

# DEVELOPMENT OF INVESTMENT RISK MANAGEMENT MODELS FOR INSURANCE COMPANIES

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## Abstract

The purpose of the article is to provide methodology for implementation of internal market risk determination and financial portfolio management model. Due to the fact that Value-at-Risk is being heavily criticized the authors propose an other alternative - downside risk measures (Lower Partial Moments) that can be used as appropriate risk measure tool for portfolio construction purpose as they are capable to provide to effective and efficient decision making process in the context of portfolio management, the particular method is proposed as internal model for Latvian insurance companies that are managing equity portfolios consisting of a few titles. The paper describes equity portfolio management process as four steps process and come up with internal model for Latvian insurance companies that are managing small equity portfolios, in accordance with Solvency II requirements coming into force by 1 January 2013.

*Keywords:* Solvency II, risk management, portfolio management, Latvian insurance companies, downside risk measures.

*JEL Classification:* G11, G22.

## Introduction

Latvian insurance companies have been affected by a decrease in sales and challenging market conditions during the last world financial and economic crisis and afterwards, so they are forced not only to de-risk their investment portfolios and to shed questionable lines of business, but also the companies are seeking to identify new sources of income generation, as for example income from investment operations, while managing financial portfolios. Moving forward from the current state of European regulatory requirements – Solvency I, it will be important that new quantitative risk capital requirements under Solvency II be framed by an appropriate risk management infrastructure, with the proper internal processes and controls at all levels. The current paper is going to discuss the importance of appropriate risk understanding - risk as a possibility that the outcome of an action or event could result in either a loss to expected level of earnings or capital, or constrain the company's ability to meet its business objectives and strategic goals. The relevance of the topic could be also explained due to the fact that "risk management" is widely used, often misunderstood and has different meaning for different organizations, while developing relevant internal risk and capital management models begins with understanding the risks facing the organization, the uncertainty it places on business performance and the organization's ability to cope with it.

The main purpose of the article is to provide methodology for implementation of internal market risk determination and financial portfolio management model. Due to the fact that Value-at-Risk is being heavily criticized the authors propose an other alternative - downside risk measures (Lower Partial Moments in particular) that can be used as appropriate risk measure tool for portfolio construction purpose as they – Lower Partial Moments – are capable to provide to effective and efficient decision making process in the context of portfolio management, the particular method is proposed as internal model for Latvian insurance companies that are managing equity portfolios consisting of a few titles. On the other hand it should be considered that the use of copula approach for estimating portfolio's conditional risk measures contributes to the discussion about appropriate risk management in the insurance companies. The paper is going to describe equity portfolio management process as four steps process consisting of formulation of policy statement, examination of market opportunities, implementation of investment strategy, and monitoring of performance; and come up with internal model for Latvian insurance companies that are managing small equity portfolios, in accordance with Solvency II requirements coming into force by 1 January 2013.

## Latvian Insurance Industry in 2008 - 2010

By the end of 2010 according to the statistics published by Financial and Capital Market Commission (2011) there were 13 insurance companies operating in Latvia, whereof four companies were engaged in life insurance and nine companies - in non-life insurance business, as well as 11 branches of foreign insurance companies. While comparing main business results in the insurance business for the time period from 2008

to 2009 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 are forced to 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 insurance companies are forced to consider other possibilities of income generation and coverage of losses. The situation has not changed much in the 2010. Table 1 provides information about market players and their performance indicators, whereby it is clearly seen that companies should pay extra attention on financial portfolio management that allows generating extra income in order to cover losses from main business operations.

**Table 1.** Company's Performance Indicators 2008 – 2010 (January to June)

<i>performance indicator:</i>		<b>combined ratio, %</b>			<b>investment return, %</b>			<b>operation ratio, %</b>		
<i>insurance company:</i>		<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
<b>Non-life Insurance</b>	<b>Balta</b>	90.5	91.5	92.6	0.9	0.9	6.0	89.6	90.5	86.6
	<b>Baltikums</b>	89.9	99.2	98.2	3.6	3.7	1.7	86.3	95.5	96.6
	<b>BAN</b>	100.3	99.4	111.1	4.9	6.6	4.7	95.4	92.8	106.4
	<b>Balva</b>	142.8	127.0	108.1	2.7	2.7	5.0	140.1	124.3	103.1
	<b>BTA</b>	87.1	95.1	90.9	-0.3	3.6	6.2	87.4	91.5	84.6
	<b>Ergo Latvija</b>	97.4	87.0	86.7	5.4	5.1	3.7	91.9	81.9	83.1
	<b>Lauto Klubs</b>	160.7	260.1	317.5	3.9	4.9	4.9	156.8	255.2	312.6
	<b>Gjensidige</b>	95.6	93.0	96.8	3.4	7.0	5.6	92.2	86.0	91.1
<b>Life Insurance</b>	<b>Ergo dzīvība</b>	102.6	95.6	89.5	1.9	5.9	4.8	100.7	89.7	84.7
	<b>Parekss dzīvība</b>	54.9	44.9	44.5	-0.7	7.0	6.3	55.7	37.9	38.2
	<b>SEB dzīvība</b>	48.1	75.1	62.4	4.5	8.3	8.1	43.5	66.8	54.3

Latvian Insurers' Association (2010) data shows that during 2009 the non-life insurance market decreased by 35.6% in comparison to 2008 (-27.6% to 2007). 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%. At end of 2009 gross premiums written by non-life insurance companies accounted for 195.5 million lats or by 35.6% (-27.6% to 2007) down from the end of previous year, while the amount of gross claims paid contracted by 20.6% (+8.1% to 2007) as compared to previous and totaled 132 million lats. In the first half of 2010 the amount of gross premiums written continued to shrink (-31.4% to first half of 2009), while the amount of gross claims paid decreased by 29.3%. Therefore there are no reasons for positive sector valuation and forecast, nevertheless in the reporting period of 2009, the non-life insurance companies operated with profit totalling 11.4 million lats (eight out of 10 non-life insurance companies reported profit in the reporting period). The solvency ratio, which characterizes the sufficiency of own funds at the disposal of an insurance company to ensure its minimum solvency was 151.7% in 2009, while the lowest permissible margin for this ratio is 100%. The life insurance market experienced a decrease of 24.1% during 2009 in comparison to 2008 (-17.4% to 2007). It is worth to mention other alarming tendency in the insurance industry: during the 2009 the health insurance industry in Latvia suffered losses of approximately 10 million lats 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 of 2008. 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. Performance indicators for life insurance companies allow the following picture: at end of 2009 the amount of gross premiums written by life insurance companies decreased by 17.4% in comparison to the previous year (-24.1% to 2007) and totaled 27.8 million lats, whereas the volume of gross claims paid grew by 30.1% (+160% to 2007) and made up 21.8 million lats. In the first half of 2010 the amount of gross premiums written increased by 9.8%

compared to first half of 2009, while the amount of gross claims paid decreased by 32.7%. In the reporting period of 2009, two life insurance companies operated with losses, however, overall life insurance companies made about 7 thousand lats profit. The leverage ratio for insurance companies that characterizes the sufficiency of own funds at the disposal to ensure its minimum solvency at end of 2009 was 159.5%, while the lowest permissible margin for this ratio is 100%. High solvency ratio shows that insurance companies are capable of operating more efficiently without jeopardizing their solvency.

In conclusion it is worth to mention that in the tough market environment the insurance companies are forced to look for other opportunities of profit generation than income from gross premiums written. According to the Latvian Law companies providing insurance services are allowed to invest up to 5% of their technical reserves in 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 due to the conservative investment politics, vulnerable financial market, etc. On the other hand due to the low interest rates during 2010 and in the beginning of 2011 investments in bond market do not provide optimal asset allocation solution, so that managers should consider other possibilities on the financial market like equities. Therefore the question about asset allocation techniques and tools arises that is going to be discussed further on.

### **Solvency II as a New Challenge for Insurance Companies**

Solvency II regulatory framework (coming into force by 1 January 2013) is to be considered both as challenge and opportunity for insurance companies and is of particular interest for both theoretical discussion and practical work (follow Basse & Friedrich, 2008; Schubert & Griessmann, 2007; Elderfield, 2009). The basis for the European solvency rules for the insurance industry is two directives which were enacted in the seventies of the last century: the non-life insurance directive and the life insurance directive. Both directives have an enormous drawback of the real general conditions of insurance companies, since they neither reflected the development of risk theory nor did they consider other risks than the underwriting risk. In 1992 an important step to form the European insurance market was set with the introduction of the third generation of European directives. The modernization of the solvency rules in Europe started in 1994 with the appointment of a commission under the direction of Müller – the author of the so-called Müller-Report, which was formulated by the commission, and published in April 1997. It contains different suggestions to adapt the established system, to the changed market conditions by modernizing the European solvency supervisory authority and the available solvency system. The result consisted of two other EU directives, which were finally adopted under the heading of Solvency I. Those modified regulations have been valid since January 2004. Solvency II is a European-wide project driven by the European Commission. Its purpose is to implement a risk-orientated solvency regime that allows the regulator to assess the insurers' solvency position. Almost all jurisdictions within the European Union calculate Solvency I numbers without risk orientation. These numbers are usually based on book values rather than market values. Solvency II, on the contrary, aims at assessing the overall solvency on a market value basis, with all risks pertaining to the company's business being considered (Doff, 2008). The overall architecture of Solvency II follows a three – pillar structure and is analogous to Basle II in the banking sector: Pillar 1 presents Quantitative capital requirements; Pillar 2 describes adequacy of risk management processes and Pillar 3 is devoted to market discipline. It is clear that Solvency II will impose stricter risk management discipline on insurers companies. The requirements highlight that risk management framework should be structured and governed by the boards of insurance companies according to the usual approach to risks including identification, quantification of the amount acceptable, management of the risks taken, control and communication, as well as assessment of capital adequacy. Some elements of the risk management framework may require more resource than others, as for example, the determination and the implementation of the IT needs according to the risk policies, or the calculation ethnics of capital requirement. However, one of the biggest challenges and eventually the most time-consuming revolve around the behavioral change on the financial markets and the difficulty in stating clearly the risk appetite of the company (in the process of investing, while building financial portfolio). The latest financial crisis has once again emphasized that the effective risk management is fundamental to the success of an insurance business. Company's boards, investors and rating agencies have sharpen their focus on risk in the face of market instability and continuing capital constraints. Solvency II raises the stakes further by requiring insurers to develop a systematic risk management framework capable of ensuring that risk considerations are appropriately understood and controlled, as well as integrated into decision making processes. The current part of the paper is going to clarify what this entails in practice,

including how the framework should be structured and governed and how it will affect the way they run businesses. Based on the literature study (Krause, 2006; Gallati, 2003) and PricewaterhouseCoopers presentation (2010) the following integrated risk management framework (Figure 1) in accordance with Solvency II requirements can be designed, which provides the strategic direction, organizational embedding and underlying infrastructure of risk identification, evaluation. The 10 components of risk management framework discussed below should be examined on three levels: business strategy, business management, and business platform (includes people and reward, management information, technology and infrastructure).

<b>Business Platform</b>	<b>Technology and infrastructure:</b> core technology has to support fully integrated approach. Focus should be set on organizational span, data quality and automated processing.
	<b>Management information:</b> requires appropriate customization to roles, responsibilities and authority levels.
	<b>People and reward:</b> People behavior aligned with group risk, capital and performance strategy / business plans through balanced score cards and incentives and rewards schemes. Required level of skill, experience and knowledge exhibited by majority of staff.
<b>Business Management</b>	<b>Risk and capital assessment (including measurement methodologies and internal models):</b> internal risk and capital models at the heart of the approach framework. Models should meet highest quality standards, and be appropriately calibrated and fully tested and documented.
	<b>Business performance and capital management:</b> should proceed on a risk adjusted basis.
	<b>Governance, organisation and policies:</b> includes establishment of clear governance structure distinguishing between management and oversight activity; clear accountability and responsibility for risks; development of detailed risk management organisation and of detailed risk policies.
	<b>External communication and stakeholder management:</b> the framework focuses external communication strategy centered around actively managing stakeholders in order to yield shareholder value added and capture wider business benefits.
<b>Business Strategy</b>	<b>Risk appetite:</b> should be clearly articulated reflecting the risk carrying capacity, business strategy and financial goals. Processes and procedures are necessary in place to manage risk on an organization wide basis within defined boundaries without stifling day to day operations.
	<b>Risk profile:</b> identification and assessment of all risks faced by the organisation. Robust processes are necessary in place to aggregate and prioritizes risks on an organization wide basis.
	<b>Risk strategy:</b> risk dimension is to be placed in the heart of the organization, as risk is a core consideration when setting strategy, formulating business plans, managing performance and rewarding management success.

**Figure 1.** Risk Management Framework

The process of portfolio management described below is tightly connected with adequate risk management that is an essential part of the risk management framework under Solvency II requirements. There is no doubt that risk modeling in the estimation of Value at Risk and other risk measures is a challenging peril for the success of any financial investments. The proper model should both provide flexible joint distributions and also capture the non-linear behaviors and extremes in the returns arising. Multidimensional copula models allow determining risk measures with the least violation number in the back-testing provides the investors to allocate the minimum regulatory capital requirement in accordance with Solvency II. In order to achieve this model an internal model based on conditional risk measures and copula approach can be used (follow description by Kuzmina, Pettere & Voronova, 2010). 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 satisfactory risk and return relation, whereby one of the main advantages of the approach described (Figure 2) is proved.

It is possible to conclude that the approach described is appropriate in order to satisfy regulatory requirements and internal risk management standards. The used copula theory 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. It is worth to underline that the method used allows 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.

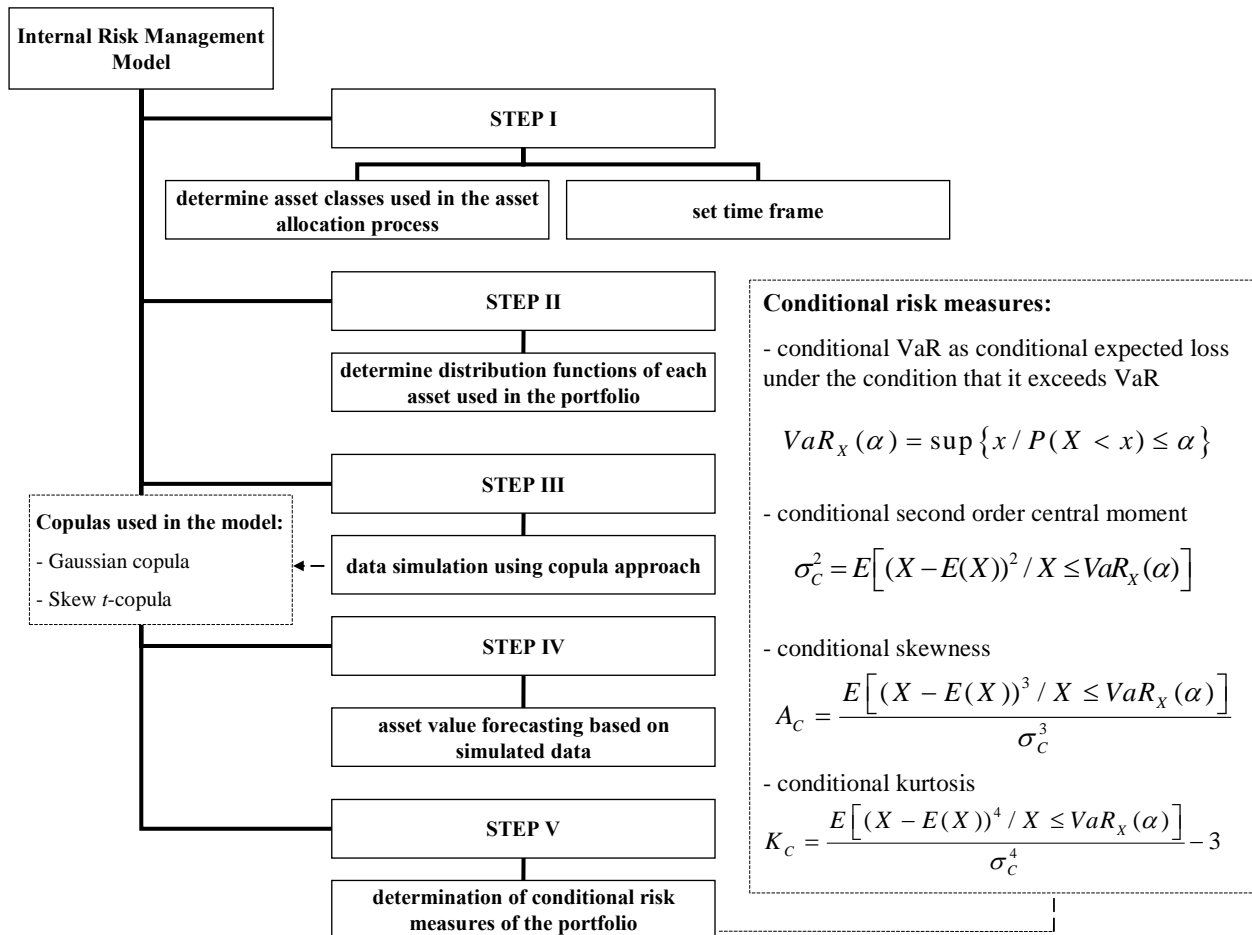
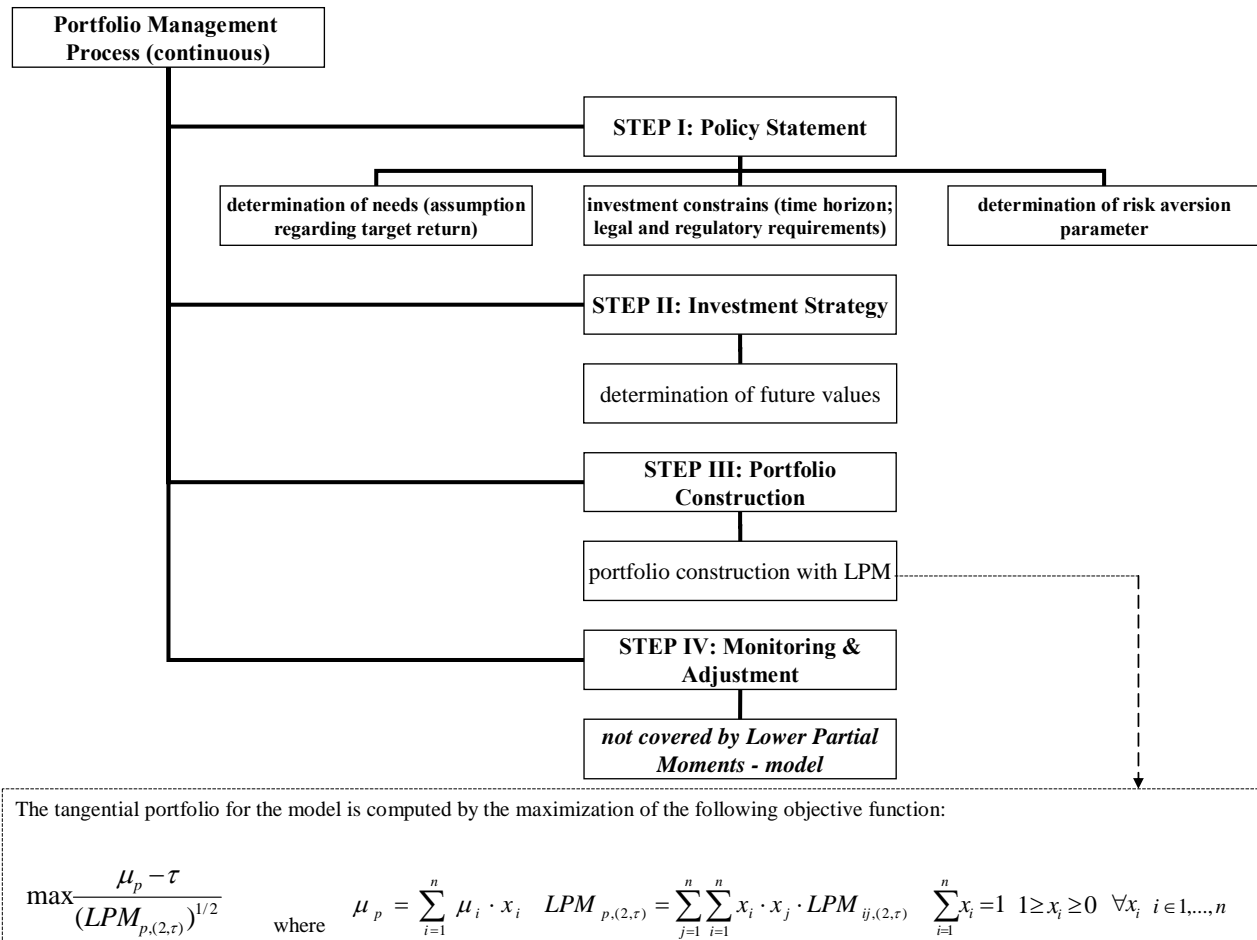


Figure 2. Internal Risk Management Model

### Portfolio Management Process

In the second section it was already underlined the importance of asset allocation (technical reserves) to the Latvian insurance companies in order to cover losses from main business operations, while the asset allocation decision is not an isolated choice, but rather it is a component of a structured four-step portfolio management process that never stops. Due to the importance of the topic the process of portfolio management (as presented in Figure 3) is going to be discussed in details below and includes portfolio construction algorithm with Lower Partial Moments (details are discussed in Kuzmina, 2009). Taking into consideration the fact that in the process of financial portfolio construction, while deciding about an investment, investors are more concerned with the downside movements of their portfolios, when their target return is failed, than with the upside potential, the main idea of the algorithm mentioned concerns possibilities of asset allocation based on the downside risk measures (Lower Partial Moment of the second order or semi-variance). The existence of Lower Partial Moment – risk measure, presenting the squared failure of the investor’s target return can be justified by its dominance being equivalent to the stochastic dominance of third order. Thus the dominance concerning Lower Partial Moments of second order fulfils the

criterion for the Bernoulli principle and therefore can be used for decision making under risk (Maurer & Valiani, 2007; Estrada, 2008).



**Figure 3.** Portfolio Management Process

The first step in the portfolio management process is for the insurance company’s management (either using internal resources – in-house team or with assistance of an external investment advisor) to construct a policy statement. The policy statement is to be understood as a road map, where the investor should specify the types of risk it is willing to take (by determination of risk aversion parameter –  $\alpha$  as explained by Poddig, Brinkmann & Seiler, 2005), investment goals (capital preservation, capital appreciation, current income by determination of target return parameter -  $\tau$ ) and constraints (like liquidity, time horizon, tax concerns, legal and regulatory requirements, etc.). As investor needs change over the time, the policy statement must be periodically reviewed and updated. The process of investment seeks to peer into the future and determine strategies that offer best possibility of meeting the policy statement guidelines determined in the previous step. In the second step of the process – determination of financial strategy – the management should study current financial and economic conditions and forecast future trends, which requires constant monitoring and updating to reflect changes in financial market expectations. The third step of the portfolio management process is to construct the portfolio. With policy statement and financial market forecast as input, the implementation of the investment strategy is done by determination of asset allocation across countries, asset classes and different securities. Portfolio construction is achieved by minimizing risk and maximizing expected return. Comparing classical  $(\mu, \sigma)$  model and  $(\mu, LPM_{\tau}^2)$  model should be said that the models differ substantially in the measurement of risk and return dependence. The  $(\mu, \sigma)$ -model takes only into account the mean and variance, whereas  $(\mu, LPM_{\tau}^2)$ -model also the skewness and kurtosis. Statistically significant skewness and kurtosis of the return time series indicate that the results of portfolio optimization will differ. By the same input data and other conditions for both portfolio models which differ only in the risk measure, better realized performance can be explained only by the application of more

appropriate and exact risk measure. In the construction process the tangential portfolio of the  $(\mu, LPM_{\tau}^2)$ -efficient frontier should be chosen. The tangential portfolio represents the maximum efficiency portfolio: the portfolio with the highest return premium on one unit of risk. In the combination with risk-free asset it provides the portfolio, which dominates efficient portfolios without the risk-free asset. The last step is the continual monitoring of the needs and capital market conditions. One of the components of the monitoring process is evaluations of portfolio's performance and comparison to the goals set in the policy statement.

In conclusion the following aspects should be mentioned that Lower Partial Moments is a risk measure that is consistent with investors understanding of risk. Thus it makes possible to make a decision concerning portfolio construction without using utility functions, but only based on the model with Lower Partial Moments. The method is simple to use in practice and that is why it can be considered to be appropriate for quick decisions under risk and time pressure. The method allows finding the best possible portfolio under different scenarios and thus to use sensitivity analysis by changing crucial parameters mentioned above. So that Lower Partial Moments of the second order represents interesting and valuable method of risk measurement in the context of portfolio construction and optimization.

## Conclusions

Insurance companies operating on the Latvian market have been affected by a decrease in sales and challenging market conditions during 2008 – 2010 and afterwards, so they are forced to identify new sources of income generation, as for example income from investment operations, while managing financial portfolios. Companies were building conservative portfolios while mainly investing in government bonds and keeping only small amount of shares due to the conservative investment politics, vulnerable financial market, etc, but due to the low interest rates investments in bond market do not provide optimal asset allocation solution, so that managers should consider other possibilities on the financial market like equities. The article provided methodology for implementation of internal market risk determination and financial portfolio management model for insurance companies managing small equity portfolios, in accordance with Solvency II requirements coming into force by 1 January 2013. The model described is based on the use of copula theory that provides an easy way to deal with otherwise complex multivariate modeling and Lower Partial Moments that are considered to be risk measures consistent with investors understanding of risk.

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