

## Credit Risk Management Models of Commercial Banks: their Importance for Banking Activities

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### Abstract

Credit risk management models and a theoretical approach to credit risk management models and their types are presented in this paper. Credit risk is one of the most important risks that incurs in banking activities. It is essential to choose the tool of restraining and managing this risk correctly with the aim to minimize credit risk. Theories of credit risk management, the main tools and models used in the Lithuanian banking system are introduced in the paper.

**Keywords:** credit risk, credit risk management, commercial bank, central bank, credit risk management models.

### Introduction

Credit risk is one of the most significant risks that commercial banks face. The supervising committee of the Basel bank points out that liberalized loaning, bad management of credit portfolios, insufficient evaluation of changing economical and other situations create huge problems for financial institutions (BCBS, 2000). According David O. Bleim (2001), most of systematic banking crisis arise because of enormous portfolios of bad loans. The question would be: How to soften danger that arises from credit risk in the portfolio of loans or in the whole banking sector? Scientific literature proposes a variety of approaches, models, methods and tools for credit risk management. The most common, simply adjusted and most often used credit risk management models are summarised and their principal features are highlighted in the paper. The main problem of the Lithuanian banking sector would be that there is no solid system of credit risk management. As a solution stress testing and its use in credit risk management are described in the paper.

**Research relevance.** It is important to analyze the specificity and circumstances of credit risk management models for the purpose of choosing the right credit risk management model and incorporating it in the policy and strategy of the commercial bank. Since the current situation in the financial sector bears series of questions for discussions on bank credit risk and its management, it is relevant to review chang-

es in the methods of the credit risk topic and analyse how these models could be used in a particular situation of the Lithuanian banking sector.

**Research novelty.** Scientific literature on this topic is systemized, the main credit risk management models are highlighted.

**Research object:** credit risk management models.

**Research objective:** to analyze credit risk management models and to compare their use in the commercial banks of Lithuania.

### Research tasks:

- To analyse importance of credit risk management and discuss the main credit risk management models.
- To analyze credit risk management models used in the Lithuanian banking sector.
- To highlight indicators that influence changes in the quality of the loan portfolio.

**Research methodology.** The following methods have been used: scientific literature analysis, comparison, systemization, grouping, inductive, deductive, search for analogy, calculation of correlation coefficients using the SSPS program.

**Results.** The concept of credit risk management models and their main features, a stress testing model and the main problem of the Lithuanian banking sector, absence of a solid system, are presented.

### Research methodology

Table 3, with correlation coefficients calculated by the SSPS program, are presented in the final part of the paper. Seeking to evaluate the situation correctly appropriate data and CoPod and CIM-DO methodologies according M. A. Segoviano Barurto and P. Padilla (2006) must be used. Due to insufficient information and limited adjustment of the methodology merely primary steps of introducing a stress testing model under negative circumstances according A. Lakstutyte, A. Breikeryte, D. Rumsaite (2009) are given in the paper. Steps of a stress testing model are given in Table 1. To evaluate probability of separate default of businesses, mortgages and

consumer credits it is important to analyze macroeconomic indicators that could influence changes in the quality of a loan portfolio. 11 macroeconomic factors were used to evaluate the reserves of the Lithuanian commercial banks for losses because of credit risk. To choose right macroeconomic indicators (independent variables) that could influence probability of default separately for different kinds of loans (dependent variables) correlation coefficients were computed. Seeking to avoid biasing and unify the measures percentage comparing with the past period was computed. Correlation coefficients of businesses, mortgages and consumer credits with the whole portfolio, correlation versus inactive loans with macroeconomic factors were computed.

### Credit risk management: theoretical approach

Many scientists state that credit risk is a probability of defaulting if the debtor is unable to meet his obligations under the contract due to circumstances. Risk occurs when the debtor cannot repay his loan because of some reasons. With the view of reducing potential losses because of unreliable clients, banks should be ready to measure and evaluate credit risk of each client separately (Mileris, 2009). If risks in the banking sector are compared (credit, market, operational, liquidity) it is obvious that credit risk is the most important (Caouette, Altman, Narayanan, 1998; Jaseviciene, Valvonis, 2003).

Credit risk management is one of the most discussed topics in Lithuania and foreign countries (Jaseviciene, Valvonis, 2003). The supervising com-

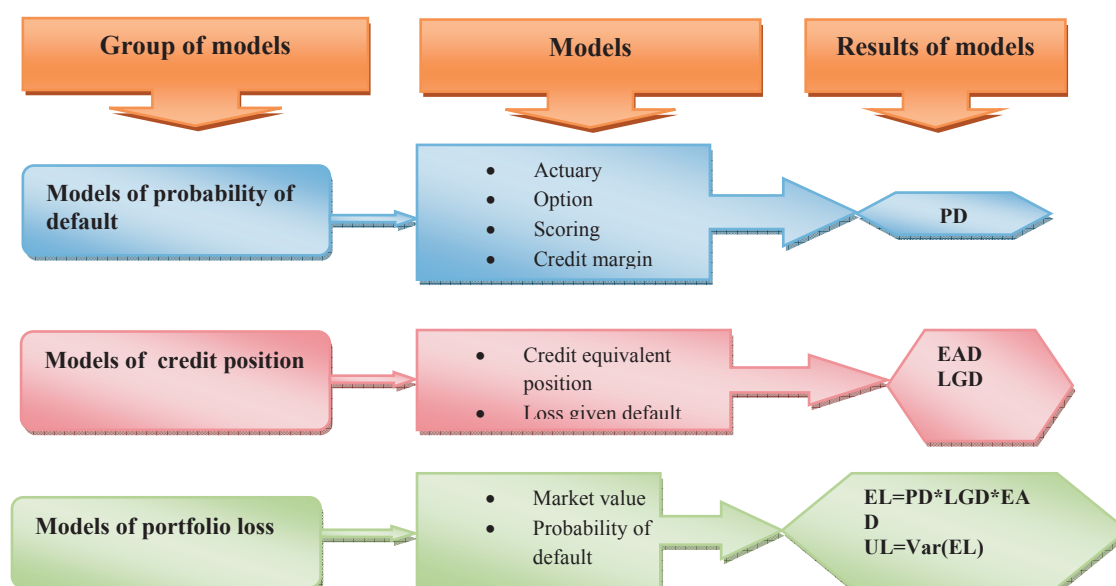
mittee of the Basel bank points out that liberalized lending, bad management of credit portfolios, insufficient evaluation of changing economical and other situations create huge problems for financial institutions (Valvonis, 2004). This is the main reason why it is important to choose right tools, procedures and methods to effectively protect loans from credit risk. Many scientists agree that good credit risk management can reduce probability of serious problems in banks (Rutkauskas, Stankeviciene, 2006; Boguslauskas, Mileris, 2009).

It is important to evaluate whether risk of a particular loan is risk of the whole portfolio, e.g. concentration of loans, correlation of the debtor's risk. A variety of credit risk evaluation models exist (Kamienas, Valvonis, 2004).

### Types of models of credit risk management

As R. Mileris (2009) maintains, earlier some models by two types of statistical methods, discriminant analysis and logistic regression were used. Altman, Deakin, Blum used discriminant analysis for testing probability of the company's bankruptcy; Ohlson, Gentry used logistic regression. Later decision trees and other methods were used. Since 2009 an artificial neural network model for the credit risk management was described.

I. Kamienas and V. Valvonis (2004) propose divide credit risk management models according to E. Falkenstein, A. Boral, L. V. Carty (2000) and J. B. Caouette, E. I. Altman, P. Narayanan (1998) (Fig. 1).



**Fig. 1.** Credit risk management models

Source: compiled by the authors according I. Kamienas and V. Valvonis (2004).

The models of default probability are used to evaluate the probability of default of the debtor. The models adjusted with the actuary calculation allow to evaluate relative frequencies of default probability of separate debtors and/or their groups during a particular time. Scoring is use of financial reports of the company. If scoring is used to evaluate a person's risk, his incomes, assets and other information are taken into account. Market information of the value of the property, obligations and securities is used for a credit equivalent position and loss given default models. Models of credit position are used to forecast probability of a credit default level. Models of portfolio loss are calculated as a result of probability of default models and models of a credit position. Demand of the economical capital is calculated and distributed to the divisions of the bank according the results of portfolio loss models (Kamienas, Valvonis, 2004).

**PD** (Probability of Default) is a probability that the debtor would not be able to meet his obligations for the bank on time. This measure is related to the debtor (a person or a company) but it is not related to loan risk. Contrarily, **LGD** (Loss Given Default) shows an average loss in the case of default of a particular loan or under particular circumstances. LGD is calculated as the percentage of a particular loan. **EAD** is the amount of the loan in the case of default. The measure **EL** (Expected Loss) shows the

evaluated level of default of the whole group: how much the bank will lose if it grants a loan of a particular risk to the debtor of a particular risk. **EL** is the average statistical loss. **UL** (Unexpected Loss) shows deviation from the average.

### Credit risk management models used in the Lithuanian banking sector

The loss that banks suffer from credit risk and the quality of bank's credit portfolio are dependent on the economic situation in the country as well as on the debtor's financial situation. Since the assets of the Lithuanian commercial banks are related to loans (~80.9% of assets is made up from loans), credit risk is one of the most significant sources of risk that banks incur. The global economic recession and the current situation in Lithuania when its economy started to weaken at the end of 2008 may influence dependence between economic development processes in the future and the results of the banking system. Therefore, it is important to evaluate consequences. Macroeconomic processes were very important for risk settlement in the banking sector. It is proven by theoretical research. Many empirical research were done in the Lithuanian banking sector according M. Sorge (2004), M. A. Segoviano Basurto, P. Padilla (2007), etc. According to the results of credit risk researchers some steps are given in Table 1.

Table 1

#### Research of credit risk based on Stress Testing

Steps	Results
1. Scenario modeling under different risk factors	<ul style="list-style-type: none"> <li>• According to the current situation in the country</li> <li>• Analysis of evaluation of experts and establishment of the main risk factors</li> </ul>
2. Evaluation of indicators that defining the quality of the bank loan portfolio	<ul style="list-style-type: none"> <li>• Evaluation of the current quality of the loan portfolio</li> <li>• Calculation of the probability of default of different loan sectors</li> </ul>
3. Establishment of macroeconomic indicators that influence changes in the probability of default and the bank net profit	<ul style="list-style-type: none"> <li>• Indicators that may influence changes in the probability of default and the bank net profit</li> <li>• Elimination of seasonal fluctuations of the selected indicators</li> <li>• Evaluation of correlation between macroeconomic indicators and the probability of default and the bank net profit and selection of the most correlating macroeconomic indicators</li> <li>• Establishment of the parameters of explanatory macroeconomic variables using a linear regression model</li> </ul>
4. Research into influence of scenarios on credit risk of the bank sector	<ul style="list-style-type: none"> <li>• Prognosis of explanatory macroeconomic variables according to the formulated macroeconomic scenarios</li> <li>• Evaluation of influence of macroeconomic scenarios on the probability of default according to the loan sectors and the bank net profit</li> </ul>

Source: compiled by the authors according A. Lakstutiene, A. Breikeryte and D. Rumsaite (2009).

As Table 1 suggests, in the case of the scenario when the Lithuanian banking system face a lack of capital to cover losses banks should keep more economical capital if they seek to avoid this risk in the future (Lakstutiene, Breikeryte, Rumsaite, 2009).

The Lithuanian Central Bank maintains that for the purpose of evaluating resistance of the banks in stress situations the liquidity of the banking system must be examined and stress tested under economic crisis conditions. The aim of stress testing for credit risk is to evaluate whether the banks hold sufficient reserves to cover possible losses that could occur in the future under the worst scenario. Stress testing for credit risk based on the scenario method allows evaluate influence of risk factors at the same time and their correlation with the macroeconomic environment of the country and the financial situation of the debtors in a long term perspective. Stress testing for credit risk under the economic crisis was done for the first time in 2007 as part of the financial sector evaluation program in cooperation with World Bank and IMF. Stress testing is based on the model of M. A. Segoviano Basurto and P. Padilla (2007). This model is based on a conditional probability of default methodology (CoPoD) and consistent with the information of multivariate density optimizing methodology (CIMDO), that allow effectively evaluate influence of macroeconomic shocks on credit risk of the banks loan portfolios in different macroeconomic scenarios comparing with other statistics and econometrics.

The Lithuanian Central Bank gives the right to each commercial bank to choose credit risk management models by themselves and indicate the most

important factors that should be taken into account when the bank sources are allocated. In conclusion, absence of a solid credit risk management model exacerbates supervision of credit risk management of the Lithuanian banking sector. If the Lithuanian Central Bank would formulate and monitor a solid credit risk management system it would be possible to protect the whole banking sector from possible economic and financial shocks. Strict restrictions and supervision of loaning would raise stability of commercial banks in loaning. Solid calculation and interpretation of credit risk measures should be supervised by an institution, e.g. the Lithuanian Central Bank.

### Analysis of credit risk and factors that influence the Lithuanian banking system

The commercial banks of Lithuania have the right to decide individually when and how much they value their loan losses. Such measures like inactive part of loans or losses because of devaluated bank loans (also known as loss provisions) comparing with the whole portfolio of loans are used to describe the quality of the whole portfolio. In Lithuania inactive loans are overdue loans more than 60 days. The principal of creating loss provisions is based on the financial state of the debtor and his ability to repay. Loss provisions are the term of the risk the loan portfolio faces and real losses it suffers (Lakštutienė, Breikerytė, Rumšaitė, 2009). Loss is fixed when the debtor is overdue more than 90 days. The dynamics of loss provisions and the loans portfolio for the years 2008-2011 in Lithuania is presented in Fig. 2.

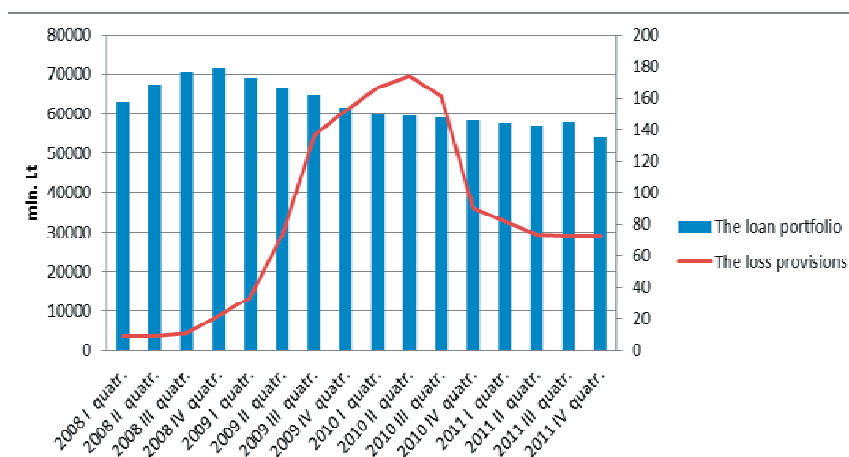


Fig. 2. Changes in the value of the loans portfolio and loss provisions for the years 2008-2011

Source: compiled by the authors according data of the LCB.

As it is seen in Fig. 2, loss provisions had significantly increased in the year 2009. This increase could be computed as a consequence of the financial crisis for the banking sector. In the year 2008 financial crisis had a huge importance for the most sen-

sitive activity of banking – loaning, when most of the debtors were not able to meet their obligations on time. Such expansion of loss provisions was accepted as a signal of danger by banks. The policy was tightened, interest rates increased. Because of these

changes the supply of loans decreased. In the year 2009 the economic activity decreased: prices of the real estate, salaries decreased, business companies went bankrupt, unemployment rate increased. Those factors together with a conservative evaluation of the banks of loaning determined a significant degradation of the quality of the loan portfolio. In the year 2010 signs of economic recovery in Lithuania show a tendency of the quality of the loan portfolio. In 2010

the state of the quality of the loan portfolio did not decline rapidly comparing with the situation in 2009. It is seen from stabilizing measures of the quality of the loan portfolio. In the year 2011 the quality of the loan portfolio improved; the banks evaluated their debtors as less risky and because of that loss provisions decreased.

Inactive distribution of loans compared to the whole loan portfolio is presented in Fig. 3.

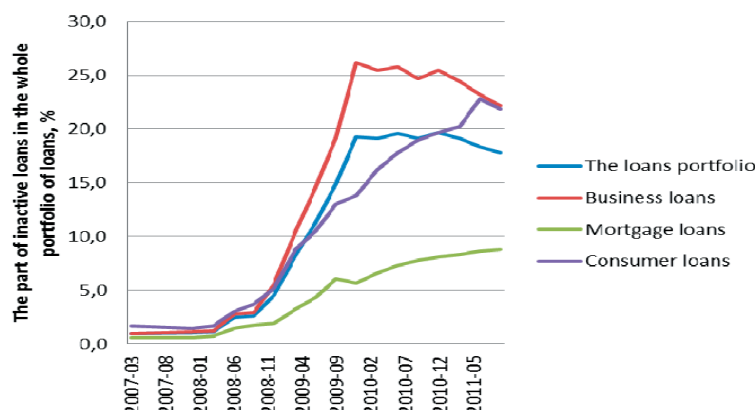


Fig. 3. Part of inactive loans in the whole loan portfolio, %, year 2008-2011

Source: compiled by the authors according data of the LCB.

It is seen that part of inactive loans increased all time until the year 2011. The biggest part of inactive loans was composed of business clients. The conclusions could be that financial crisis had a huge impact on the loaning activity of the Lithuanian banking sector. The value of loans decreased, loss provision became negative and the share of inactive loans made up a significant part in the loan portfolio.

For the purpose of evaluating the probability of default separately in businesses mortgages and consumer credits, it is important to analyze macro-

economic measures of the country that could have the biggest influence on changes in the quality of the loan portfolio. Evaluation of macroeconomic factors that could have influence on changes in risk of the banks is based on the model of M. A. Segoviano Barurto and P. Padilla (2006). For evaluation of the reserves of the Lithuanian commercial banks to cover possible losses of credit risk 11 macroeconomic factors were identified. Computed correlation coefficients are presented in Table 2.

Table 2

### Correlation coefficients of the macroeconomic factor and inactive loans

	Dependent indicators					
	Business loans		Mortgage loans		Consumer loans	
	Inactive	Whole	Inactive	Whole	Inactive	Whole
<b>GDP</b>	-0.299	0.068	0.094	0.048	-0.185	0.103
<b>Household consumption</b>	<b>-0.330</b>	0.063	-0.068	0.040	-0.276	0.057
<b>Unemployment rate</b>	<b>0.565</b>	-0.180	0.234	-0.040	<b>0.441</b>	-0.102
<b>Prices of the real estate</b>	<b>-0.857</b>	<b>0.449</b>	-0.202	0.174	<b>-0.439</b>	0.232
<b>Average salary</b>	<b>-0.319</b>	<b>0.727</b>	<b>-0.392</b>	<b>0.758</b>	<b>-0.497</b>	<b>0.706</b>
<b>Amount of loans</b>	-0.093	0.014	-0.237	0.017	0.163	0.002
<b>Interest rates</b>	-0.143	0.212	<b>-0.315</b>	0.170	<b>-0.346</b>	0.200
<b>Export</b>	-0.285	0.004	0.166	-0.138	-0.164	0.011
<b>Import</b>	<b>-0.354</b>	-0.086	0.045	-0.294	<b>-0.334</b>	-0.144
<b>Inflation</b>	<b>-0.532</b>	<b>0.503</b>	-0.013	<b>0.332</b>	<b>-0.544</b>	<b>0.403</b>
<b>FDI</b>	-0.246	-0.283	0.207	<b>-0.346</b>	-0.274	-0.243

Source: compiled by the authors.

According to the data in Table 2, the main macroeconomic indicators that have the biggest influence on changes in the loan portfolio could be identified. Significant indicators are those the value of which is more than 0.3. The results allow draw conclusions that changes in average salary had the biggest influence on changes in inactive loans. Also changes in unemployment, prices of the real estate, interest rates and inflation should be taken into account. For further stress testing research based on CoPoD and CIMDO methods should be made and then the most significant factors could be used to create scenarios of credit risk management. These scenarios could help commercial banks to choose economic amounts of capital to rationally seek to avoid losses.

## Conclusions

It is important to evaluate risk of a particular loan or risk of the whole portfolio, e.g. concentration of loans, correlation of the debtor's risk. There are a variety of credit risk evaluation models.

Earlier some models according to two types of statistical methods: discriminant analysis and logistic regression were used. Later decision trees and other methods such as an artificial neural network model for credit risk management, etc. were started to be used. A variety of different risk management models, tools and methods exist. The most common models: the probability of default, credit position and portfolio loss models, stress testing, etc. are grouped and described in the paper.

This research on the Lithuanian banking sector takes into account risk factors and are use the models of M. Sorge (2004), M. A. Segoviano Basurto, P. Padilla (2007), etc. Four steps and the final decision explains which scenario should be used managing bank reserves. However, no solid policy for credit risk management exists. Absence of a solid credit risk management model exacerbates supervision of credit risk management of the Lithuanian banking sector and allows choose indicators for banks themselves. What is acceptable for one bank may be viewed as risk for another. Different interpretations create uncertainty and could have negative influence either on a particular commercial bank or on the whole financial sector. If the Lithuanian Central Bank tightened loaning and concentrated on establishing a solid policy for credit risk management, that would stimulate all commercial banks interpret the origin of possible

risks and prevent possibility of default.

The financial crisis of 2008 had a negative impact because the quality of the whole loan portfolio decreased. Changes in average salary, unemployment rate, prices of the real estate and inflation had the biggest impact.

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## Komercinių bankų kredito rizikos valdymo modeliai: jų svarba bankų veiklai

Santrauka

Šiame straipsnyje pristatoma kredito rizikos valdymo modelių specifika ir tipai. Kredito rizika yra viena svarbiausių rizikų, su kuriomis savo veikloje susiduria komerciniai bankai. Todėl svarbu teisingai pasirinkti riziką ribojančias priemones ir siekti sumažinti šią riziką iki minimalaus lygio. Šiame straipsnyje pristatomos kredito rizikos valdymo teorijos, pagrindinės priemonės ir modeliai, naudojami Lietuvos bankiniame sektoriuje.

Viena reikšmingiausių rizikų komerciniams bankams – kredito rizika. Bazelio bankų priežiūros komitetas yra nurodęs, kad daugiausia problemų kredito įstaigoms kelia per daug liberalios kreditavimo sąlygos, prastas paskolų portfelio rizikos valdymas, nepakankamas besikeičiančios ekonominės ar kitokios aplinkos vertinimas (BCBS, 2000). David O. Bleim (2001) teigimu, dauguma sisteminių bankų krizių kyla dėl per didelio blogų paskolų portfelio. Kyla natūralus klausimas, kaip būtų galima sušvelninti kredito rizikos keliamą grėsmę ne tik pačiam paskolų portfeliui, bet ir visam bankiniam sektoriui. Mokslinėje literatūroje pateikiama modelių, metodų ir priemonių, naudojamų valdant kredito riziką, įvairovė. Šiame straipsnyje susisteminti ir pateikiami labiausiai paplitę, paprasčiausiai pritaikomi ir dažniausia naudojami kredito rizikos modeliai, išskiriant pagrindines jų savybes. Atliekant tyrimą, naudoti šie metodai: mokslinių šaltinių analizė, lyginimas, sisteminimas, grupavimas, indukcinis ir dedukcinis metodai, analogijų ieškojimas, esminių grandžių išskyrimas.

Straipsnyje pateikiama susisteminta kredito rizikos valdymo modelių samprata ir pagrindiniai jos bruožai. Pateikiamas testavimo nepalankiomis sąlygomis modelis ir nusakoma pagrindinė Lietuvos bankinio sektoriaus kredito rizikos valdymo problema – vieningos sistemos nebuvimas. Siekiant, kad kredito rizika būtų valdoma veiksmingai, reikia įvertinti ne tik tam tikros paskolos, bet ir viso paskolų portfelio riziką, pavyzdžiui, paskolos koncentraciją, skolininkų rizikos koreliaciją.

Tam naudojami kredito rizikos vertinimo modeliai. Juos taikant, tenka pasikliauti indukciniu metodu – iš dalies spręsti apie visumą. Iš pradžių kredito rizikai apskaičiuoti buvo taikomi du metodai: diskriminantinė analizė ir logistinė regresija. Vėliau pradėta naudoti ir kitus metodus: sprendimų medžius, dirbtinius nervų tinklus ir t. t. Mokslinėje literatūroje pateikiama daug įvairių rizikos valdymo modelių, priemonių ir metodų. Straipsnyje sugrupuoti užsienio šalių mokslininkų aprašyti modeliai ir suskirstyti į atitinkamas grupes: įsipareigojimų nevykdymo modeliai (aktuariniai, pasirinkimo sandorio, vertinimo balais, kredito maržos), kredito pozicijos modeliai (kredito ekvivalento pozicijos, grąžinimo lygio) ir portfelio nuostolio modeliai (rinkos vertės, įsipareigojimų nevykdymo). Lietuvos bankinio sektoriaus kredito rizikos tyrimai atliekami pagal modelius, naudojantis M. Sorge (2004), M. A. Segoviano Basurto, P. Padilla (2007) ir kitų mokslininkų tyrimų pavyzdžiais. Šie tyrimai apima keturis etapus, kurie lemia, kokį scenarijų naudoti prognozuojant bankų rezervus. Tačiau vieningos kredito rizikos valdymo politikos Lietuvos bankiniame sektoriuje nėra. Tai pasunkina ne tik pačių komercinių bankų kredito rizikos valdymą, bet ir palieka pačioms finansų institucijoms nusistatyti indikatorius ir rodiklius, į kuriuos reikėtų atsižvelgti formuojant kreditavimo politiką. Kas vienam bankui priimtina, kitame gali būti traktuojama kaip rizikos atsiradimo šaltinis. Tokios skirtingos interpretacijos sukuria neaiškumą ir gali turėti neigiamų pasekmių ne tik pačiam komerciniam bankui, bet ir visam finansų sektoriui. Jei Lietuvos Centrinis bankas imtųsi griežtesnės ir labiau koncentruotos kredito rizikos valdymo politikos sukūrimo, tai paskatintų visus Lietuvoje veikiančius komercinius bankus vienodai interpretuoti galimas rizikos atsiradimą ir užkirsti kelią didesniems nuostoliams.

**Pagrindiniai žodžiai:** kredito rizika, kredito rizikos valdymas, komerciniai bankai, centrinis bankas, kredito rizikos valdymo modeliai.

The article has been reviewed.

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