

Credit Risk Assessment for Financial Institutions Activity

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Abstract The authors have presented analysis fundamentals and credit risk assessment in international practice based on statistical data of Ukrainian enterprises, such as financial companies and credit unions. The authors have been proposed a technique of assessments of the following indicators that have a significant impact (provided by the author) to assess the credit and financial institution's activity. To solve this problem the authors offer a geometric interpretation to determine the aggregation vector as a level of credit risk, whereas we must consider all the indicators. Because their quantity of these indicators is three, then they are convenient to interpret in the 3D execution.

Keywords: financial stability, financial risk, mathematical methods, financial institutions, risk management

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1. Introduction

The effectiveness of financial resource redistribution in the country depends on the financial intermediary's organization in the financial market. We should find a new ways to increase the investment activity in conditions of reducing investment flows, decreasing real economy sector landings by the banks. The current investment climate in Ukraine cannot be considered as favorable for both domestic and foreign investors because of a number of reasons. In this regard, the question of non-bank credit institutions role increasing in the domestic economy should be paying attention. However, for their activity success it is necessary to properly evaluate the financial institutions lending risks. There are the financial institution's activity always faced with various risk types. The risk management process in non-banking financial institutions is seen as a management key direction [22]. The risk in financial business often associated primarily with financial institution's losses that arise in the case of uncertainty about the event implementation in the future. To minimize the financial institution risks should be organized the main activities varieties identification and evaluation, the search of effective control and monitoring methods, and the appropriate systems management establishment.

There are many specialized methods of assessing of financial institution's activity credit risk, the most common of which are: statistical method, analysis of the feasibility costs method, expert estimate method, the analytical method and using counterpart's method.

An example of statistical methods in practice using is the rating industry financial institution's activity risk, the

client risk assessment [21], competitive risk calculation. This method makes it possible to analyze and evaluate the scenarios for the financial institution's activity specific type implementing. Thus, in recent years has become widespread method so-called "statistical test method" - "Monte Carlo" method. There is in the quantitative financial institution's credit risk widely used indicators of the average expected value and standard deviation in investment finance as a criterion. The statistical method of the financial institution's activity credit risk determining used in the system Perth, to calculate the each job duration expectancy and the whole project.

One more method - the cost feasibility analysis method - based on the fact that the cost of each financial institution's business line, as well as some of the elements has varying degree of risk. In other words, the risk of various activities of one and the same set of financial risk on its individual cost elements in the same direction of the financial institution activity.

2. Literature Review

Since 1960's a significant volume of the publications and manuscripts has been published. Beaver [17], who proved that some indicators could show some differences between failed and non-failed enterprises with univariate analysis, and Altman [18], who proposed the use of linear multiple discriminant analysis (LMDA), have published the first papers. Later publications include many extensions and additions to these and some another methodologies and techniques, but they were often criticized because limit assumptions in multiple discriminant analysis models' were frequently violated.

The main goal of one from those papers by [16] is modeling credit risk of non-financial businesses entities by assessing the rating migration probabilities and predicting the probability of default over one year horizon based on corporate financial accounts. The author's research provides a number of new important insights. Ratings migration matrices are symmetrical in every observed period, which implies that default state is not final terminal state.

The authors have found a high degree of rating stability, with the exception of some volatility generated by firms in the middle of the ratings scale. In the period of lower economic growth, probabilities of transition between different risk's categories are lower than in the period of higher economic growth. Probabilities of default are relatively stable across enterprises operating in different economic activities. After considering a wide range of potential predictors of default, multivariate logistic regression results reveal that the most important are the ratio of shareholders' equity to total assets and the ratio of EBIT to total liabilities, both negatively related to the probability of default. In addition, higher liquidity, profitability and sales as well as construction and real estate sector affiliation all decrease the companies' probability of default in the following year. The model correctly classifies relatively reasonable percentage of companies in the sample (74% of all the companies, 71% of defaulted and 75% of non-defaulted companies) when the threshold is set in such a way to maximize the sum of correctly predicted proportions for both defaulted and non-defaulted companies.

The paper [19] applies a classifier, hybridizing rough set approach and improved support vector machine (SVM) using genetic optimization algorithm (GA), to the study of credit risk assessment in commercial banks. The authors could get reduced information table, which implies that the number of evaluation criteria such as financial ratios and qualitative variables is reduced with no information loss through rough set approach. Then, this reduced information table is used to develop classification rules and train SVM. Especially, in order to improve the assessment accuracy, GA is applied to optimize the parameters of SVM classifier. The rationale of our hybrid system is using rules developed by rough sets for an object that matches any of the rules and SVM for one that does not match any of them. The effectiveness of their methodology was verified by experiments comparing traditional discriminant analysis model, BP neural networks (BPN) and standard SVM with their approach.

Risk assessment of financial intermediaries is an area of renewed interest due to the financial crises of the 1980's and 90's. An accurate estimation of risk, and its use in corporate or global financial risk models, could be translated into a more efficient use of resources. One important ingredient to accomplish this goal is to find accurate predictors of individual risk in the credit portfolios of institutions. In this context the authors [20] make a comparative analysis of different statistical and machine learning modeling methods of classification on a mortgage loan data set with the motivation to understand their limitations and potential. They introduced a specific modeling methodology based on the study of error curves. Using state-of-the-art modeling techniques, they built more than 9,000 models as part of the study. The results

show that CART decision-tree models provide the best estimation for default with an average 8.31% error rate for a training sample of 2,000 records. As a result of the error curve analysis for this model, the authors concluded that if more data were available, approximately 22,000 records, a potential 7.32% error rate could be achieved. Neural Networks provided the second best results with an average error of 11.00%. The K-Nearest Neighbor algorithm had an average error rate of 14.95%. These results outperformed the standard Probit algorithm, which attained an average error rate of 15.13%. Finally, the authors have discussed the possibilities to use this type of accurate predictive model as ingredients of institutional and global risk models.

With the help of expert assessments methods effectively solved so important for risk analysis tasks as identifying the sources and causes of risk, different risk identification, identifying ways to reduce risk, the scenarios in the case of risk prediction implementation, prognostication the competitors' actions and others. Two heuristic methods belong widely known methods used in international practice, BERI and Swiss Banking Corporation method. They are global in their nature, and on their basis, we can conclude of the whole economy riskiness degree, but not specific financial institution.

One more method of quantitative risk assessment - analytical method - is a kind of statistical evaluation principles combination and expert analysis. Authors V. Lukyanova and TV Chef in their book "General assessment procedures and modeling risk" delivering the most precise definition of this method, claiming that "the analytic risk assessment method" - a system of statistical estimates based on preliminary expert selection key parameters for subsequent analysis of these impact factors" [1].

The next method - a counterpart's method - usually used in the case, when other methods of risk assessment are unacceptable. Using this method is most useful when you need to identify the risk degree of any financial institution activity innovative trend provided no basis for comparison, but this method allows for only one activity direction - innovation.

3. Legal Fundamentals

The National Bank has identified a system for assessing each risk of category in accordance with the Guidelines for the examination of banks 'Risk assessment system" [2]. This assessment system provides banking risks consistent (a key factor, which today is not entirely objective, and that does not include the dynamic changes of the financial institution's state) way to measure risk and to determine which supervisory procedures be taken. For nine risk categories [3] - credit risk, liquidity risk, changes interest rate risk, market risk, currency risk, reputation risk, legal and strategic risk, operational and technological risk - observers estimate the amount of risk, quality risk management, the cumulative risk and risk direction (Table 1).

However, for ease of analysis, the National Bank identifies and evaluates these risks separately, so for the effective use of risk assessment the observers should include the current financial institution's state, as factors that may denote increased risks. In general, it can confirm

that such risk assessment system does not give a clear idea of numerical parameters of money losses from banking risks for financial institutions, and therefore considered by us as inefficient and need of improvement in part of the identification mechanism, analysis and assessment of certain risk types, including financial institutions credit risk assessment [4].

Basic approaches to the banking risks assessment and management shown in the basic Basel Committee on

Banking Supervision recommendations. Besides, the question of the banking sector stability paying much attention by the International Monetary Fund and the World Bank. Basic methodological Ukrainian banking practices to assess and manage the risk approaches contained in the Guidelines for the banks examination "Risk assessment system" [2] and the guidelines for managing risk in the Ukrainian banks organization and operation [5], made by the NBU.

Table 1. Factors of each risk category estimation in accordance to the guidelines for the banks surveillance 'risk assessment system' that defined by the National Bank of Ukraine

Risk type	Factors
Credit risk	<ul style="list-style-type: none"> - the existence of adequate, effective, proven to the internal regulations performers (regulations, procedures, etc.) of credit risk management, approved by the bank relevant authorities, based on the corporate management principles and appropriate practices implementation of its requirements; - the portfolios compose (credit, investment, etc.) and the concentration existence.
Liquidity risk	<ul style="list-style-type: none"> - the existence of adequate, effective, proven to the internal regulations performers (regulations, procedures, etc.) of credit risk management, approved by the bank relevant authorities, based on the corporate management principles and appropriate practices implementation of its requirements; - the assets balance quantity and their distribution by the liquidity degree on the liabilities structure; - the amount, structure and liabilities diversity level; - borrowed funds to a chosen bank weighted average cost in relation to its comparative banks group; - net funding gaps focus on short-term gaps, including: projected funding requirements; ability to cover a potential financing gap at reasonable interest rates by additional resources attraction; the financial market liquidity, where the funds can be attractive [23]; - the composition of the balance and off-balance portfolios, including: the funds outflow and inflow; - liquidity and the existence of collateral agreements, which can be broken prematurely (e.g., deposit agreements, etc.); - secondary market liquidity where you can get the refinancing; - the deterioration of the bank's reputation on the market, that revealed through credit ratings decreasing and interest rates increasing during the fundraising by the bank; - official or unofficial conclusions of rating services and analysts about the institution, including current ratings and ratings trend (publications in mass media); - the availability of an adequate plan in case of crisis situation; - the existence of timely, accurate and informative management information; - the qualification level of management and staff; - the availability of appropriate control mechanisms for the information accuracy monitoring of relevant accounting treatment and regulations or law compliance.
Interest rate risk change	<ul style="list-style-type: none"> - the existence of adequate, effective, proven to the internal regulations performers (regulations, procedures, etc.) of credit risk management, approved by the bank relevant authorities, based on the corporate management principles and appropriate practices implementation of its requirements; - the value of net interest margin dynamic stability and the adequacy compared with its comparison bank groups; - the interest rate risk component and total level, including the resources value changing risk, basis risk, yield curve risk and risk associated with the choice right (option) and income and capital concerning; - how adequately the bank estimate the interest rate risk both in the short and long term; - the vulnerability of earnings and capital in the case of significant interest rate changes conditions, such as the gradual shift rates and the yield curve shape changing; - the different products nature risk, i.e. their quantity and sensitivity level to the interest rate changes; - the prolonged use relative quantity and prospects of cheap and stable funding sources; - the availability of timely, accurate and informative management information for interest rate risk monitoring; - the bank practice existence of periodic force inspection and estimates validity and valuation risk model; - whether developed independent measurement process or not and analysis connecting with the risk of interest rate changes in all significant activities with the different scenarios using; - whether the bank has enough experience or not and how adequately it responds on market condition changes; - whether the bank has sufficient access to the market for flexible risk level adjustment or not; - the qualification level of management and staff; - the existence of adequate control mechanisms for the information accuracy monitoring, the appropriate accounting treatment and internal regulations compliance, the regulations and laws.
Market risk	<ul style="list-style-type: none"> - the existence of adequate, effective, proven to the internal regulations performers (regulations, procedures, etc.) of credit risk management, approved by the bank relevant authorities, based on the corporate management principles and appropriate practices implementation of its requirements; - market risk Sources, including price changes on the interest rate instruments, commodities and equity securities, as well as the exchange rate dynamics; - the size, duration and complexity of the positions; - market risk components and various product price sensitivities, including off-balance sheet arrangements (such as swap, forward and option contracts); - stability of real cash flows from trading operations; - value and capital under risk dynamic revenue; - bank vulnerability by the interest rate changes probabilistic scenarios and market shocks (stress testing); - the hedge or risk positions closing possibility that is always available, including the professional management ability to make hedging transactions and bank access to their respective markets; - the open positions amount compared with the real cash earnings expecting (i.e. risk versus reward); - the availability of timely, accurate and informative management information; - the qualification level of management and staff; - the existence of adequate control mechanisms for the information accuracy monitoring, the appropriate accounting treatment and internal regulations compliance, the regulations and laws.
Currency risk	<ul style="list-style-type: none"> - the existence of adequate, effective, proven to the internal regulations performers (regulations, procedures, etc.) of credit risk management, approved by the bank relevant authorities, based on the corporate management principles and appropriate practices

	<ul style="list-style-type: none"> implementation of its requirements; - the amount of balance and off balance items which are subject to reassessment due to the currency exchange and term exchange rate changes; - the structure of balance and off-balance items for the following factors: currency and products; - existence or expected period of subsequent position maintenance; - the amount and period of inconsistent cash flow; - the size of currency positions quantity trading of which are limited; - potential capital loss amount connected with the currency positions transfer into their Hryvnia equivalent in the case of exchange rate changes, considering last trends and forecasts; - the availability of timely, accurate and informative management information; - the qualification level of management and staff; - the existence of adequate control mechanisms for the information accuracy monitoring, the appropriate accounting treatment and internal regulations compliance, the regulations and laws.
Operational and technological risk	<ul style="list-style-type: none"> - the existence of adequate, effective, proven to the internal regulations performers (regulations, procedures, etc.) of credit risk management, approved by the bank relevant authorities, based on the corporate management principles and appropriate practices implementation of its requirements; - the number and complexity of operation processing compared with the development level and operational capacity and control systems, including the preliminary results of these systems, their current state and further improvement prospects; - the probability of technological and operational failures, overrun of staff authority, shortcomings in the preliminary operations analysis during the decision-making and the monitoring absence (including temporary) or logging operations with clients or counterparties; - the bank availability and compliance of technological operations cards; - the availability, quantity, nature and causes of administrative procedures and accounting controls violations; - the potential financial loss due to the performer or fraud error, low operating bank competitiveness, information systems inadequate, incomplete information about the counterparty or transaction, operational and technology failures; - the history and nature of customer complaints and appeals to the bank due to operating system's drawbacks and the bank reaction to them; - the amount and adequacy of the banking software and its accompanying and other services control which are carried out with the third party involved (outsourcing); - the information technology strategy adequateness, the strategy must conform the current and anticipated requirements in relation to the bank and include the structure of technological means, telecommunication and software, data networking, and information database's integrity; - for the process availability: determine the information needs for effective bank management; determine the information systems architecture for transactions processing and products and services providing; information integrity and preservation (e.g. creating, processing, storage and data); - the qualifications and skills level of managers and staff; - the adequate control mechanism's existence to the information accuracy monitoring, the accounting treatment appropriate and regulations or law compliance.

Therefore, we turn to the analysis fundamentals and credit risk assessment in international practice. Basel Committee on Banking Supervision defines credit risk as "probability of default by the borrower or counterpart of its obligations under the specified conditions" [6]. Capital adequacy requirements of the banking institution for credit risk covering are different and depend on whether the Bank is exposed the risk within its commercial activities or as a part of its banking activities (which is spread on the requirement to capital adequacy set out in Basel I and Basel II). Capital adequacy requirements for credit risk covering on bank transactions that include in the so-called banking book, the Basel Committee requirements range

from 0 to 8 units from the outstanding amount of 100 units. The capital requirement calculation based on the counterparty risk ratio and (or) instrument provides that certainly there is not required risk by the government, and therefore capital for its coverage is not required (weight - 0%), to cover the risks of Organization for economic cooperation and development country member banks should be 1.6 units of capital per 100 unit loans (weight - 20% in the Ukrainian banking practice - 50%), and to cover the borrower risks of - individuals and businesses need 8 units of capital on 100 units loan (weight - 100%). Some types of instruments can be assigned less risk weight (e.g. guarantees and mortgage loans) [7].

Table 2. Rate risk determination (the credit financial institutions risk level, LCR) depending on the requirements category, debtor category, and external rating

Depending on the ratio of a particular asset class and external rating, %							
Long-term rating categories (from - to)	AAA AA-	A+ A-	BBB+ BBB-	BB+ BB-	B+ B-	Less B-	Without rating
Central government agencies	0	20	50	100		150	100
Banks: variant 1	20	50		100		150	100
Variant II: IICII more than 3m	20	50		100		150	50
Variant II: IICII less than 3m		20		50		150	20
Corporation	20	50	100		150		100
Short-term rating categories	A1/P1		A2/P2		A3/P3		інші
All debtors	20		50		100		150
Depending on the ratio of a particular asset class, but no ranking							
Type of asset	rate risk (the risk level), %						
Regulatory retail portfolio	75						
Mortgage loans: a) residential real estate	35						
b) commercial realty	100						
Capital expenditure: a) non-banks institution	150						
b) bank institutions	100						
Claims overdue more than 90 days	50-150						
Other assets, that do not depend on non-trading portfolio	100						

Recall that, according to the new Basel Committee on Banking Supervision on bank institution capital adequacy requirements, the minimum capital for credit risk covering can be determined with the help of two methods: the standardized approach and method, based on internal ratings, moreover the latest has two versions - stock and progressive approach [8].

The risk ratio (risk level) can be determined depending on the requirements category, debtor category, and external rating and take values that hover in the Table 2 [9].

These methods take into account input indicators alone without their integrated assessment and mutual influence, i.e. in this case, the overall level of risk will be determined based on a direct linear relationship that does not reply current state of financial institution activities.

The conclusion the authors could form based on statistical analysis of the Ukrainian financial entities that

also does not confirm this practice can be exist in the while world.

The authors have been proposed technique assessments of the following indicators that have a significant impact (provided by the authors) to assess the credit financial institution's activity risk:

1. The territorial distribution (normalized weighted value in total quantity, Territorial Distribution, TD_j) credit unions (Figure 1) and financial companies (Figure 2) with guidance cluster number (based on cluster analysis). Since the normalized weighted value is determined by the number of clusters, then to it, with the help of the logic theory rules, apply the rule of "the smaller the cluster number - the better the normalized weighted value," which will determine the operation type of taking into account normalized weight value - inverse relationship, $1 / TD_j$.

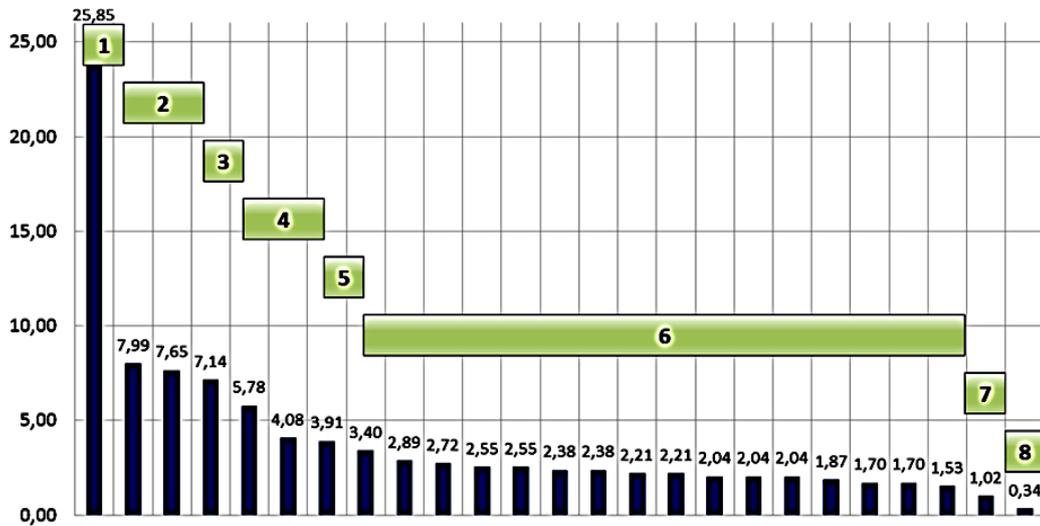


Figure 1. Territorial distribution of the credit unions with a volume of TD_j (based on author's cluster analysis [11])

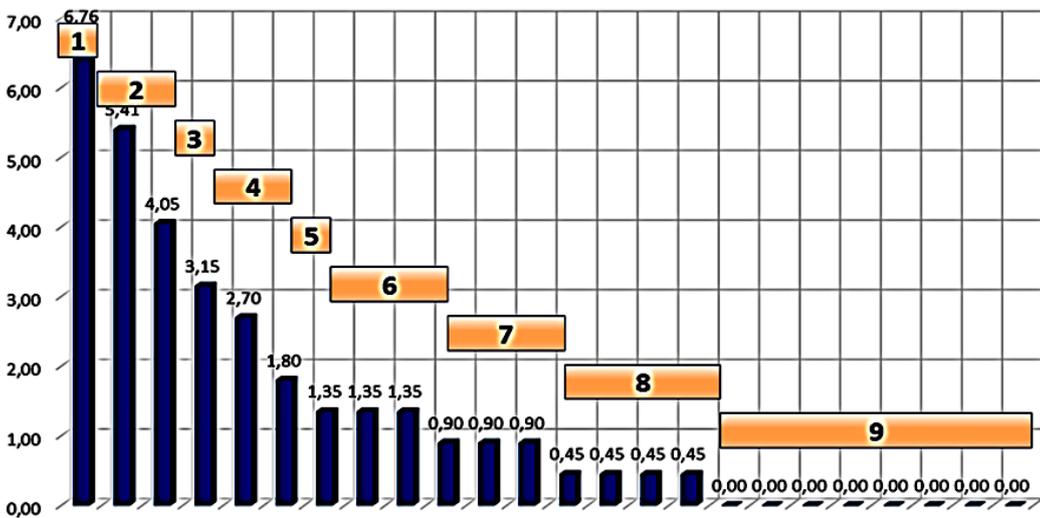


Figure 2. Territorial distribution of the financial companies with a volume of TD_j (based on author's cluster analysis [11])

2. Interdependence and interrelation assessment of financial companies and credit unions on financial services market on their own authoring method on the density distribution of financial companies and credit unions basis (Consistence of the Financial Institutions, CFI_k , Figure 3) the defined limits between clusters at the average integral indicator based on the author's own

calculating model of the debtor integral index - businesses (obtained on the multivariate discriminant analysis basis). Since the distribution density of financial companies and credit unions is determined by the weighted average integral factor (ratio), then to him, with the help of the logic theory rules, apply the rule "the more the average integral index - the better distribution density of financial

companies and credit unions", which will determine the operation type of the financial companies and credit

unions in financial services market interdependence and interrelation assessment - a direct correlation, CFI_k .

	2	1,2	0,95	0,52	0,1	-0,25	-0,83	-4,2
2009	0	7	1	5	3	3	1	1
2010	0	6	2	4	4	2	1	1
2011	0	9	0	2	6	2	1	0
2012	1	7	0	4	3	5	0	0
2013	1	9	2	3	4	0	0	1
2014	1	8	1	3	3	1	1	1
2015	1	8	1	3	3	1	1	1

Figure 3. Consistence of the financial institutions by years with a volume of CFI_k (based on author's cluster analysis [10])

3. Estimates of the financial companies and credit unions on financial services market interdependence based on the author's own mechanism based on the finance companies and credit unions connectedness weight by the other finance companies and credit unions average number between which is the Z_i term connection among the financial companies and credit unions entire set (Figure 4). Since the financial companies and credit unions interdependence on financial services market estimation is determined by the finance companies connectedness and credit unions weight by the other finance companies and credit unions average number

(coefficient Z_i – is base integral indicator of the financial state of business entity based on multifactor discriminant analysis [2,5,9]), then to him, with the help of the logic theory rules, apply the rule "the more weight finance companies and credit unions connectedness by the other finance companies and credit unions average number - the better the financial companies and credit unions on financial services market interdependence estimation", which will determine the operation type of the financial companies and credit unions in financial services market interdependence - direct relationship, Z_i .

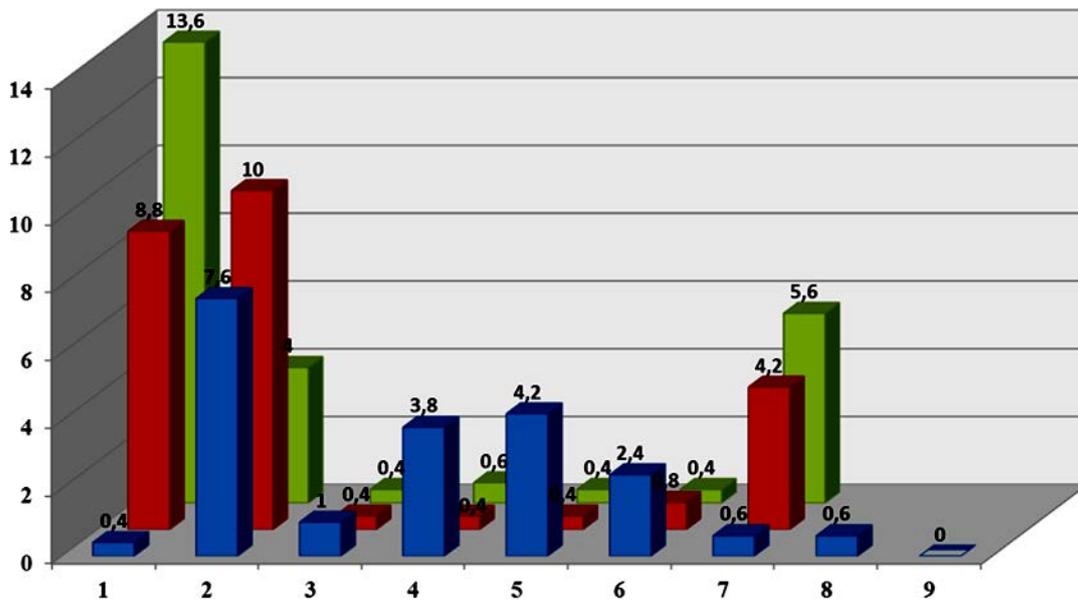


Figure 4. Graphical distribution of the base integral indicator Z_i based on a number of clusters (1-9) : first front line – based on state legislations [2,5,9]; second middle line – for the financial companies; third rearward line – for the credit unions

Thus, the financial institution credit risk assessment depends (as proved by the author) on: spatial distribution (normalized weighted value in total quantity, Territorial Distribution, TD_j) credit unions and finance companies; financial companies and credit unions interdependence and interrelation on financial services market estimation based on the financial companies and credit unions distribution density (Consistence of the Financial Institutions, CFI_k) and the financial companies and credit unions on financial services market interdependence assessment based on the finance companies and credit unions weight connection by the other finance companies

and credit unions average number between which there is a connection in Z_i term.

Thus, there is a need to determine the dependence type of the financial institutions activity loans risk assessment of designated factors (indicators); moreover, this dependence should include these parameters properties at the same time and in the proper direction. To solve this problem the authors offer a geometric interpretation to determine the addiction type, whereas we must at the same time, consider all the indicators, and their quantity number is three, then they are convenient to interpret in three dimensions, as shown in Figure 5.

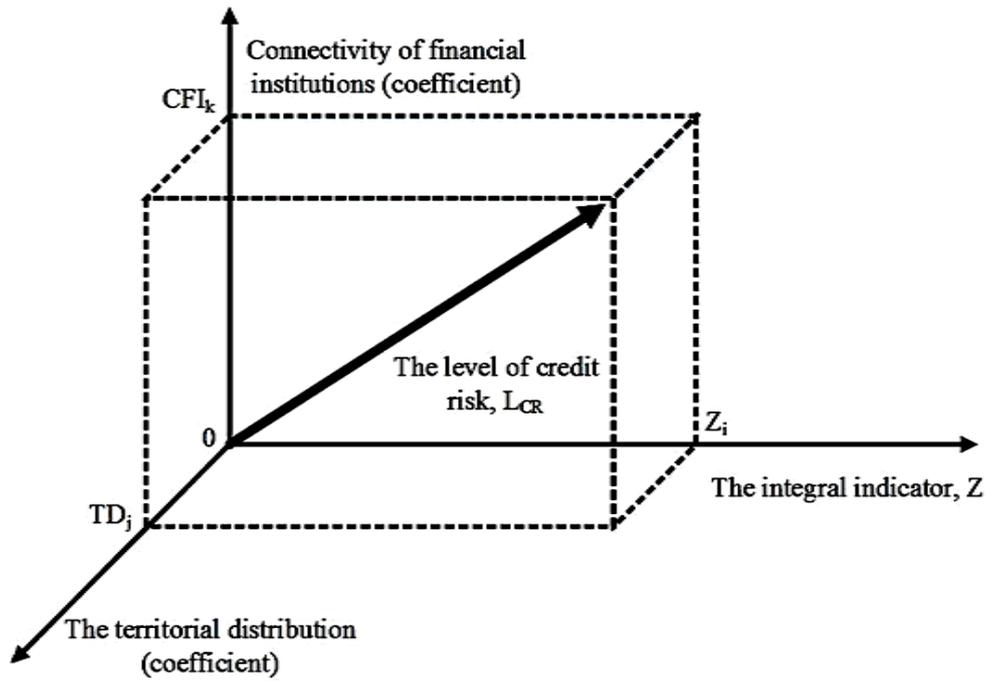


Figure 5. Geometric interpretation in 3D as assessment dependence type of financial institutions loans risk from aforementioned figures (indicators)

Since the market figures (indicators) can take different values, so the result will be shown as an obtained space figure - a parallelogram, where its main diagonal will determine the financial institutions credit risk assessment, so purposed the following formula:

$$L_{CR} = \sqrt{\left(\frac{1}{TD_j}\right)^2 + (CFI_k)^2 + (Z_i)^2}. \quad (1)$$

Since the financial institution’s credit risk assessment is dynamic, i.e. changing through the time depending on changes in the market figures (indicators), so it is transformed into the following formula:

$$L_{CR}^n = \sqrt{\left(\frac{1}{TD_j}\right)^2 + (CFI_k)^2 + (Z_i)^2}, \quad (1)$$

where n is consideration period number.

Calculating of the selected financial institution’s credit risk assessment contained by the authors for all financial institutions (as for credit union and financial companies).

4. Results

Graphic distribution of results was received. They are presented on the Figure 6 - Figure 7. All data were being normalized and reduced to single scale of distribution (in percent of total). Thus, the distributions for these financial institutions in dynamics and after ranking are presented in Figure 6 - Figure 7.

Volume of a set for each kind of financial institutions is 50 entries. In both Figure 6 - Figure 7, a horizontal line of black color is the middle level of loan risk: especially, for financial companies this middle level is equal 11,92, and for credit unions this middle level is equal 1,55. Besides, in Figure 6 – Figure 7, a part of institutions, the loan risk level of which is higher than middle level, has been shown in percent’s from all set of the financial institutions.

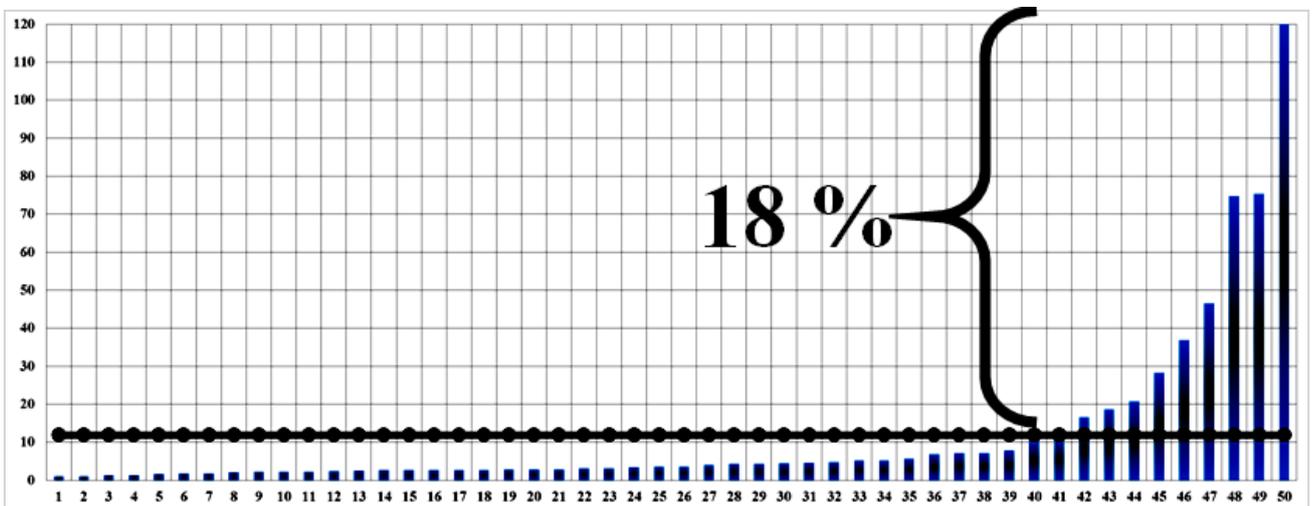


Figure 6. Distribution of loans risk level for a set of financial companies

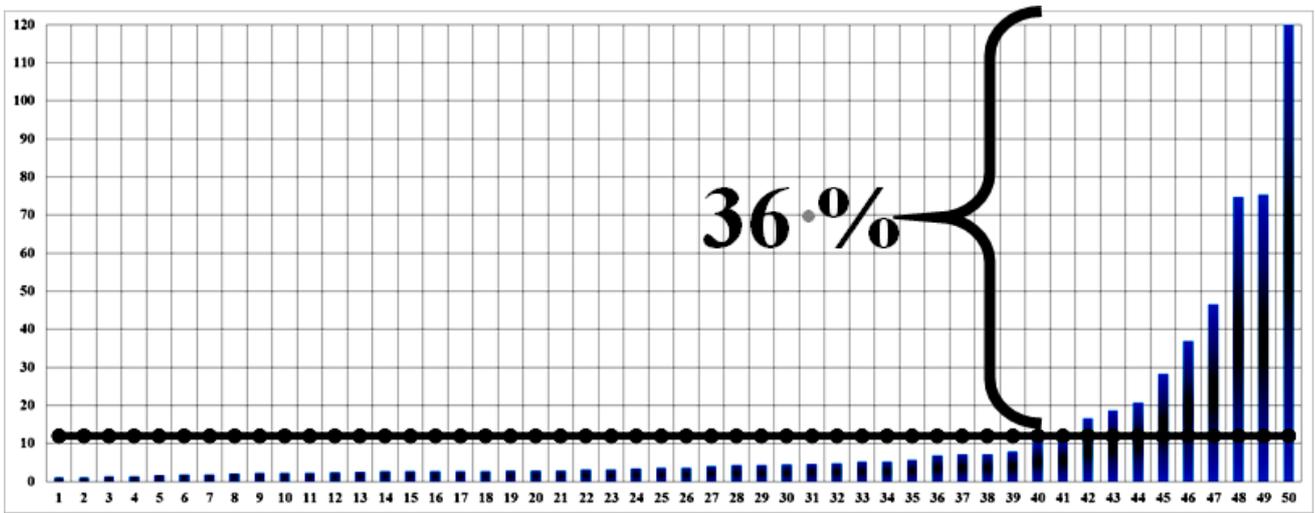


Figure 7. Distribution of loans risk level for a set of credit unions

In addition, for any kind of financial institutions has built or can be built 2D distribution as the counter surfaces, which are shown in Figure 8 - Figure 9. These counter

surfaces (maps) can be used for obtaining the common view of general distribution for a set of any kind of financial institutions for further analysis.

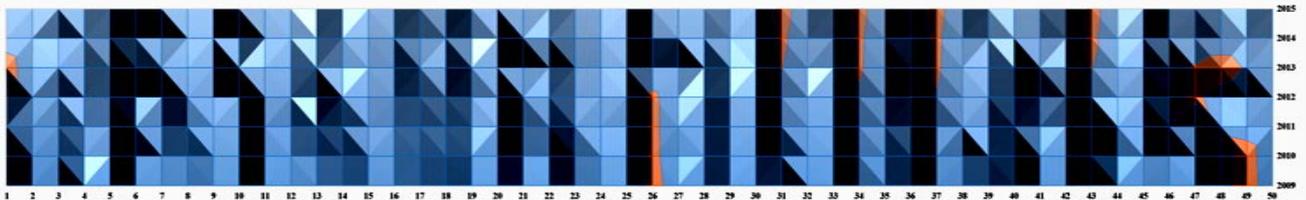


Figure 8. 2D distribution as the counter surfaces for a set of credit unions

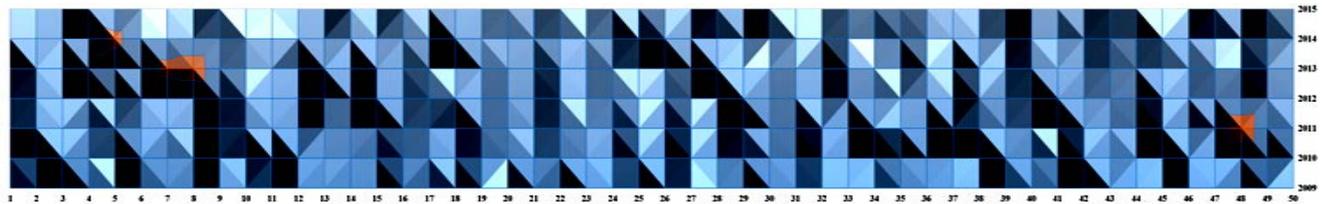


Figure 9. 2D distribution as the counter surfaces for a set of financial companies

5. Conclusions

A precise and fast credit risk assessment and appropriate evaluation model are mandatory for creating and adopting a risk management culture in the financial companies and credit unions in developing a suitable credit risk management environment. Usually credit risk assessment generates from improper policies, procedures and systems within the financial institutions. This manuscript focuses on the weakness of the existing credit risk assessment that entails assessing risk through the current indicators that have a significant impact (it was proved by the author) to assess the credit and financial institution’s activity. The new proposed credit risk assessment and its mathematical model describe a new technique that specifically addresses the geometric interpretation to determine the aggregation vector as a level of credit risk. Based on the proposed credit risk assessment, it is expected that the credit risk analysis policies should: always follow the detailed and formalized credit evaluation or appraisal process, provide risk identification, measurement, monitoring and control,

define target markets, risk acceptance criteria, credit approval authority, credit maintenance procedures and guidelines for portfolio management, be communicated to financial companies and credit unions and clearly spell out roles and responsibilities of units involved in origination of credit risk assessment.

As a result of analysis fundamentals and credit risk assessment in international practice based on statistical data of Ukrainian enterprises were calculated. Due to them next conclusions can be drawn. Firstly, on the basis of the conducted scientific-practical research, the authors are ground directions of perfection of the system of determination of bank risks in Ukraine in direction of introduction of the requirements of international regulative bodies in a bank sphere. Additional researches and new approaches in this area are needed. There are not enough scientific researches in the research area, therefore researches about analysis fundamentals and credit risk assessment are topical in Ukraine. Secondly, the demand of researches about cash flow optimization has some disposition in Ukraine. There is necessity for research and creating new methods and approaches to credit risk assessment, which will be more adapted to the modern

economic conditions of entities development. Thirdly, directions to improve the system of banking risk assessment in Ukraine should be justified more detail.

6. Direction of Further Researches

Due to the analysis fundamentals between research definitions, next directions can be determined. Researched definitions do not have close relations; in this case, these definitions could be helped to create a new aggregated concepts and conceptions. Therefore, demand fluctuations of researches about credit risk analysis and credit risk assessment optimization in the world do not influence to demand fluctuations of researches about this and some adjacent topics in Ukraine. So, the internal economic, political and social events influence of the interest to researchers in the researched area more than foreign economic factors and indicators.

Because of time constraint, only the important indicators of the all-financial institutions categories have been suggested and implemented in this technique, but there is a huge scope of expanding the indicator's range with more important parameters for more credit risk assessment. It is also recommended to incorporate advanced level statistical tools and other analytical indicators and parameters in the future credit risk assessment approach in order to make it responsive to the global trends and changes of the economic and financial environment. The credit risk assessment technique described here is mainly applicable for financial companies and credit unions. It can be recommended that with the help and reference to this technique (or described methods), future risk assessment technique can be prepared which will be applicable for any kind of companies of any size or durations easily and accurately.

Acknowledgement

This research was done in the context of analysis fundamentals and credit risk assessment in international practice based on statistical data of Ukrainian enterprises. It confirms the topicality of researches in the researched area. The directions of further researches are a formation of the technique stages of the credit risk assessment and searching ways of the credit risk assessment optimization for any financial institutions on the state level.

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