropriate and effective those portfolios, whose RAROC is higher than 1, which means that the return from each unit invested is higher than the desired creation of the SCR. The maximum risk-adjusted return was 0,4830 in our research. The minimum value at the level of 0,1137 reached the BONDS portfolio, in the application of the current returns. RAROC of all tested and created investment instruments included in the paper is evaluated in our paper by means of comparison with outputs

of Braun et al. [3] as insufficient. There are several possibilities for increasing the indicator. The most beneficial would be to increase the level of interest rates. In this case, it would be possible to apply the downward shock, whose current level has been at 1.47% for nine years. If we used the median value of returns of examined instruments and the downward shock, RAROC for the BONDS portfolio would reach 2,74. If we apply the actual returns of BONDS portfolio, the indicator would be 0,67. SCR for the interest rate sub-module is in our contribution 8.71% of the value of investments of instruments sensitive to interest rate changes. A further possibility might be the use of ALM techniques. This would significantly reduce the SCR_{IR} . The reduction would lead to a significant increase of RAROC for both BONDS and efficient portfolios. A thorough use of ALM techniques in the portfolio of the three examined instruments would reduce reallocation effects. An alternative to increasing the total portfolio RAROC could also be investments in riskier “govies”.

Figure 2

The RAROC of various investment instruments



Source: Own processing.

In alternative asset classes, which we addressed in our paper, it would be beneficial to incorporate symmetric adjustment mechanism in the calculation of capital requirement to cover the equity risk. Mechanism may adjust the SCR_{EQ} , depending on stock market developments by $\pm 10\%$. Its current value is -4.24% . Another possibility to increase the indicator is to

invest into the individual equities, thus a proactive approach to managing of investment portfolio. Within it, the insurance company can find equities that offer higher returns than ESTXX50. Moreover, life insurance companies may, in the strategic interests and long-term investments, apply the reduced factor for the calculation of the SCR_{EQ} (22%). The reduced factors could significantly affect the riskiness of the equity risk sub-module as well as the riskiness of the whole portfolio. The insurance company could therefore, in comparison with our effective portfolios, invest a significantly greater proportion of funds in equities and achieve higher profitability. In the case of property risk sub-module RAROC was at 0.1743. If the index was denominated in EUR, we did not count with the currency risk in the calculations. In this case, the indicator reached the level of 0.2756. Investing in the local real estate would therefore be less risky for the insurance company and would bring it eventually higher return.

Conclusion

The aim of our research was to quantify the differences in risk-adjusted returns, resulting from investments in selected asset classes and the creation of efficient portfolios. Next, we tried to point out to a potential rebalancing of portfolios of insurance companies, due to the implementation of a new regulatory regime as well as the current situation on the financial market.

In the research, we used three asset classes based on which we have created two effective insurance portfolios. Prerequisite for the creation of the EPs (Efficient portfolios) was the limitation of the SCR that is used to cover the risk of investing in those instruments. SCR or the change of BOF was limited to 897,000,000 EUR. The total value of investments was set at 10 billion EUR. Input data to supplement SOLVER by EXCEL program represented median return, the standard deviation of individual instruments and volumes of capital requirements. On the basis of those attributes we created efficient portfolios that maximise the return of the insurance company. Median income was used for the calculation of the effective portfolio A. In creating the EP B we exchanged, within the BONDS portfolio the median return for current return. The reason was to create real preconditions for creating portfolios, as government bond returns in the case of most Western European countries are close to zero or even in negative territory. Through the aim of creating efficient portfolios that maximizes the return of the insurance company, we found the level of maximum returns,

composition of the portfolios and amount of their RAROC. The values are shown in Tab. 9.

Table 9

The composition of efficient portfolios

	BONDS portfolio	ESTXX50	MSCI	EP
Weights A	88.08%	8.90%	3.01%	100.00%
E[r] A	4.03%	6.46%	6.89%	4.33%
Weights B	87.99%	9.74%	2.27%	100.00%
E[r] B	4.03%	6.46%	6.89%	1.66%

Source: Own processing.

The return of the EP A was 4.33%, while the return of the EP B reached only 1.66%. These have a primary impact on the level of their RAROC. In the case of the EP A reached the level of 0.4830, while the risk-adjusted return of the EP B was 0,1847. We evaluated the RAROC within the portfolio as very positive. The indicator was larger than the maximum risk-adjusted return of individual investment instrument – BOND portfolio, which was at first effective portfolio 0.4627. The reason for the relatively high level of the indicator of the EP A was the diversification effect resulting from the aggregation of capital requirements under Solvency II standard formula. The complex SCR decreased, compared to the sum of the individual risk for each SCR sub-modules about 27.25%. In the methodology of our paper, we said that the inspiration for our research was the work of Braun et a. [5]. On the basis of comparison of results obtained in both contributions, we have to state that the RAROC indicators in our research were significantly lower. The authors consider those portfolios to be as effective that achieve the RAROC values higher than 1. The reason for the different results may be on the one hand the fact that we did not use ALM techniques in our paper. We examined only the impact on the asset side of the balance of the insurance company. If we specify the liability side of the insurance company, SCR_{IR} and complex SCR would significantly decrease and RAROC significantly increase. On the other hand, the selection of one of the shocks within the interest rate sub-module. If we under current conditions applied the downward shock, then the risk-adjusted returns of the BONDS portfolio would rise to the level of 2.74 or 0.67 in EP A or EP B.

Another objective of our research was to evaluate the effect of calibration of the Solvency II standard formula on the rebalancing of investment portfolios of insurance companies. Our assessment of potential rebalancing was not based on a comparison with the current composition of investment

portfolios of the insurance companies. The effects of the reallocation of assets of insurance companies were measured only by changing the BONDS portfolio returns. The share of “govies” was within the EP A 88.08%, due to the use of actual returns this declined by 0.09%. Changes in the proportions of the other two instruments were also insignificant, less than 1%. The reason for insignificant changes was the fact, that we used the original median income for the remaining two instruments.

Based on these findings, we cannot definitely confirm the significant impact of the implementation of Solvency II on the reallocation of investment portfolios of insurance companies and structure of financial markets. Reallocation will be according to our results, achieved in a large extent limited area, related mainly to the reallocation of investments in alternative asset classes. Finally, we confirm that the calibration of the standard formula considers as the best investments in government bonds.

References

- [1] AXA. 2012. Solvency II has and will make corporate bonds more expensive. Available online at: <<https://www.axa-im.com/en/publications/-/news/research-research-and-strategy-weekly-solvency-ii/maximized/k6Rb>>, [accessed 29.11.2016]
- [2] BOROVCOVÁ, M. 2007. Komparace metod měření solventnosti pojistitele. (Comparison of methods of measuring the insurer's solvency). In: *Vývojové trendy v poistovníctve, I.* (Development trends in the insurance industry, I). Bratislava: University of Economics in Bratislava, 2007, s. 1 – 7. ISBN 978-80-225-2318-9.
- [3] BRAUN, A. – SCHMEISER, H. – SCHREIBER, F. 2015. Maximizing the Return on Risk-Adjusted Capital: A Performance - Perspective Under Solvency II. Available online at: <http://www.fox.temple.edu/cms/wpcontent/uploads/2015/05/Braun_Schmeiser_Schreiber-RORAC-Solvency-II.pdf>, [accessed 25.11.2016]
- [4] CEIOPS. 2009. Advice for Level 2 Implementing Measures on Solvency II on: The procedure to be followed for the approval of an internal model. Available online at: <<https://eiopa.europa.eu/CEIOPS-Archive/Documents/Advices/CEIOPS-L2-Final-Advice-Procedure-approval-internal-model.pdf>>, [accessed 1.12.2016]

- [5] CEIOPS. 2010. Advice for Level 2 Implementing Measures on Solvency II: Article 111 a 304. Equity risk sub-module. Available online at: <<https://eiopa.europa.eu/CEIOPS-Archive/Documents/Advices/CEIOPS-L2-Advice-Design-and-calibration-of-the-equity-risk-sub-module.pdf>>, [accessed 3.12.2016]
- [6] CUMMINS, J. – DAVID, J. 2000. Allocation of capital in the insurance industry. In: *Risk Management and Insurance Review*. Vol. 3, issue 1. Available online at: <<http://www.huebnergeneva.org/documents/Allocate.pdf>>, [accessed 2.12.2016]
- [7] EIOPA. 2011. EIOPA Report on the Fifth Quantitative Impact Study (QIS5) for Solvency II. Available online at: <https://eiopa.europa.eu/Publications/Reports/QIS5_Report_Final.pdf>, [accessed 13.12.2016]
- [8] EIOPA. 2012. Revised Technical Specifications for the Solvency II valuation and Solvency Capital Requirements calculations (Part I). Available online at: <https://www.knf.gov.pl/Images/A_Revised_Technical_Specifications_for_Solvency_II_valuation_and_Solvency_Capital_Requirements_calculations_Part_I_tcm75-32220.pdf>, [accessed 1.12.2016]
- [9] EIOPA. 2013. Technical Report on Standard Formula Design and Calibration for Certain Long-Term Investments. Available online at: <https://eiopa.europa.eu/Publications/Reports/EIOPA_Technical_Report_on_Standard_Formula_Design_and_Calibration_for_certain_Long-Term_Investments_2_.pdf>, [accessed 14.12.2016]
- [10] EIOPA. 2014a. Technical Specification of the Preparatory Phase (Part I). Available online at: <https://eiopa.europa.eu/Publications/Standards/A_-_Technical_Specification_for_the_Preparatory_Phase_Part_I.pdf>, [accessed 3.12.2016]
- [11] EIOPA. 2014b. The underlying assumptions in the standard formula for the Solvency Capital Requirement calculation. Available online at: <http://eiopa.europa.eu/Publications/Standards/EIOPA-14-322_Underlying_Assumptions.pdf>, [accessed 5.12.2016]
- [12] EIOPA. 2014c. EIOPA Insurance stress test 2014. Available online at: <<https://eiopa.europa.eu/Publications/Surveys/Stress%20Test%20Report%202014.pdf>>, [accessed 15.12.2016]
- [13] EUROPEAN PARLIAMENT. 2014. Commission delegated regulation (EU) 2015/35. Available online at: <http://www.fktk.lv/texts_files/Del_Regulation_2015_35_Solvency_II.pdf>, [accessed 1.12.2016]

- [14] FITCH RATINGS. 2011. Solvency II Set to Reshape Asset Allocation and Capital Markets: European Insurers' EUR7trn Assets Face Reallocation, Available online at: <http://www.actuarialpost.co.uk/downloads/cat_1/Fitch%20Solvency%20>, [accessed 28.11.2016]
- [15] INSURANCE EUROPE. 2016. European Insurance – Key Facts. Available online at: <<http://www.insuranceeurope.eu/sites/default/files/attachments/European%20Insurance%20%20Key%20Facts%20-%20August%202016.pdf>>, [accessed 1.12.2016]
- [16] KPMG. 2012. Solvency II: Data Impacts on Asset Management. Available online at: <<https://www.efama.org/Publications/Public/Solvency%20II/EFAMA%20KPMG%20Solvency%20II.pdf>>, [accessed 27.11.2016]
- [17] MAJTÁNOVÁ, A. – VACHÁLKOVÁ, I. 2011. Trendy v oceňování majetku a závazkov poist'ovní. (Trends in the valuation of property and insurers' commitments). In: *Trendy v podnikání* (Business trends), 1/2011, p. 57 – 64. Available online at: <<https://otik.uk.zcu.cz/bitstream/handle/11025/16169/Majtanova.pdf?sequence=1>>, [accessed 24.11.2016]
- [18] NATIXIS. 2015. Solvency II Capital Requirements for Debt Instruments: Impact of Solvency II on the Debt Markets. Available online at: <<http://www.nam.natixis.com/Content/Documents/Publications/Research%20paper/SII%20Debt%20Instruments%20Final.pdf>>, [accessed 5.12.2016]
- [19] UNIGESTION 2016. Meeting economic and regulatory objectives under Solvency II. Available online at: <<https://www.unigestion.com/wp-content/uploads/2016/06/Meeting-economic-and-regulatory-objectives-under-Solvency-II.pdf>>, [accessed 7.12.2016]