Audrius DZIKEVIČIUS

TRADING PORTFOLIO RISK MANAGEMENT IN BANKING

Summary of Doctoral Dissertation
Social Sciences, Economics (04S)

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Vilnius TECHNIKA **2006**

VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

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Audrius DZIKEVIČIUS

PREKYBINIO PORTFELIO RIZIKOS VALDYMAS BANKE

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1. General characteristics of the dissertation

Topicality of the problem. Rapidly changing conditions in performance of financial institutions, increasing volatility and global turnover of financial markets, emerging new financial instruments along with new risk types of financial institutions are stimulating the arising need for the risk management of trading portfolio. This is proved by the fact that the largest financial institutions of the world started to tighten risk management and controlling procedures after a number of financially sound and conservative financial institutions suffered huge losses or even gone bankrupt. As subsequent historical analysis revealed, main reason behind the losses or collapses was the inability to manage market risks of trading portfolios adequately. Trading portfolio risk management becomes more and more important for financial institutions of Lithuania and other Eastern European countries as well, especially for managers of investment and retirement funds investing into foreign financial instruments denominated in other currencies than litas or euro. The topic is very important to central banks and international regulatory bodies seeking financial stability in local and international markets.

The scientific problem. Means adequate to current market conditions are needed for a trading portfolio risk management. More than a decade the concept of Value at Risk had been used as a tool of trading portfolio risk management, but after analysis of the scientific literature was done by the author, it was concluded that this concept is not sufficiently theoretically developed in order it could be straightforward applied to manage trading portfolio of a certain financial institution.

The scientific problem of the dissertation is search of adequacy of the trading portfolio risk management methods and models to the current economic, technological, and informational circumstances of financial institutions. This problem may be researched in different aspects. The dissertation mainly concentrates into the following aspects: i) in scientific papers there is no common opinion regarding choosing and reasoning of estimation method for value at risk as a measure of a trading portfolio risk adequate to a certain conditions and this is relevant aspect of the scientific problem; ii) scientific debates are also actively going on regarding choosing, theoretical reasoning and application of volatility (that directly influences value at risk measure) and covariance's adequacy to the market financial instruments return forecasting models; this is also relevant aspect of the scientific problem; iii) discussions regarding theoretical reasoning and application into trading portfolio management process of measures in a single ratio combining financial results and risks taken; besides, it is starting to put efforts towards plugging of modern measures of financial risk such as Value at Risk into risk–adjustment methodologies, so a lot of unsolved questions are also in this field. This is also relevant aspect of the scientific problem.

Research object is trading portfolio risk: estimation methods, forecasting of volatility and covariance, incorporation of Value at Risk into portfolio management decisions.

Aim and tasks of the work. The main **aim** of the dissertation is the following. From one side, in virtue of Value at Risk as a methodology of an aggregated portfolio risk measure, to explore relevant selected problems of trading portfolio risk management such as selection of Value at Risk estimation method, selection of volatility and covariance's forecasting method and selection of risk–adjustment measure and its application to manage trading portfolio. From the second side, in virtue of research results, to suggest solutions to portfolio risk management problems under investigation.

The following main **tasks** are raised and worked out in the dissertation:

- To define the structure of problems of trading portfolio risk management topic;
- To overview results relevant to the research object and directions of scientific researches;
- To analyze assumptions behind Value at Risk estimation methods and to highlight their features and possibilities to apply in a certain specific situation for risk management purposes; to determine does the selected method influence the magnitude of VaR and how, if so;
- To analyze assumptions behind volatility and covariance's forecasting models and to highlight their features and possibilities to apply in a certain specific situation for risk management purposes; to determine does the accuracy of forecasts depend on chosen criterion of accuracy assessment, and how if does;
- To analyze assumptions behind risk–adjusted measures and to highlight their features and possibilities to apply in a certain specific situation for risk management purposes.

Research methods. To solve research tasks mentioned above the following knowledge of science fields was used: economics, mathematics, statistics and probability theory, management, etc. In empirical studies real rates of foreign exchanges and their derivatives were used.

Multidisciplinary research methods such as analysis, synthesis, analogy, modeling, extrapolation and verification were used in the studies.

In empirical studies the following specific research methods were used: descriptive statistics, chi–square, Kolmogorov–Smirnov and Shapiro–Wilk tests to define whether empirical probability distribution functions are close to normal probability distribution function, correlation–dispersion analysis, simulation technology, time series forecasting, error estimation according to statistical and operational criteria, and formulation of statistical conclusions.

Practical results of the research:

- Original structure of trading portfolio risk management problems was suggested;

- The original empirical comparative study on Value at Risk estimation methods was done. Valuable practical results were achieved, using which, practical recommendations regarding application of Value at Risk estimation methods were suggested;
- The original empirical comparative study on performance of volatility forecasting models was done. Valuable practical results were achieved, using which, practical recommendations regarding application volatility and covariance's forecasting models were suggested.

Scientific novelty of the research. The main features of science novelty characteristic to this research are the following:

- The comparative study on Value at Risk estimation methods allowed to make important theoretic conclusion that selection of Value at Risk estimation methods depends mostly on characteristics of the portfolio under investigation; theoretic recommendations regarding selection of Value at Risk estimation methods were suggested as well;
- The comparative study on performance of volatility forecasting models allowed to make important theoretic conclusion that selection of Value at Risk estimation methods depends on characteristics of the data under investigation and selected criteria for assessment of forecasting accuracy; in the context of risk management, the priority was given to operational rather than statistical accuracy assessment techniques in the context of risk management;
- The comparative study on risk adjustment measures allowed making important theoretic conclusion that selection of risk adjustment measures depends mostly on characteristics of the portfolio under investigation; theoretic recommendations regarding selection of risk adjustment measures were suggested as well.

2. Theoretical models, their characterization and improvement

Value at Risk model became very popular in the banking sector, because it has wide possibilities of practical application. Value at Risk (or VaR) indicates the maximum expected loss over a certain time period under normal market conditions within a specified confidence level (Jorion, 1996).

It is very important to know how Value at Risk measure to use properly and apply in specific situations. There are known three groups of methods for portfolio Value at Risk estimation (variance–covariance, historical simulation and Monte Carlo simulation), each of them has a number of different versions that are based on different assumptions. A comprehensive theoretical comparative analysis of Value at Risk estimation methods was performed that revealed advantages and disadvantages of each of them, and also possibilities of application in a certain specific situations.

The decision of choosing the certain approach is influenced mainly by the kind of portfolio for which we wish to estimate Value at Risk.

If the portfolio complies with the underlying assumptions of the Variance–Covariance approach, then this approach will be the best for a given portfolio, since applying other approaches to it would not give us more accuracy, but would require more financial, human and time costs.

So concluding there is no the best approach suitable for all possible situations, the decision to choose a specific model s determined mainly by the characteristics of data, length of historical data set and available technical facilities to perform necessary calculations.

The author worked out recommendations regarding selection of Value at Risk estimation approach.

In the second chapter volatility and covariance's forecasting models were overviewed and theoretical comparative analysis of main volatility and covariance's forecasting models – Bank for International Settings (BIS), Exponentially Weighted Moving Average (EWMA), and GARCH (1,1) – presented. The comparative analysis was performed using the following criteria:

- Volatility/covariance's change in time;
- Response speed to changes in the market;
- Mean–reversion.

Three main volatility and covariance's forecasting models were compared – BIS, EWMA and GARCH (1,1).

From the comparative analysis of the three forecasting models it was concluded that BIS and EWMA models are traditional time series average forecasting models so we may assume that they should forecast averages of Value at Risk well, but financial analysts are concentrated on deviations from the mean rather that mean, so in this situation GARCH (1,1) model should be superior to other two models.

In the third chapter risk adjustment concept and risk adjustment measures were introduced, the results of comparative analysis of them described. Management of financial institutions and their shareholders seek to see real picture of achieved financial results, because it is important what risks bearing were or will be achieved certain financial results. Financial results and risks taken are being combined through the concept of risk adjustment.

The author suggested recommendations regarding selection of appropriate risk adjustment technique and developed the possibilities of the generalized Sharpe rule, expressed in Value at Risk form, for application for portfolio management decisions and capital allocation among structural units of the bank.

3. Empirical studies

Three original empirical studies are presented in the dissertation.

The aim of the first empirical study was to perform a comparative study of three main Value at Risk estimation approaches – Variance–Covariance approach, Historical simulation and Monte Carlo simulation – and to determine their features and to suggest recommendations for financial analysts.

Scientific novelty of this empirical study is in the following aspects:

- All three main Value at Risk approaches are being compared – Variance–covariance, Historical simulation and Monte Carlo simulation;
- Real trading portfolio consisting of spot foreign exchange contracts was used in the study;
- The dependence between results of Monte Carlo simulation and the number of iterations used is studied.

Data. Daily real exchange rates of EU euro (EUR) and pounds of Great Britain (GBP) expressed in dollars of the U.S. were collected for the empirical analysis.

Daily data covers the period from 5 May 2000 through 8 July 2002, i.e. 600 observations.

Methodology. We constitute a trading portfolio of the two exchanges under consideration using an assumption that the weights of both exchanges in the portfolio are equal. Also we made an assumption that the value of a trading portfolio on July 8, 2002 is equal to MUSD 1.

Using the data and three VaR estimation approaches we calculate VaRs for 9 July 2002.

All necessary calculations were performed using MS Excel 2002 spreadsheet software.

With each one of the approaches VaR has been calculated for the different parameters:

- ✓ Confidence levels specifically for 99 %, 97.5 % and 95 %.
- ✓ Time periods: one day, one week (5 trading days), two weeks (10 trading days) and one month (20 trading days).

Moving from one time period to the other we use the square root of time rule $\sqrt{t}$, where t is the number of trading days.

Regarding the Variance–Covariance approach, first of all standard deviations of selected foreign exchanges log returns were calculated (σ_{EUR} = 0.3 %, σ_{GBP} = 0.2 %), correlation matrix Σ with single correlation coefficient (ρ = 0.607), weighted standard deviations (σ'_{EUR} = 0.15 %, σ'_{GBP} = 0.11 %). And finally, the standard deviation of the trading portfolio (σ_p = 0.23 %) and Value at Risk were calculated.

In Historical simulation case, VaR's were calculated from the histogram of daily profits and losses.

Regarding Monte Carlo simulation two series of random values Y_{EUR} and Y_{GBP} were generated that were distributed according to normal distribution with

real averages and standard deviations inferred from series of logarithmic changes in exchange rates.

Then, using *Cholesky decomposition*, two series of correlated random variables Z_{EUR} and Z_{GBP} were calculated:

$$Z_{EUR} = Y_{EUR},$$
$$Z_{GBP} = Y_{EUR}\,\rho + Y_{GBP}\,(1-\rho^2)^{0,5},$$

where ρ is a correlation coefficient between foreign exchange rates under consideration.

Finally, using weights the profits and losses on the trading portfolio were calculated. From the histogram of profits and losses of the trading portfolio using specified parameters and VaRs were calculated.

Also, the relationship between VaRs calculated using Monte Carlo simulation and the number of iterations used was investigated. For this reason the following numbers of iterations were used: 100, 1000, 10000, and 30000.

Results. In Table 1 empirical study results are presented. The layout of the table is explained below.

By „V–C“ we mean the Variance–Covariance approach (Assets–normal version), by „HS“ we mean Historical simulation, and finally, by „MCM“ we mean Monte Carlo simulation.

Monte Carlo simulation results correspond in this order to the different number of iterations used in the simulation: 30000, 10000, 1000 and 100.

Table 1. VaR empirical estimation, July 9, 2002 (in thousands of US dollars)

		Confidence level								
		99 %			97.5 %			95 %		
		Method			Method			Method		
		V–C	HS	MCS	V–C	HS	MCS	V–C	HS	MCS
Period, trading days	20	23.97	32.98	29.20	20.16	27.28	24.45	16.97	23.48	20.56
				29.81			24.43			20.34
				27.32			23.81			20.02
				18.77			17.12			16.34
	10	16.95	23.32	20.65	14.26	19.29	17.29	12.00	16.60	14.54
				21.08			17.27			14.38
				19.32			16.84			14.16
				13.28			12.11			11.55
	5	11.98	16.49	14.60	10.08	13.64	12.22	8.49	11.74	10.28
				14.90			12.21			10.17
				13.66			11.9			10.01
				9.39			8.56			8.17
	1	5.36	7.38	6.53	4.51	6.10	5.47	3.80	5.25	4.60
				6.66			5.46			4.55
				6.11			5.32			4.48
				4.20			3.83			3.65

The following conclusions were made:

- The largest VaRs were obtained when historical simulation was used. The least VaRs were obtained when analytic method was used and intermediate VaRs were obtained when Monte Carlo simulation was used for calculations (with some exceptions when least number of iterations was used). It means that commercial banks will tend to use analytical approach, because in this may the least capital requirement will be calculated;
- The results of our empirical study also showed that VaRs calculated by Monte Carlo simulation were larger when a larger number of iterations were used with the exception of 99% confidence level and 30000 iterations. In this case VaRs were smaller that those calculated using 10000 iterations. Also except just mentioned cases the differences between VaRs calculated by different methods become smaller when the number of iterations used in the Monte Carlo simulation increases;
- The longer the period of time and/or the higher the confidence level, the larger VaR estimates are obtained.

The aim of the second empirical study was to perform comparative analysis of the accuracy of volatility and covariance's' forecasting models – BIS model, EWMA model and GARCH (1,1) model, using statistical and operational criteria, and to determine weather model selection depends on criteria used to assess the accuracy of forecasts.

Scientific novelty of this empirical study is in the following aspects:

- All three main volatility and covariance's' foresting models are studied – BIS model, EWMA model and GARCH (1,1) model;
- Real FX rates are used;
- The mean values of volatility forecasts of different currencies calculated by a certain model are verified for statistical significance regarding the results produced by the other two models.

Data. Daily real exchange rates of Australian dollar (AUD), Canadian dollar (CAD), Swiss frank (CHF), EU euro (EUR), pounds of Great Britain (GBP) and Japan yen (JPY) expressed in dollars of the U.S. were collected for the empirical analysis.

Daily data covers the period from 23 February 2000 through 8 July 2002, i.e. 632 observations. Then the logarithmic returns of FX rates were calculated.

Methodology. All three models generate forecasts for the period from 01 January 2000 till 08 July 2002. Four different forecasting horizons are used – one day, a week (5 business days), two weeks (10 business days) and 5 weeks (25 business days). Forecasts for longer horizons than one day are calculated using the square root of time rule.

The accuracy assessment according to operational criteria is performed for one day horizon forecasts only.

BIS and EWMA models produce forecasts for 250 days.

In EWMA model smoothing parameter λ is set equal to 0.94 – like in J.P. Morgan Riskmetrics™ system (J.P. Morgan, 1996).

In GARCH (1,1) model case, forecasts are produced for the period from 01 January 2002 till 08 July 2002. The following steps were used for forecasting with GARCH (1,1) model:

- ✓ parameters ω, α, β were estimated using software package Statistika 6.0 and optimized for the period from 23 February 2000 till 31 December 2001 (see Table 2);
- ✓ Using estimated parameters returns of FX are forecasted for the next period;
- ✓ The procedure was repeated until forecasts up to 08 July 2002 were generated.

Table 2. Parameters of GARCH (1,1) model

	ω	α	β
AUD	1.22E–06	0.023238	0.87600
CAD	3.00E–07	0.019067	0.83998
CHF	1.04E–06	0.000636	0.89396
EUR	9.75E–07	0.029498	0.87705
GBP	5.35E–07	0.025962	0.87651
JPY	1.83E–07	0.029016	0.94347

The accuracy of forecasting results was verified using the following statistical criteria: Mean Square Error (MSE) and Maximum Likelihood Methods.

The accuracy of forecasting results was also verified using the following operational criteria: back–testing and forward–testing.

The following conclusions were made:

- Assessment of accuracy of volatility forecasting results according to statistical criteria should be refused because this technique calculates deviations of forecasts from the average while risk management concentrates on forecasting of extreme events, not averages;
- From what was said above follows that volatility forecasting models should be elaborated and researched using operational criteria of forecasting accuracy assessment, operational criteria not statistical ones also should be further elaborated;
- From the three–studied volatility forecasting models priority should be given to the family of GARCH models because of their theoretical features. But the author failed to get undoubted confirmation for all foreign currencies that were used in the empirical study.

The aim of the third empirical study was to employ the Double Trump Decisions Model of A.V. Rutkauskas in order to maximize the purchasing power of a trading portfolio.

It was used the same data as in the second empirical study.

The results showed increase in capital from 1.0 till 1.24 in 783 days. It was concluded that joining together Double Trump Decisions Model with other models studied in the dissertation may produce even better results in terms of profitability and securing of acceptable level of risk and reliability of the outcomes.

4. Final conclusions and suggestions

1) The search of adequacy of trading portfolio risk management methods and models to the current economic, technological, and informational circumstances of financial institutions as the scientific problem is being solved by researching the following three closely interrelated aspects – selection of Value at Risk estimation method, selection of volatility and covariance's forecasting model and criteria to assess the accuracy of forecasts, and selection of risk–adjusting measure as a tool of trading portfolio risk management.
2) Different Value at Risk estimation methods generate considerably different results of estimation; since the latter depends highly on a large number of various factors. This conclusion was confirmed by the empirical comparative study of Value at Risk estimation approaches.
3) Theoretical comparative analysis of Value at Risk estimation methods revealed that the decision to choose a certain method is determined, among the other factors, by a scope of valid assumptions and the characteristics of a trading portfolio. The author suggested appropriate scheme and recommendations regarding the selection of a certain estimation approach taking into account factors mentioned above.
4) In the formula of variance–covariance or analytic VaR estimation method the main element is current or forecasted portfolio volatility. So when assessing trading portfolio risk it is important to choose right volatility forecasting model. Analysis of scientific literature on the topic revealed that up to date scientists has no unanimous opinion regarding giving priority to a certain forecasting model.
5) The theoretical analysis of main volatility and covariance's forecasting models revealed that forecasting volatility and covariance's using GARCH (1,1) model is superior to BIS and EWMA models, because it accounts for long–term average level of volatility, it also has a mean–reversion feature characteristic to financial series.
6) Accuracy of forecasts of volatility and covariance's may be assessed using two types of criteria – statistical and operational. The first case concentrates on how forecasts generated by the model are in line with

the mean of time series under consideration, and the second one – on extreme events. Forecasting of extreme events is more important in risk management, so volatility forecasting models should be elaborated taking into account operational accuracy assessment criteria.

7) The empirical comparative analysis of volatility forecasting models revealed that in nearly all cases according to statistical forecasting accuracy assessment criteria priority should be given to the EWMA model, but according to operational criteria from the three studied volatility forecasting models priority should be given to the of GARCH (1,1) model because of their theoretical features and possibilities.
8) While measuring returns of alternative investments ex ante or investments ex post, it is important to account not only for expected or achieved returns, but also for expected or taken level of risk. This sort of analysis may be carried out using risk adjustment measures. It is showed in the dissertation how risk adjustment methodologies may be used to manage trading portfolio risk, grounding on Value at Risk figures.
9) Theoretical comparative analysis of risk adjustment measures helped to suggest appropriate scheme and recommendations regarding the selection of the measures that helps to select the measure taking in account statistical characteristics of the data under investigation.
10) Possibilities of one of the recommended to apply in practice risk–adjusting measures – the generalized Sharpe rule, expressed in Value at Risk form, are suggested and developed to solve practical portfolio management problems such as investments decisions, portfolio insurance decisions and selection of portfolio structure. Possibilities of the generalized Sharpe rule are also suggested and developed for making decisions of capital allocation among structural units of the bank and setting of trading limits according Value at Risk measures.

Published works on the topic of the dissertation

In the periodical scientific editions:

- Dzikevičius, A. Risk–Adjustment and Performance Measurement: Symmetrical versus Asymmetrical Measures. *Business: theory and practice* , Vol. VI, No. 2, 2005, p. 77–84.
- Dzikevičius, A. A Comparative Analysis of Market Risk Measurement Approaches of FX Portfolio. *Bridges*, No. 2 (31), Klaipėda university publishing, 2005, p. 1–13 (in Lithuanian).
- Dzikevičius, A. Comparative Analysis of Risk Adjusted Procedures. *Trenches*, No. 64 (17), Lithuanian university of agriculture publishing, 2004, p. 97–103 (in Lithuanian).

- Dzikevičius, A. A Comparative Analysis of Different Value at Risk Estimation Methods: Empirical Evidence. *Business: theory and practice*, Vol. V, No. 4, 2004, p. 182–188.
- Dzikevičius, A. Forecasting of Volatility and Covariances of Foreign Exchange. *Economics*, No. 63, Vilnius university publishing, 2003, p. 182–195 (in Lithuanian).

In the other editions:

- Dzikevičius, A. Application of the Generalized Sharpe Rule for Portfolio Management. In: Business, Management and Education'2004: Proceedings. Vilnius: Technika, 2005, p. 31–38 (in Lithuanian).
- Dzikevičius, A. Concept of Risk Adjustment. In: Proceedings of the VII Conference of Lithuanian Young Scientists *Lithuania without Science – Lithuania Without Future, Humanitarian and Social Sciences* held in Vilnius, Lithuania on 12th February 2004. Vilnius: Technika, 2004, p. 56–60 (in Lithuanian).
- Dzikevičius, A. The Analysis of Some Risk–Adjustment Rules. In: Business, Management and Education'2003: Proceedings. Vilnius: Technika, 2004, p. 21–25.
- Dzikevičius, A. Volatility Forecasting Models. In: Proceedings of the Scientific Conference *Problems and Perspectives of Economics and Management 2003* held in Šiauliai, Lithuania on 21st November 2003. Šiauliai: Šiauliai university publishing, 2004, p. 98–100 (in Lithuanian).
- Dzikevičius, A. Covariance Matrix Forecasting. In: Proceedings of the VI Conference of Lithuanian Young Scientists *Lithuania without Science – Lithuania Without Future, Humanitarian and Social Sciences* held in Vilnius, Lithuania on 13th February 2003. Vilnius: Technika, 2003, p. 66–69.
- Dzikevičius, A., Lukoševičius, M. Interest Rate Risk and its Measurement at a Commercial Bank. In: Proceedings of the VI Conference of Lithuanian Young Scientists *Lithuania without Science – Lithuania Without Future, Humanitarian and Social Sciences* held in Vilnius, Lithuania on 13th February 2003. Vilnius: Technika, 2003, p. 85–89 (in Lithuanian).
- Dzikevičius, A. FX Portfolio Risk Measurement Using Analytical Approach. In: Business, Management and Education'2002: Proceedings, Vol I. Vilnius: Technika, 2003, p. 32–35 (in Lithuanian).
- Dzikevičius, A. Market Risk Management Function in a Commercial Bank. In: Proceedings of the Scientific Conference *Problems and Perspectives of Economics and Management 2002* held in Šiauliai, Lithuania on 22nd November 2002. Šiauliai: Šiauliai university publishing, 2003, p. 42–45 (in Lithuanian).

- Dzikevičius, A. Internal Models for Risk Management of a Financial Institution‘s Trading Portfolio. In: Proceedings of the V Conference of Lithuanian Young Scientists *Lithuania without Science – Lithuania Without Future*, *Humanitarian and Social Sciences* held in Vilnius, Lithuania on 14th February 2002. Vilnius: Technika, 2002, p. 58–65 (in Lithuanian).

About the author

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A Bachelor degree in Management, Business Management Faculty, Vilnius Gediminas Technical University, 1999. A Master‘s degree in Management, Business Management Faculty, Vilnius Gediminas Technical University, 2002. In 2001–2005, PhD student of Vilnius Gediminas Technical University. From April to May in 2002, Audrius Dzikevičius was on internship at Swiss Banking Institute of Zurich University in Switzerland (Gebert Ruef Swiss Baltic Net Foundations Scholarship). In June, 2003 he participated in the programme „Today‘s research training – tomorrow‘s scientific quality“ of Nordic Academy for Advanced Studies in Latvia. In May, 2004 he made presentation and participated in the workshop of EUMOptFin „The Drivers of Performance of Large Financial Institutions” in Bergamo, Italy.

PREKYBINIO PORTFELIO RIZIKOS VALDYMAS BANKE

Temos aktualumas. Sparčiai kintant finansinių institucijų veiklos sąlygoms, didėjant finansinių rinkų nepastovumui bei apimčiai, atsirandant vis naujoms finansinėms priemonėms, o kartu su jomis ir naujoms finansinių institucijų rizikos rūšims, ypač išaugo prekybinio portfelio rizikos valdymo poreikis. Prekybinio portfelio rizikos valdymas tampa vis aktualesnis ir Lietuvos finansinėms institucijoms, ypač investicinių bei pensijų fondų valdytojams, investuojantiems į užsienio vertybinius popierius, denominuotus kitomis valiutomis nei litai ar eurai. Prekybinio portfelio rizikos valdymas yra labai aktuali tema ir atskirų šalių centriniams bankams bei tarptautinėms finansų sistemos priežiūros institucijoms.

Šiame darbe sprendžiama **mokslo problema** – tai prekybinio portfelio rizikos valdymui taikomų metodų bei modelių adekvatumo dabartinėms finansinių institucijų ekonominės, technologinės bei informacinės aplinkos sąlygoms paieška.

Tyrimų objektas – prekybinio portfelio rizika: apskaičiavimo metodai, nepastovumo bei kovariacijų prognozavimo modeliai, rizikos įtraukimas į prekybinio portfelio valdymo sprendimų priėmimą.

Tyrimų tikslas – iš vienos pusės, remiantis rizikos vertės, kaip portfelio rizikos agreguoto mato metodologija, ištirti aktualias pasirinktas prekybinio

portfelio rizikos valdymo problemas, tokias kaip rizikos vertės apskaičiavimo metodo pasirinkimas, nepastovumo bei kovariacijų prognozavimo modelio pasirinkimas bei vertinimo, koreguoto pagal riziką, metodikos pasirinkimas ir jos taikymas prekybiniam portfeliui valdyti, bei, iš kitos pusės, remiantis gautais tyrimų rezultatais, pasiūlyti tiriamų prekybinio portfelio rizikos valdymo problemų sprendimų būdus.

Disertacijoje keliami ir sprendžiami tokie pagrindiniai **uždaviniai**:

- apibrėžti prekybinio portfelio rizikos valdymo problemų struktūrą;
- apžvelgti tyrimo objektui aktualių jau atliktų mokslinių tyrimų rezultatus bei kryptis;
- išanalizavus prielaidas, kuriomis remiasi rizikos vertės apskaičiavimo metodai, išryškinti jų savybes bei taikymo galimybes tam tikrose situacijose rizikai valdyti; nustatyti, ar pasirinktas rizikos vertės apskaičiavimo metodas lemia skaitinę rizikos vertės išraišką ir kaip, jei lemia;
- išanalizavus prielaidas, kuriomis remiasi pagrindiniai nepastovumo bei kovariacijų prognozavimo modeliai, išryškinti jų savybes bei taikymo galimybes tam tikrose situacijose rizikai valdyti, nustatyti, ar prognozavimo tikslumas priklauso nuo pasirinkto tikslumo vertinimo kriterijaus ir kaip, jei priklauso;
- išanalizavus prielaidas, kuriomis remiasi vertinimo, koreguoto pagal riziką metodikos, išryškinti jų savybes bei taikymo galimybes tam tikrose situacijose rizikai valdyti.

Praktiniai darbo rezultatai. Praktiniai darbo rezultatai atsispindi šiuose aspektuose:

- darbe pasiūlyta originali prekybinio portfelio rizikos valdymo problemų struktūra sudarys prielaidas finansinėms institucijoms atkreipti dėmesį į didesnį veiksnių skaičių formuojant prekybinio portfelio valdymo politiką;
- atliktas originalus empirinis rizikos vertės apskaičiavimo metodų tyrimas atskleidė labiausiai tikėtiną komercinių bankų elgsenos modelį praktiniam taikymui renkantis rizikos vertės apskaičiavimo metodą ir siekiant sumažinti privalomų atidėjimų rinkos rizikai padengti kiekį;
- atliktas originalus empirinis nepastovumo modelių veikimo tyrimas patvirtino svarbią praktinę nepastovumo bei kovariacijų prognozavimo tikslumo priklausomybę nuo tikslumui vertinti pasirenkamo kriterijaus.

Mokslinis naujumas. Mokslinis darbo naujumas pastebimas šiuose aspektuose:

- rizikos vertės apskaičiavimo metodų palyginamoji analizė leido padaryti svarbią teorinę išvadą, kad rizikos vertės apskaičiavimo metodo pasirinkimą pagrinde lemia tiriamo prekybinio portfelio ypatumai; taip pat palyginamosios analizės rezultatų pagrindu buvo suformuluotos

teorinės rekomendacijos dėl rizikos vertės apskaičiavimo metodo pasirinkimo;

- nepastovumo bei kovariacijų prognozavimo modelių palyginamoji analizė parodė, kad modelio pasirinkimą gali lemti tiek tyrimui naudojamų duomenų pobūdis, tiek ir tikslumui vertinti pasirenkami kriterijai; taip pat buvo nustatyta, kad rizikos valdymo kontekste prognozavimo tikslumas turėtų būti vertinamas pirmenybė atiduodant operaciniams, o ne statistiniams tikslumo vertinimo kriterijams;
- vertinimo, koreguoto pagal riziką, metodikų palyginamoji analizė leido padaryti svarbią teorinę išvadą, kad konkrečios metodikos pasirinkimą pagrinde lemia tiriamo portfelio ypatumai; taip pat šios analizės rezultatų pagrindu buvo suformuluotos teorinės rekomendacijos dėl vertinimo, koreguoto pagal riziką, metodikos pasirinkimo.

Galutinės išvados ir pasiūlymai.

1) Prekybinio portfelio rizikos valdymui taikomų metodų bei modelių neadekvatumas dabartinėms finansinių institucijų ekonominės, technologinės bei informacinės aplinkos sąlygoms kaip mokslinė problema sprendžiama tiriant tris tarpusavyje glaudžiai susijusias jos sritis – rizikos vertės apskaičiavimo metodo pasirinkimo problematiką, nepastovumo bei kovariacijų prognozavimo modelių bei tuo pačiu prognozių tikslumo vertinimo kriterijų pasirinkimo problematiką, taip pat vertinimo, koreguoto pagal riziką, metodikos kaip prekybinio portfelio rizikos valdymo priemonės pasirinkimo problematiką.
2) Portfelio rizikos vertės apskaičiavimo metodai pasižymi didele jais gaunamų rezultatų variacija, kadangi skaičiavimo rezultatai labai smarkiai priklauso nuo didelio skaičiaus skirtingų veiksnių. Tai patvirtino ir disertanto atlikta empirinė rizikos vertės apskaičiavimo metodų palyginamoji analizė.
3) Atlikus teorinę portfelio rizikos vertės apskaičiavimo metodų analizę paaiškėjo, kad rizikos vertės apskaičiavimo metodo pasirinkimą, be kitų veiksnių, labiausiai lemia pasirinktų prielaidų visuma bei turimo prekybinio portfelio ypatumai. Remiantis teorinės analizės rezultatais buvo pasiūlyta atitinkama schema bei rekomendacijos, padedančios pasirinkti rizikos vertės apskaičiavimo metodą įvertinant aukščiau paminėtus veiksnius.
4) Variacijos–kovariacijos arba analitinio rizikos vertės apskaičiavimo metodo formulėje svarbiausias elementas yra esamas arba prognozuojamas portfelio nepastovumas, todėl, vertinant prekybinio portfelio riziką, yra svarbu pasirinkti tinkamą nepastovumo prognozavimo modelį. Aktualios mokslinės literatūros analizė parodė, kad iki šiol mokslininkams nepavyko prieiti prie vieningų išvadų ir pirmenybės atiduoti tam tikrai prognozavimo modelių šeimai.

5) Teorinė pagrindinių nepastovumo bei kovariacijų prognozavimo modelių palyginamoji analizė parodė, kad nepastovumo bei kovariacijų prognozavimas GARCH (1,1) modeliu yra pranašesnis už BIS bei EWMA modelius, nes jis įvertina ilgalaikį vidutinį nepastovumo lygį, todėl turi finansinių atsitiktinių dydžių sekoms būdingą sugrįžimo prie vidurkio savybę.
6) Nepastovumo bei kovariacijų prognozavimo tikslumas gali būti vertinamas naudojant dviejų tipų kriterijus – statistinius ir operacinius. Pirmuoju atveju koncentruojamasi į tai, kaip tiksliai modelis prognozuoja laiko eilutės vidurkį, o antruoju atveju – į ekstremalių pokyčius. Rizikos vertinimui didesnės reikšmės turi ekstremalių pokyčių prognozavimas, todėl būtina tobulinti nepastovumo prognozavimo modelius atsižvelgiant į operacinius tikslumo vertinimo kriterijus.
7) Empirinė nepastovumo prognozavimo modelių palyginamoji analizė parodė, kad pagal statistinius prognozavimo tikslumo vertinimo kriterijus beveik visais atvejais pirmenybė teiktina nepastovumo prognozavimui EWMA modeliu, tačiau pagal operacinius prognozavimo tikslumo vertinimo kriterijus gaunami kitokie rezultatai – iš trijų tirtų nepastovumo bei kovariacijų prognozavimo modelių pirmenybė teiktina GARCH (1,1) modeliui dėl jo teorinių savybių bei galimybių.
8) Vertinant alternatyvias potencialias investicijas arba jau atliktas investicijas, yra svarbu atsižvelgti ne tik į tikėtiną ar pasiektą pelningumą, bet ir į numatomą prisiimti ar prisiimtą rizikos lygį. Tokio pobūdžio analizę padeda atlikti vertinimo, koreguoto pagal riziką, metodikos. Darbe parodoma kaip vertinimo, koreguoto pagal riziką, metodikos gali būti taikomos prekybinio portfelio rizikai valdyti, besiremiant rizikos vertės rodikliais.
9) Remiantis teorinės vertinimo, koreguoto pagal riziką, metodikų palyginamosios analizės rezultatais buvo pasiūlyta atitinkama schema bei rekomendacijos, padedančios pasirinkti vertinimo, koreguoto pagal riziką metodiką, įvertinant tiriamų duomenų statistines savybes.
10) Vieną iš disertanto rekomenduojamų vertinimo, koreguoto pagal riziką, metodikų – Apibendrintą Sharpe metodiką – galima išreikšti rizikos vertės forma ir taip ją tiesiogiai taikyti tokioms praktinėms portfelio valdymo problemoms spręsti kaip investavimo sprendimai, portfelio apdraudimas bei portfelio struktūros parinkimas. Taip pat darbe yra pasiūlytas bei išplėtotas apibendrintos Sharpe metodikos taikymo kapitalo paskirstymui tarp atskirų banko struktūrinių padalinių galimybės jų pozicijų limitus nustatant pagal rizikos vertės rodiklius.

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