ISSN 1822-6515

INVESTMENTS BY INSURANCE COMPANIES – CHALLENGES AND OPPORTUNITIES

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Abstract

Due to the economic situation insurance companies are forced to consider other possibilities of income generation and coverage of losses. One of such opportunities could be seen in cash flows from investment operations. The process of financial portfolio management is tightly connected with adequate risk management. We strongly believe that multidimensional copula models allow determining risk measures and provide information to allocate the minimum regulatory capital requirement in accordance with the Solvency II. The topic of the copula approach in the portfolio management was already discussed (e.g. Ozun / Cifter (2007) using copula models for estimating portfolio VaR; Jansons / Kozlovskis / Lace (2006) comparing the cumulative returns of two portfolios formed by traditional Markowitz's approach and simulating copula), while the object of the current paper is to use the approach for estimating portfolio's conditional risk measures and though to contribute to the discussion about appropriate risk management in the insurance companies.

Keywords: insurance companies, portfolio management, copulas, conditional risk measures.

Introduction

Latvian Insurers' Association data shows that during 9 months period (2009) the non-life insurance market decreased by 33.7%. Industry experts foresee that the non-life insurance market will continue to shrink by 10% to 15% during 2010, thus reaching its size of 2006. Total shrinkage of the non-life insurance market in 2009 and 2010 combined might reach 45% to 55%. The life insurance market experienced a decrease of 23.9% during 9 months period (2009) and about 33% in 12 months (provisional data). It is worth to mention an other alarming tendency in the insurance industry: during the 12 months of 2009 (provisional data), the health insurance industry in Latvia suffered losses of approximately LVL 10 million (EUR 14.23 million) mainly as a result of price increases for medical services and a decrease in State financing for the medical sector. Insurance indemnities paid out during this time increased by 52% in comparison to the same period last year. Statistics available allow concluding that there is no evidence that this particular sector and the industry as a whole are going to show any signs of improvement during the year 2010. It is expected that insurance market is going to reach its "normal" growth by the end of 2011 or beginning of 2012.

While comparing main business results in the insurance business it should be mentioned that all the sectors (both life and non-life insurance) are suffering from the economic downturn as the total amount of net premiums earned is decreasing, while the total amount of net claims incurred is increasing, and it is expected that such a trend is going to continue in the following periods further on. On the one hand the income from main business operations does not show sustainable growth and companies should gain extra income from investing activities in order to stay on the market, but on the other hand due to the vulnerable financial markets the return on investment decreased in the previous periods. Due to the economic situation on the local market in the previous and in the current year insurance companies are forced to consider other possibilities of income generation and coverage of losses.

One of such opportunities could be seen in cash flows from investment operations, while managing financial portfolios. According to the Latvian Law - On Insurance Companies and Supervision Thereof - companies providing insurance services are allowed to invest up to 5% of their technical reserves securities, excluding Latvian and OECD country's securities. In the previous periods insurance companies were building conservative portfolios while mainly investing in government bonds and keeping only small amount of shares. Latest data have already shown that during the previous year income from financial activities was main income generation source.

According to analyst 2009 was the first year after the crisis and featured a massive rebound in stock prices. In the beginning of 2010 asset's valuations are not looking that cheap anymore and have more or less returned to average level (see figure 1), the risk of a correction has increased significantly. This is all the more the case as the economic outlook in the developed markets for 2010 and 2011 remains cloudy, due to the high levels of private and public sector debt.

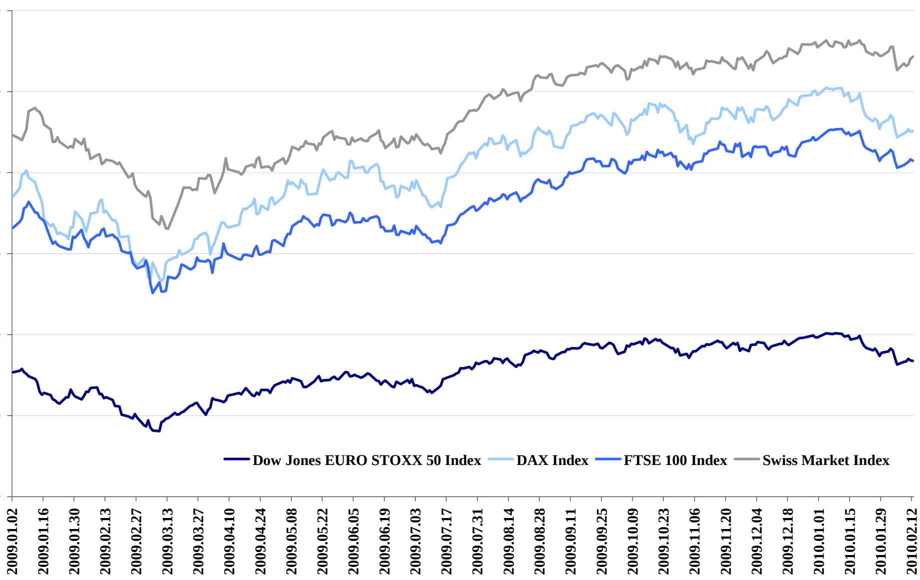

Figure 1. Returns of Main European Equity Indices (Bloomberg, 2010)

It is to mention that while deciding about investment in equities and bonds or other asset classes (regardless the economic situation), it is to be considered that the process of portfolio management is to be integrated in the risk management system in order to fulfil European and local regulatory requirements.

Risk Management in Insurance Companies

As it was already mentioned the ability of insurance companies to identify and manage risks as well as the efficient use of capital is becoming increasingly important in a highly competitive market environment. The capital that could be allocated is so – called “economic capital” that is defined as the organization’s capital, which covers potential losses at a given risk tolerance level and time horizon, and it is used as an economic metric to formulate strategic decisions to strengthen long-term profitability as well as competitiveness (Schulte-Herbrüggen, 2006).

Risk management systems are embedded into two major initiatives, one regulatory and the other managerial. The regulatory framework that needs to be considered is Solvency II. Solvency II has been initiated by the European Community, and it will introduce a new solvency regime which will be characterized by an integrated risk management approach. In 2001 the European Commission started this project in order to review the European framework for the prudential supervision of insurers, and Solvency II Framework Directive was presented in July 2007, Europe-wide implementation is scheduled to be completed by 2011 (Eling, 2007).

Solvency II has a number of objectives, whereby the protection of policyholders is one of the most important. While previous regulatory action regulated the industry on the product level to protect the policyholders, the focus has been shifted to the level of capitalization. But as there is no commonly accepted expression of risk in the financial statements – and therefore there is no possibility to rely on “general level” capital requirements, and specific regulation is necessary. The overall architecture of Solvency II according to the Design of a future prudential supervisory system in the EU follows a three – pillar structure (see figure 2) and is analogous to Basle II in the banking sector.

The first pillar includes the risk-based quantitative capital requirements, which are calculated by a standard model or a more detailed, specified internal model. Solvency II divides the capital requirements in two levels: the minimum capital requirements designate the “level of capital below which an insurance undertaking’s operations present an unacceptable risk to policyholders. If an undertaking’s available capital falls below the minimum capital requirements, ultimate supervisory action should be triggered” (Consultation Paper No. 7, 2005). The Solvency Capital Requirements is the amount of capital, to which we will refer as economic capital, reflects the required capital to meet all obligations over a specified time horizon. The second pillar reflects the qualitative risk management. Its key elements are the control of internal risk models, governance processes, stress tests or the quality of risk mitigation (Consultation Paper

No. 4, 2005). And finally the third pillar stands for disclosure and transparency to reinforce the market mechanisms and risk-based supervision (Consultation Paper No. 9, 2005).

Solvency II		
Measurement of assets, liabilities and capital	**Supervisory review process**	**Disclosure requirements**
Eligible capital Technical provisions Capital requirements Asset valuation Risks to be included Risk measures and assumptions Risk dependencies Calculation formula Internal model approach	**Internal control Risk management Corporate governance Stress testing Continuity testing**	**Current disclosure Requirements (National GAAP; National regulatory reporting; IFRS 4; IFRS 7) Future disclosure requirements (IFRS; IAIS; EU legislation)**
Pillar I	**Pillar II**	**Pillar III**

Figure 2. Solvency II: tree – pillar structure

It is commonly accepted goal that company's management strives for delivering value to the shareholders. Many concepts exist to integrate tools of value based management into the management process. Most of the tools rely on an adaptation of general purpose financial statements. But it is to be considered that financial statements are not an adequate solution to measuring risk and therefore measuring the performance of an insurance company as a risk intermediary will fail and specific solution – Value at Risk model is required. This model first computes from the portfolio of current transactions the distribution of profits calculates a necessary amount of capital, given a maximum potential loss on the portfolio, based on a timeframe and a confidence level. The concept is shown in figure 3.

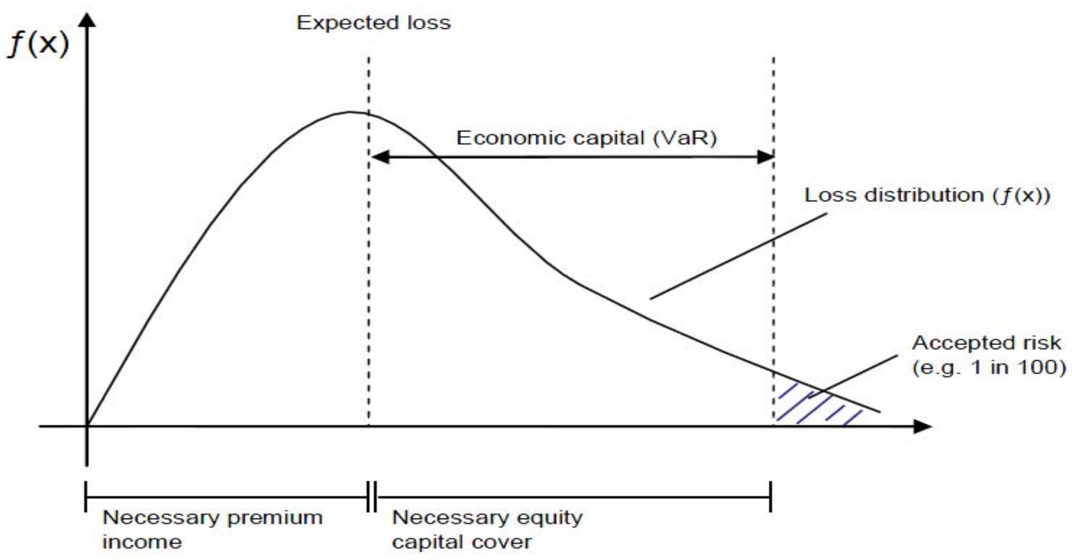

Figure 3. Economic profit / loss distribution and risk measures (Hull, 2006)

The concept of the Value at Risk has obvious structural similarities to the pillar 1 of the Solvency II concept, and if an insurance company chooses to apply internal risk measurement models, the management results can be immediately used for regulatory purposes, as Value at Risk gives a necessary amount of economic capital that is tied up in supporting the business. In financial risk management VaR has certainly represented a significant step forward with respect to more traditional measures mostly based on sensitivities to market variables as the “Greeks”. But even though VaR has several strengths, in the case of complex portfolios that are exposed to many risk variables such as in financial institutions, the computation of VaR can often is a formidable and challenging task. That is why in the last years new risk measures were determined in order to satisfy portfolio managers’ requirements.

As it was already mentioned in the recent years a growing attention has been devoted to a clear treatment of the quantification of financial risks. Artzner et al. (1999) proposed in their work a set of advantageous axioms that every risk measure should satisfy, defining in such a way the class of coherent risk measures. Delbaen (2002) proved that, under a mild continuity assumption, every coherent risk measure can be represented as worst expected loss with respect to a given set of probabilistic models.

In our work we are going to use the following idea presented by Bion-Nadal (2004): a financial position on the market could be described by a bounded map defined on the set of different possible scenarios (Ω – set of scenarios). Let us consider a linear space χ of financial positions and a σ-algebra F on the space Ω, and denote EF the set of all bounded real valued (Ω;F) measurable maps. Let us assume that a probability measure P is given on the σ-algebra F, which is the case of partial uncertainty relevant to the market situation. A mapping:

$$\rho_F : \chi \to L^{\infty}(\Omega; F; P) \qquad (1)$$

is called conditional a risk measure to the probability space (Ω;F;P) if it satisfies the following conditions:

- monotonicity for all X, Y being part of linear space χ if $X \leq Y$ then $\rho_F(Y) \leq \rho_F(X)$;
- translation invariance for all Y being part of E_F and all X being part of χ then $\rho_F(X+Y) = \rho_F(X) - Y$;
- multiplicative invariance for all X being part of χ, for all A being part of F $\rho_F(X1_A) = 1_{a\rho F}(X)$.

Practical Example

In order to determine conditional risk measures we are building test portfolio consisting of 3 European equity indices: CAC 40 - French stock market index; ATX - Austrian traded index; SBF 120 - Paris stock exchange index and with following weights: w1 = 20%; w2 = 50% and w3 = 30% (please note that the question about appropriate asset allocation and weights is not a question discussed in the current paper, so the indices were chosen randomly).

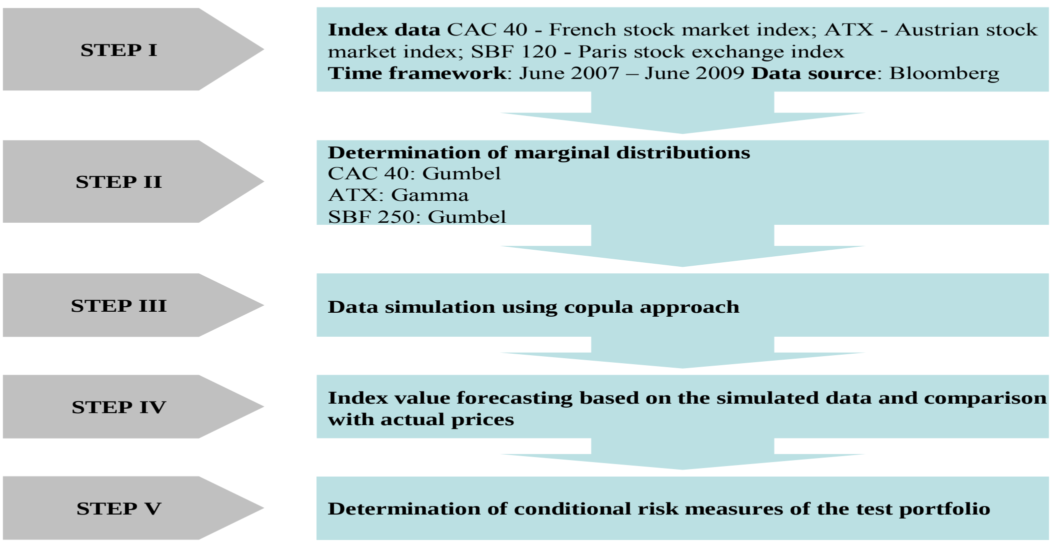

Figure 4. Modelling of portfolio’s conditional risk measures – schematic description

Figure 4 is describing the proceeding in the current example. It is worth to mention that the algorithm could be repeated as many times as it is necessary while searching for the appropriate portfolio with

ISSN 1822-6515

satisfactory risk and return relation, whereby one of the main advantages of the approach described is proofed.

In the first step we selected several European stock indices (returns in the time frame from June 2007 to June 2009), while using Bloomberg data source (Bloomberg key: WEI); in the next step we determined marginal distribution function for each index selected and to carry out data simulation using copula approach. Marginal distributions for stock indices price changes were checked using Kolmogorov test and they are:

- for CAC 40 – Gumbel (extreme value) distribution $a = 0.655$ and $b = 0.089$;
- for ATX – Gamma distribution with $\lambda = 100$ and $\alpha = 65$;
- for SBF 120 – Gumbel (extreme value) distribution $a = 0.45$ and $b = 0.148$.

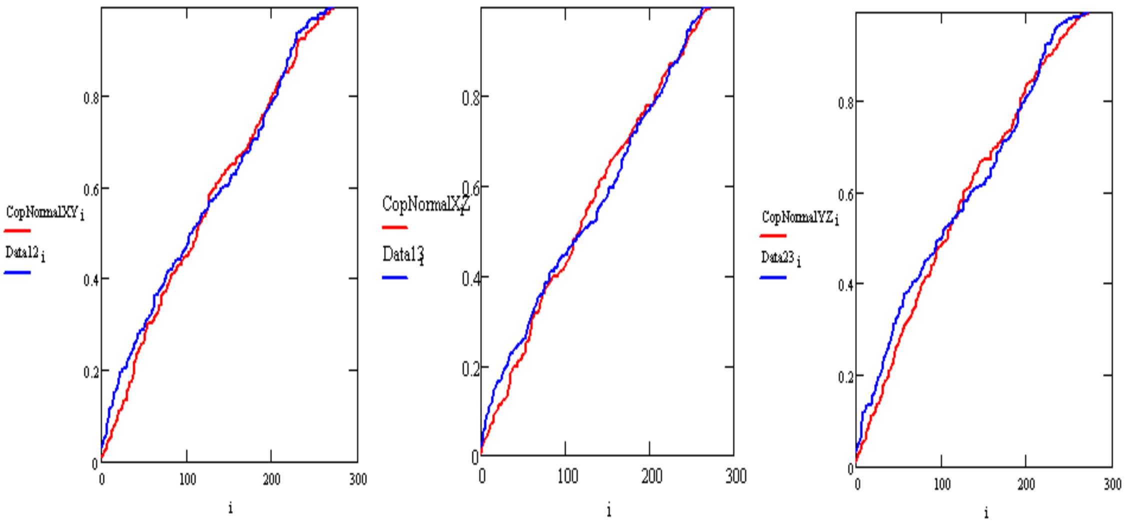

Figure 5. Distribution modelling

In step III we used normal copula. In order to prove fitness of copula to data we built up one dimensional distributions from simulated and existing data in each coordinate plane using Genest, Rivest construction and found stochastic Kolmogorov test value (follow figure 5, whereby X stands for CAC 40 - French stock market index; Y for ATX - Austrian traded index; Z for SBF 120 - Paris stock exchange index). Please note that test values' in each coordinate plane characteristics after 150 replications are as shown in the table 1 (Kolmogorov critical value corresponding to 5% significance level is equal to 0.0823).

Table 1. Kolmogorov test values and their characteristics

	X_Y plane	X_Z plane	Y_Z plane
Number of simulations	150	150	150
Mean	0.0758	0.0712	0.0801
Median	0.0733	0.0696	0.0788
Min	0.0586	0.0586	0.0586
Max	0.0989	0.0916	0.1172
Standard deviation	0.0085	0.0069	0.0103
Skewness	0.4875	0.4198	0.5842
Kurtosis	0.1845	0.0196	0.4416
Percentile 1%	0.0586	0.0586	0.0592
Percentile 99%	0.0989	0.0910	0.1156

Based on the simulated index prices we have computed conditional risk measures. We define conditional mean (or conditional tail expectance) as:

$$\mu_C = E\left[X / X \le VaR_X(\alpha)\right] \quad (2)$$

where X is a vector of variables on which the condition of value being lower then conditional VaR is determined. We define conditional VaR as conditional expected loss under the condition that it exceeds VaR:

$$VaR_X(\alpha) = \sup\{x / P(X < x) \leq \alpha\} \quad (3)$$

where ά is probability of loss defined (for example 1%). In order to be in compliance with risk measures determined in the 1 table we are going to use also the following measures: variance or conditional second order central moment; conditional skewness and conditional kurtosis:

$$\sigma_C^2 = E\left[(X - E(X))^2 / X \leq VaR_X(\alpha)\right] \quad (4)$$

$$A_C = \frac{E\left[(X - E(X))^3 / X \leq VaR_X(\alpha)\right]}{\sigma_C^3} \quad (5)$$

$$K_C = \frac{E\left[(X - E(X))^4 / X \leq VaR_X(\alpha)\right]}{\sigma_C^4} - 3 \quad (6)$$

The purpose of building test portfolio was to proof that based on the data simulated and while using Excel (there is no need for using challenging mathematical calculations) it is possible to determine several risk measures in order to satisfy requirements of regulatory authorities and choose appropriate tools for risk management. Table 2 shows results of test portfolio's stochastic risk measures.

Table 2. Conditional stochastic risk measures of test portfolio

	Mean	Variance	Standard deviation	Skewness	Kurtosis	Percentile 2.5%	Percentile 97.5%
Value at Risk (5%)	1 575.53	315.95	17.78	-0.27	0.13	1 538.84	1603.92

The following table (Table 3) provides characteristics of descriptive statistics which are obtained after 150 replications. It is important to underline that the current calculations are providing an example of using particular approach in practice (in order to show its advantage over complex modelling methods), but it provides no conclusion about the value of the investment in the assets of the test portfolio.

Table 3. Characteristic of conditional stochastic risk measures of test portfolio

Conditional risk measures / Characteristic of risk measures	Mean	Variance	Standard deviation	Skewness	Kurtosis	Percentile 2.5%	Percentile 97.5%
Mean	2 270.37	253.16	15.91	0.07	-0.24	2 240.85	2 302.31
Standard deviation	522.47	262.01	16.19	0.16	-0.27	492.32	552.27
Skewness	1.02	0.03	0.16	0.47	-0.16	0.77	1.36
Kurtosis	1.84	0.87	0.93	1.23	2.27	0.61	3.99
Percentile 2.5%	1 490.10	433.07	20.81	-0.03	-0.13	1 454.76	1 529.72
Percentile 97.5%	3 500.53	5 003.12	70.73	0.36	0.86	3 360.79	3 668.58

Conclusions

Current economic situation on the local market forces insurance companies operating on the Latvian market forces management to look for alternative profit generating opportunities. One of such possibilities is seen in investment on the global financial market. It is to be considered that while investing insurance companies are to be in accordance with international and national requirements concerning appropriate risk management. In the current paper we have shown the algorithm of computation conditional risk measures in the copula approach framework and claim that the approach described is appropriate in order to satisfy regulatory requirements and internal risk management standards.

In the current research the authors used copula theory as it provides an easy way to deal with otherwise complex multivariate modeling. The main advantage of the copula approach is that a joint distribution can be factored into the marginals and a dependence function called a copula is established, by which the dependence relationship is entirely determined, while scaling and shape (mean, standard deviation, skewness, and kurtosis) are entirely determined by the marginals.

Based on the practical example it is possible to conclude that the method used in the current research allow handling large number of different instruments – stochastic risk measures – and scenarios, and while conditional risk measures management constraints can be used in various applications to bound percentiles of loss distributions, it is an adequate tool for risk management in insurance companies.

References

1. Artzner, P., Delbaen, F., & Eber, J.-M. (1999). Coherent measures of risk. Mathematical Finance, 9, 203 – 228.
2. Bion-Nadal, J. (2004). Conditional risk measure and robust representation of convex conditional risk measures. CMAP, Ecole Polytechnique. Electronic Resource (used on August, 25 2009): http://nanna.u-cergy.fr/AFFI_2004/IMG/pdf/BION-NADAL.pdf
3. Bloomberg (2010). European Equity Indices. Electronic Resource (used on February, 12 2010): http://www.bloomberg.com
4. Committee of European Insurance and Occupational Pensions Supervisors. (2005). Consultation Paper No. 4. Draft Answers to the European Commission on the First Wave of Calls for Advice in the Framework of the Solvency II Project. Electronic Resource (used on August, 15 2009): http://www.ceiops.org
5. Committee of European Insurance and Occupational Pensions Supervisors. (2005). Consultation Paper No. 7. Draft Answers to the European Commission on the Second Wave of Calls for Advice in the Framework of the Solvency II Project. Electronic Resource (used on August, 15 2009): http://www.ceiops.org
6. Committee of European Insurance and Occupational Pensions Supervisors. (2005). Consultation Paper No. 9. Draft Answers to the European Commission on the Third Wave of Calls for Advice in the Framework of the Solvency II Project. Electronic Resource (used on August, 15 2009): http://www.ceiops.org
7. Delbaen, F. (2002). Coherent measures of risk on general probability spaces. Advances in Finance and Stochastics, 114 – 135.
8. Eling, M. (2007). The Solvency II Process: Overview and Critical Analysis. Risk management and insurance review, 1, 69 – 86.
9. European Commission. (2003). Design of a future prudential supervisory system in the EU. Recommendations by the Commission Services. Electronic Resource (used on August, 15 2009): http://ec.europa.eu
10. Hull, J.C. (2006). Options, Futures and Other Derivatives. New Jersey: Prentice Hall.
11. Jansons, V., Kozlovskis, K., & Lace, N. (2006). Portfolio Modeling Using the Theory of Copula in Latvian and American Equity Market. Electronic resource (used on August, 15 2009): http://www.comp.glam.ac.uk/ASMTA2005/Proc/pdf/se-20.pdf
12. Likumi.lv. (2009). On Insurance Companies and Supervision Thereof. Electronic Resource (used on August, 16 2009): http://www.likumi.lv
13. Ozun, A., & Cifter, A. (2007). Portfolio Value–at–Risk with Time–Varying Copula: Evidence from the Americas. MPRA Paper, 2711, 1 – 13.
14. Schulte-Herbrüggen, W. (2006). Economic capital: An aggregation question. Risk, 11, 60 – 66.