Politecnico di Torino

Financial Risk Management in Banks

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Abstract

Banking sector is a subject to a large number of risks. Ability to correctly assess both the consequences and the possibility of onset of risks to resist and prevent risks, as well as to control and carry out operations to eliminate them within the framework of limited financial resources, are key points in the competent planning of business processes in the field of banking. The main purpose of this research is to find possible solutions to the problem of confronting banks with credit risk. In this regard, the main tasks are theoretical consideration of banking risks, study of the causes of credit risk, its prerequisites for the sphere of influence of this risk, as well as the identification of ways to eliminate and minimize the onset of this type of risk.

In this research we discuss in detail the risks that commercial banks face in the course of their activities, and also substantiates the importance of competent management of these risks. Thus, the essence of banking risks is considered, a detailed classification of banking risks proposed by various authors is presented. This research revealed that banking risks are diverse and their occurrence directly determines the scope of a commercial bank.

Financial Risk Management in Banks

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Introduction

Banks are very important and internal part of financial system which provides reproductive process with financial resources. Bank system is intermediary between the owners of temporarily free financial resources and economic entities that need these resources. This means that a feature activity of a banks is working on attraction of funds from clients, which include funding from individuals and legal entities, as well as borrowings in interbank financial markets. This activity is associated with both the possibility of their loss and their increase, eventually, with risks. The risks associated with the financial activities of the organization are allocated to a special group of risks, which are called financial risks. Financial risks play the most significant role in the overall portfolio of entrepreneurial risks of any commercial organization and financial and credit institutions. Increase of influence of financial risks on the financial performance of a bank is connected to the rapid volatility of economic situation and financial market conditions, expansion of the sphere of financial relations of organizations, development and emergence of new financial technologies and tools for companies, and other factors.

Analysis of the post-crisis and COVID-19 conditions indicates the need to improve the system banking risk management systems. Implementation of this task, identified as the core direction of the anti-crisis program in the conditions of economic modernization, pandemic, political crisis is possible only if a comprehensive risk management and regulation system in commercial banks will exist. As practice has shown, in their commercial activities, banks faced a combination of different types of risks, differing in geography and time of occurrence, external and internal factors affecting their level, their classification and methods of assessment and analysis. The lack of generalized experience and comprehensive scientific developments in the field of risk management in banking leads to losses and a decrease in the efficiency of the functioning of commercial banks.

The purpose of this thesis work is to develop theoretical provisions, methodological approaches and practical recommendations for managing and regulating banking risks. To achieve this goal, it was necessary to solve the following tasks:

- determine the economic content of the concept of “banking risks” and their classifications;
- to study risk management by highlighting the inherent characteristic for “bank risk management”;
- make a comparative analysis of the techniques used by the commercial banks to assess credit risk, identifying their strengths and weaknesses;
- describe the role and importance of the credit bureau and the credit policy of a commercial bank in the credit risk management system;
- disclose the content of banking risks, such as credit, market, operational risks, the risk of insolvency (bankruptcy), etc.

1. Theoretical and methodological basis of banking risk management

1.1 Foundations of bank risks

Today, especially under COVID-19 and political crisis conditions, risk occupies a significant place in science and practice. The formation of risk theory is still far from complete. In the economic literature, there are many approaches to the disclosure of the essence of risk, but each of them reflects only one or another side of the disclosed object, focusing only on the disclosure of the essence of the concept of risk or on its functions. In this work, risk analysis carried out through the historical patterns of development of risk theory, distinctive features, functions, laws of its existence.

The emergence of risk as a risk phenomenon can be attributed to the moment of the origin of human being on Earth. Primitive people, like all living beings, foresaw all sorts of danger, avoided risks, but often risked for the sake of life itself. This was one of the first forms of risk management.

The first economic work in which the theory of risk was considered was “The Theory of Interest”. Thus, adherents of the church doctrine that existed in the 12-14th centuries, who were called canonists, trying to justify the existence of interest on a loan, introduce the concept of payment for risk. At the beginning of the 18th century François Quesnay[1], the founder of the physiocratic school, stood the necessity of the existence of risk in economic life. (“Banking risks”, A.A. Kazimagomedov, 2020).

A big push to the further development of the risk theory was given by the classical school, which introduced risk theory into the theory of wages and profits and continued to develop in the theory of interest. A. Smith in his well-known work "The Wealth of Nations" paid much attention to such a question as the content in wages of the premium for the risk that arises from the difficulty of acquiring a particular profession. He writes: "The neglect of risk and exaggerated hope of success in any period of life are not appeared so strongly as at the age when young people choose their profession." (“An Inquiry into the Nature and Causes of the Wealth of Nations”, Adam Smith, 1776).

Next step in this direction was taken by an adherent of the mathematical school J. Schumpeter[2]. While, developing the theory of entrepreneurship, profit and interest, he expresses several interesting thoughts. Firstly, he rejects the idea of the entrepreneur as a bearer of risk. Secondly, the risk premium is not a source of profit for the manufacturer, since he takes measures to eliminate the danger. This approach was the beginning of the formation of risk theory. A. Marshall[3], one of the founders of neoclassical economics, continues the development of risk theory, who rejects utility as a determining factor of choice under

[1] François Quesnay - was a French economist and physician of the Physiocratic school. He is known for publishing the "Tableau économique" (Economic Table) in 1758, which provided the foundations of the ideas of the Physiocrats.
[2] Joseph Schumpeter - was an Austrian-born political economist and one of the most influential economists of the early 20th century.
[3] Alfred Marshall - was an English economist, who was one of the most influential economists of his time. His book, Principles of Economics (1890), was the dominant economic textbook in England for many years. It brought the ideas of supply and demand, marginal utility, and costs of production into a coherent whole.

conditions of risk, thereby introducing risk into utility theory. (“Banking risks”, A.A. Kazimagomedov, 2020).

D. Keynes, in his work "The General Theory of Employment, Interest and Money", for the first time tries to classify the risk according to the objects of research and analysis: "The volume of investment is affected by two types of risk, which are usually confused, but must be distinguished. The first is the entrepreneur's risk or the borrower, arising out of doubt as to whether he will be able to get the expected return he is counting on. If a person invests his own money, then this kind of risk is involved. But where there is a system of borrowing and narrowing money, by which I mean lending against real security or in the good name of the borrower, there is a second kind of risk which we may call the lender's risk.” (“The General Theory of Employment, Interest and Money”, D.M. Keynes, 1936).

Analysis of modern works dedicated to the problems of risk suggests that risk is a complex phenomenon that has many different, sometimes conflicting real components. This is explained by the fact that the risk is based on the probability of market activity of economic entities and the uncertainty of the situation. Production planning, sales forecasting, cash flow, project development and business plans are based only on estimated expected calculations, and not on actual values. Often, instead of the expected profit, a business can bring losses, the amount of which can exceed not only the invested funds, but also the value of all property at the disposal of the enterprise (“Banking risks”, A.A. Kazimagomedov, 2020).

Importance and prospects of this problem were expressed by the famous banker-economist P.A. Korotkov, who writes: "Assessing risks that commercial banks face in their activities, it is not possible to miss one more aspect. We are talking about the risks arising from a sharp change in the existing conditions of commercial activity, "rules of the game" in the economic and financial space. This risk caused by regulations that can be introduced almost overnight. Such a sharp intervention by government agencies can have the most unfortunate consequences for new and not yet sufficiently strong commercial structures. (“Experience and Problems of risk management in Credit Organizations. Money and credit”, P.A. Korotkov, 1997).

V.M. Usoskin in the work "Modern Commercial Bank. Management and Operations" points out the importance of an optimal ratio between profitability and risk, which is one of the main and most difficult problems of bank management. (“Modern Commercial Bank. Management and Operations”, V.M. Usoskin, 1994).

It is obvious that despite the variety of definitions presented, the essence of banking risk is a kind of uncertainty, the danger of an unforeseen circumstance, the possibility of losses or shortfall in income compared to the expected forecasts. Of course, these features are to some extent associated with banking risks, however, they do not express its specifics. Thus, financial and economic activities of financial institutions and commercial enterprise are carried out in conditions of uncertainty. In conditions of uncertainty, there are always many alternatives decision making. Probability of successful implementation (obtaining maximum income with a minimum of losses) depends on internal and external factors affecting the enterprise. These realities fully demonstrate the essence and concept of risk. All this allows to conclude that the risk is associated with overcoming uncertainty in a situation of inevitable

choice, during which it is possible to assess the probability of achieving the desired result, failure and deviation from the goal contained in the chosen alternatives.

Summarizing the above material, we can distinguish the following main characteristics of banking risk:

- risk always accompanies banking activities;
- risk is the uncertainty associated with an event or its consequences that are difficult or impossible to foresee;
- the source of risk is an unexpected change;
- risk is expressed by the probability of obtaining undesirable results, in particular, financial damage (deterioration of the possibilities for obtaining the expected and (or) additional profit) and the occurrence of losses;
- there is a certain interconnection between accepted risk and expected profitability of bank's activities: higher risk is characterized by higher profitability;
- optimal risk return combination is the one that achieves the minimum risk-return ratio or, equivalently, the maximum return-risk ratio;
- banking risks must be qualified according to the main parameters, their level should be determined and a risk management system should be developed in order to minimize losses from the operation carried out by the bank.

Analysis of various interpretations of banking risk allows to formulate the concept as following. Banking risk is a characteristic of banking activity, expressed in the uncertainty of its outcome, with one of three economic results: negative (loss), zero (balance), positive (income). Taking risks, it is necessary to classify them, predict, determine their level, achieve the optimal ratio of profitability and risk, and develop a risk management system in order to minimize them ("Banking risks", A.A. Kazimagomedov, 2020).

1.2 Classification of banking risks and methods for their assessment.

One of the first problems that any bank faces when starts to build a risk management system is optimizing the composition of indicators that characterize risks. It should be noted that during their activities, banks are faced with a combination of different types of risks that differ in place and time of occurrence, a combination of external and internal factors affecting their level, and, consequently, in the way they are analysed and methods of their description. In addition, all types of risks are interrelated and affect the activities of a commercial bank. Changes in one type of risk entail changes in almost all other types. All this ultimately makes it difficult to choose a method for analysing the level of a particular risk and making decision on its optimization leads to an in-depth analysis of many other risk factors. Therefore, the choice of a specific method for analysing their level and selection of optimal factors are very important.

Many authors, by approaching the issue of varieties of banking risks, determine certain basic parameters that form the basis of their classification. Indeed, at the initial stage of banking activity it is almost impossible to immediately establish control over a large number of parameters. Therefore, it is necessary to define a limited number of controllable indicators, but they must be selected in such a way that the bank's management can effectively monitor

the level of risks taken by the bank in the main positions. All the main types of risks are interconnected, and it is often difficult to separate them in practice.

Risk classification should be understood as the distribution of risk into specific groups according to certain characteristics in order to achieve the set goals. Scientifically based risk classification allows you to clearly determine the place of each risk in their overall system. It creates opportunities for the effective application of appropriate methods, risk management techniques. ("Banking risks", A.A. Kazimagomedov, 2020).

According to studies, there is no unified classification of risks in economic theory. This is due to the diversity of manifestations of risk and the stability of the distinction between its various types. At the same time, there is still unanimity in views on the typology of risks. An important role in risk management activity played Coopers & Lybrand research, published in 1996, provided an investigative classification of risks involved in engaging institutional financial intermediaries, including commercial banks, with the involvement of their risks:

- credit and market risks;
- operational and liquidity risks;
- business risk.

("Generally accepted risk principles", Coopers and Lybrand, UK, 1996)

This classification is currently generally accepted in the practice of banking risk management and is taken as a basis by most commercial banks, including the Basel Committee on Banking Supervision of the Bank for International Settlements.

1.3 Banking risk management

In the global economy, the starting point for the development of risk management is 1970s, when in 1976 at the "Jamaica Accords" currency conference the Bretton Woods agreements were cancelled, which was a complete rejection of the gold exchange standard, which to a certain extent regulated the pricing of assets in the global financial market. Since that time, risk management has been intensively developed in the 1990s and turned into a new branch of banking. Increasing role of risk management during this period was facilitated by such factors as the globalization of financial markets, the growth of international competition, the increase in market volatility, growth in the intensity of defaults.

The transition to new standards of risk assessment and banking supervision requires time and financial costs. Based on the readiness of the banking systems, national supervisors should determine when and how they should introduce the next component or set of measures proposed. At the same time, supervisory authorities should assess the current situation in the country's banking sector and global markets in order to be ready to use the risk instruments and principles of supervisory activities proposed by Basel III. Improving the system of regulation of international banking activities in the field of risks consists in tightening the requirements for risk insurance systems for various types of activities of commercial banks and degree of mutual consistency of these systems within an individual bank (Basel Committee standards).

Acceptance of risk is the basis of the banking business. Commercial banks are successful when the risks they take are reasonable, manageable and within their financial capabilities. Any commercial activity is associated with “surprises”, the degree of which depends on the bank's ability to predict the economic situation, calculate the financial payback of the project, choose partners for its activities, quickly respond to market changes and make effective management decisions. However, it is usually impossible to foresee all the “surprises” that accompany banking activities, and therefore there is always a risk of loss or failure to receive the intended profit.

Risk management is the process of their identification and assessment, as well as implementation of a set of measures to reduce the level of risk. Banking risk management system allows to organize effective asset and liability management, reducing the risks inherent in the latter, and increase its competitiveness in the market of banking products. However, no risk management system can eliminate losses 100%. Risk management system is aimed to minimize risks and increase efficiency of a bank. The goal of this system can be: to reduce losses, identify new risks, increase profitability, reduce debt levels, etc. Risk management system should organically fit into the overall development strategy. For example, if a bank is relatively new and needs to find its positions, it pursues a more aggressive policy, which means that the level of risk it takes on can be significantly higher than if the bank pursues a conservative policy. With an aggressive policy of the bank, the limit of losses can be the volume of its own capital, and with a conservative policy, it is rather the profit of the bank.

Another important element of management is establishment of limits on various risks, with the definition of parameters, duration and structure. An important stage in the creation of a risk management system is the organization of control aimed to maintain planned level of risk. After introduction of risk management system, constant monitoring and adaptation of it and all its components to the constantly changing external environment is necessary. A big role in risk reduction is played by division of functions between those who create risk and those who control it. For this purpose, a special department for dealing with risks is being created, whose functions include analysis, assessment, risk control. This is since, for example, credit department of a bank is interested in increasing the volume of lending, and risk department, on the contrary, is interested in strict compliance with lending limits, improving the quality of loans, etc.

Specific areas of banking activities related to risk management are also significant for the bank from the standpoint of the need to have organizational structures in its system that organize, perform and control these actions. In the current work of banks, this task, as a rule, is solved in two ways:

1) risk management functions are included in the staffing of employees of operational departments and committees (deposit, settlement, credit, securities, etc.), as well as bank services (personnel, legal, administrative and economic departments, etc.);
2) divisions are created and included in the organizational structure of the bank, specializing in the management of a complex of elements of the factor or resultant aspects of risks. The status, functions, and place in the hierarchy of these elements of

the organizational structure of banks vary considerably both theoretically (in various schools of banking management) and practically in specific banks. ("Banking risks", A.A. Kazimagomedov, 2020).

In the book Analyzing Banking Risk, Hennie van Greuning and Sonja Brajovic Bratanovic define that effective governance and relationship between bank's management, board, shareholders and stakeholders is the key factors of an effective business in banking sphere. As the conclusion of importance of each payer they made the following table:

Table 1.1 Key Players and their responsibilities

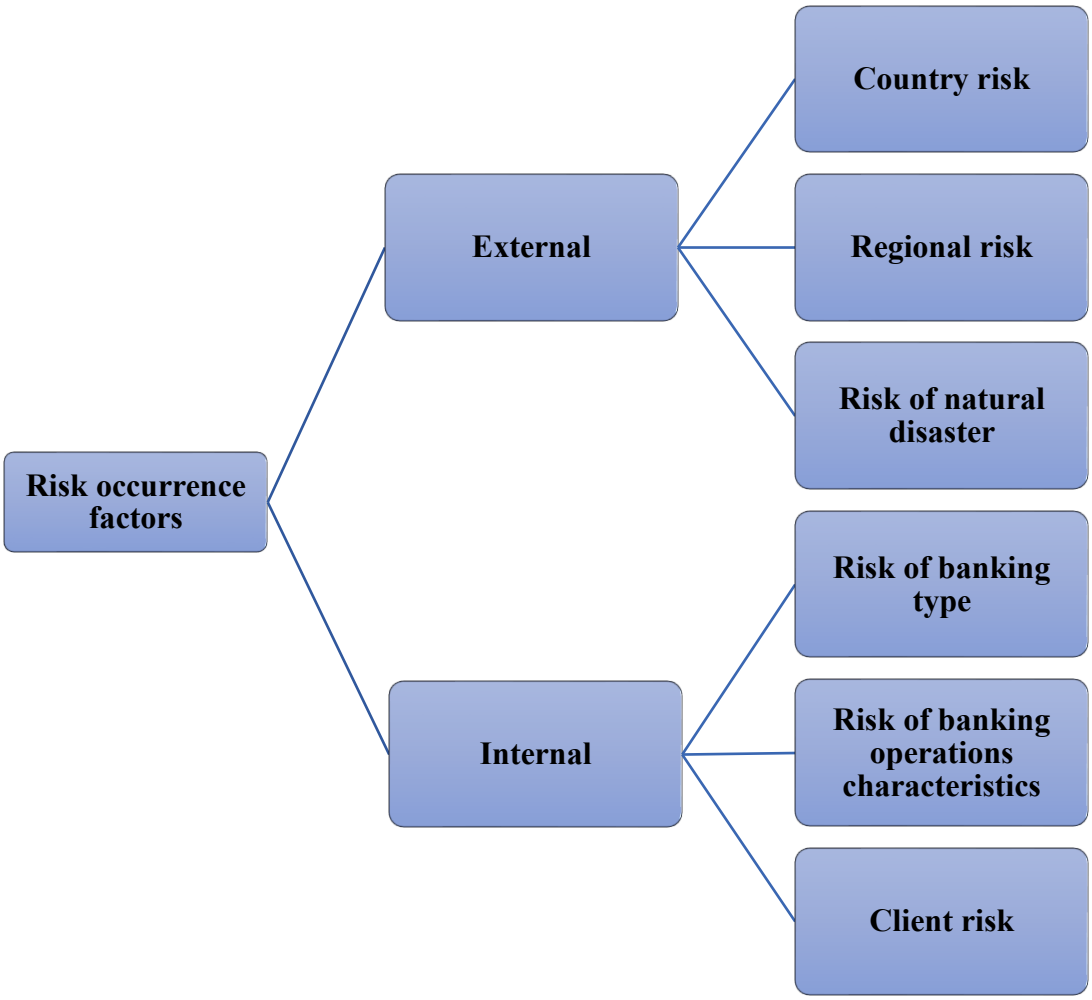
Key players	Responsibility	Importance	
		Policy level	Operational level
Systemic			
Legal and regulatory authorities	Set stage	Critical	N/A
Bank supervisors	Monitor	Indirect monitoring	Indirect
Institutional			
Shareholders	Appoint key players	Indirect	Indirect
Board of directors	Set policies, monitor effects, approve any changes	Critical	Important
Executive management	Implement policies and strategies, manage day-to-day operations	Critical	Critical
Audit committee/Internal audit	Test compliance with bank policies regarding corporate governance, risk management processes and control systems	Indirect (compliance)	Critical
External			
External auditors	Evaluate and express opinion	Indirect (evaluation)	Very important
Outside stakeholders/Public	Act responsibility	N/A	Indirect

("Analyzing Banking Risk", Hennie van Greuning, Sonja Brajovic Bratanovic, 3rd edition, 2009)

1.4 Risk occurrence factors

Factors of risk occurrence are divided into external and internal.

Figure 1.1 Division of risk occurrence factors



External factors are country, regional and natural disaster risks.

Country risk is the risk of losses which connected to investment of the national currency and (or) currency values in foreign banks, which is directly related to the internationalization of banking activities, depends on the political and economic stability of client countries and counterparties, importers, and exporters.

The country risk factors include:

- civil unrest, criminality and corruption in the country's economy;
- instability of the political regime, tax, legal and banking systems, the exchange rate of the national currency;
- ownership types of business entities and lack of a mechanism for controlling owners, including the state, over financial flows that lead to the theft of investment resources by owners and are exported abroad (capital outflow from the country)
- decrease in the profitability of the main income-generating industries in the country, the volume of industrial production, retail sales, consumer credit;
- a high level of inflation and a trend towards an increase in external debt and an increase in unemployment;
- low indicators and downward trend of GDP, GDP per capita, living wage and purchasing power of the population;

- deficit payments balance and the country's budget;
- decrease in the size of gold and foreign exchange reserves and their volume is less than the amount of a three-month import of the country.

The main components of the country risk are risk of transferring currency values, political and economic risks.

The risk of transferring currency values is a possible suspension of servicing the country's external debt associated with the liquidity of the balance of payments, the availability of funds in freely convertible currencies, and the country's ability to meet its obligations.

Political risk is associated with instability of country's political regime. In economic activity, it is associated with possibility of losses or reductions in profits resulting from government policy: a change in government's course, redistribution of funds for the benefit of more priority sectors of the economy, etc. ("Banking risks", A.A. Kazimagomedov, 2020).

American economist Franklin Ruth, a researcher of the impact of political risk on company's performance, summarized the way how American managers deal with political risk:

- avoid countries where political risks are assessed as prohibitive in relation to foreign economic activity;
- to expand company's presence in countries where national interests are consistent with their foreign operations strategy;
- transfer political risks to others, such as the government, where possible.

According to these methods, strategies of firms are formed with avoidance of political risks, adaptation and transfer of risks. ("US business abroad and political risks", F.R. Root, 1968)

Regional risk is related to authorities of the region, which affects the creditworthiness of the borrower associated with the region to fulfil its obligations under the loan agreement. It is determined by the level of socio-economic development of a particular region, considering political, national and tax policies, as well as the actions of the local administration. As a rule, regional risk is not singled out as an independent type of banking risk management, however, when assessing them, it is advisable to single it out as a separate factor.

The risk of natural disasters depends on both, presence or absence of natural disasters and consequences associated with them, and on various kinds of restrictions on the part of government agencies.

Thus, all types of banking risks are closely interconnected, intertwined, and affect each other. Therefore, banks that seek to take a strong position in the monetary and financial markets must stabilize their activities, protect themselves from unwanted losses, and must deal with the issues of studying, analyzing, assessing, managing, and regulating their inherent risks.

The internal risks of the bank depend on the specifics of the bank, nature of its activities (operations) and composition of its partners (clients and counterparties).

Risks associated with the type of bank. There are three types of commercial banks: specialized, sectoral, and universal. Each of them contains all types of risks, but the probability of their occurrence frequency and specifics depends on the type of the bank itself.

Specialized commercial banks focus their activities on providing mainly some specific services, have a clear specialization. For example, innovative, investment, savings, mortgage, deposit, clearing and other banks. Some banks specialize in servicing certain categories of sectoral clients (agricultural, industrial, construction) or functional (stock, insurance, trust, cooperative, utility) purposes. In addition, there is a market orientation of the activity of specialized commercial banks: regional, interregional, transnational.

Specialized commercial banks, such as innovative ones, are dominated by the risks associated with lending to new technologies. According to the results of a selective statistical analysis, the biggest risk is the commissioning of a technological innovation without a qualified preliminary assessment of its potential effectiveness. Here, the reasons for the increased risk may be:

- the use of new technology started prematurely, even before production costs are brought into line with the real level of market prices;
- products released before the buyer is willing to pay for innovations, i.e. the volume of potential demand is insufficient to recoup the costs;
- the number of suppliers and intermediaries involved with the prospect of demand growth is excessive for a particular market (market segment, window, niche), which leads to an increase in the cost of a particular banking product.

Risks associated with the nature of banking operations. Depending on the nature of banking operations, risks may be associated with the specifics of balance sheet or off-balance sheet operations, both of which are divided into risks of active and risks of passive operations. It is with the help of passive operations that the bank regulates its resources for the implementation of active banking operations. Passive operations of commercial banks include:

- deductions from profit for the formation (increase) of the authorized capital;
- the amount of loans received from the central and other banks;
- deposit operations and operations with issued debt securities.

The risks of passive operations are associated with possible difficulties in ensuring the active operations of the bank. Most often, this risk is associated with the deposit policy of the bank. To prevent the risk of attracted and borrowed funds, banks should observe the optimal ratio between passive and active operations, in particular:

- deposits in the bank and deposits placed in other banks;
- the size and liquidity of securities to increase the level and quality of liquid assets;
- the minimum ratio of own funds and risky assets;
- methods for calculating the coefficient of connectedness of deposits, taking into account the characteristics of a given bank, and be guided by it when placing them.

The correct choice of the client by the bank is also essential. The composition of the bank's clients determines the method of calculating bank risks and the degree of the risk itself. For example, a small borrower is more exposed than a large borrower to the contingencies of the market economy. At the same time, large loans issued to one borrower or group of related

borrowers, industry, region or country are often the cause of bank failures. ("Banking risks", A.A. Kazimagomedov, 2020).

2. Credit risk

2.1 Definition of credit risk.

Credit risk is the possibility of a loss resulting from a borrower's failure to repay a loan or meet contractual obligations. (https://www.investopedia.com/terms/c/creditrisk.asp).

Credit risk is the risk that interest and/or principal debt will not be paid. ("Commercial bank financial management", Joseph F. Sinkey, Jr., 1986).

Credit risk is the potential for loss of principal and interest on it, arising as a result of a violation of the integrity of the movement of the loaned value, due to the influence of various risk-forming factors. ("Banking", G.G. Korobkova, 2004).

According to definitions above, credit risk is unforeseen or intentional circumstances when the borrower will not be able to repay interest payments on the loan or the principal amount of the debt in accordance with the terms of the loan agreement. Thus, credit risk means that the loan amount and interest on it may be delayed or not paid at all by the borrower, which, in turn, may lead to problems in the movement of credit resources and adversely affect the financial condition of a commercial bank. ("Banking risks", A.A. Kazimagomedov, 2020).

2.2 Analysis, control, regulation, and limitation of credit risks in commercial banks.

For an effective credit risk management system for commercial banks, it is necessary to determine a reliable way to assess it. Based on the definition of risk as the degree of probability of non-repayment of a loan, interest on it or delay in payments, which can lead to significant losses on the part of the lender, there are several ways to assess credit risk. Existing set of methods for assessing credit risk is based on number of general principles, which allows them to be grouped into certain categories. In this thesis work mathematical methods based on a weighted assessment of the probability of a change in the borrower's rating, methods proposed by the Basel Committee on Banking Supervision will be analyzed.

Scoring method is a mathematical or statistical model by which, based on the credit history of "past" customers, the bank tries to determine how likely it is that a particular potential borrower will repay the loan on time. This probability is the degree of riskiness of this loan for the bank (this method will be discussed later).

Mathematical methods. In 1998, the Basel Committee on Banking Supervision, which includes the central banks of the world's leading countries, allowed usage of internal methods for assessing banking risks, including credit ones. In this regard, quite a lot of different methods for assessing credit risk based on mathematical methods have appeared. As a rule, these methods are based on the Credit Value at Risk (VaR) approach. ("A comparative analysis of current credit risk models" /Journal of Banking & Finance, M. Crouchy, D. Galai, R. Mark, 2000).

Some approaches based on this technology are Credit metrics/Credit VaR, KMV method, Credit Suisse Financial Products (CSFP) approach using Credit Risk+. The considered approaches are based on the analysis of the portfolio of debt obligations of potential borrowers.

Credit metrics/Credit VaR - a technique proposed by JPMorgan, based on the probability of a borrower moving from one category of creditworthiness to another, including the probability of default. For analysis, data from rating agencies on the current state of the borrower's rating is used along with an assessment of the probability of its transition from one rating category to another. Based on this data, a transition matrix is built, which is a key component of the model. Then it is necessary to determine a considered period for which the risk assessment is built. Typically, the time horizon is one year. Although for a detailed analysis of long periods it can be increased up to 10 years. Next comes the construction of a graph of threshold values for the probability of a corporation moving from one level of credit rating to another. At the final step, all information that has been obtained is presented in the form of a distribution of changes in the value of the portfolio.

KMV methodology is based on a structural approach, was initiated by KMV (Kealhofer, McQuown, and Vasicek) and uses Merton's asset value models. In this model, default is considered as an internal process associated with the capital structure of the enterprise. Default occurs when the value of a firm's assets falls to a certain critical level. Unlike the previous model, which relies on average default rates and changes in credit ratings, this model considers the specifics of each company, its capital structure, the distribution of capital income and the probability of default.

The Credit metrics/Credit VaR model is based on assumption that all companies in the same rating category have the same probability of default, which is equal to the historical average. The same assumptions apply to other probabilistic estimates. Thus, changes in credit rating and credit quality are the same.

This approach has been substantially revised by KMV. Indeed, these assumptions are not true, since the default estimates change continuously, while the ratings change discretely, since the revision of the rating takes a certain time and occurs with a certain frequency. Using KMV modelling, analysts have shown that the average historical default estimates differ significantly from their true values. In addition, the actual values of default estimates vary within the same rating category. The distribution is quite skewed so that the default estimate is higher than the typical (median) estimate for each credit class.

Unlike Credit metrics/Credit VaR, KMV does not use statistical indicators of the probability of default by Moody's and Standard & Poor's for analysis. In contrast, KMV derives the actual probability of default for each borrower based on the Merton model, probability of which in this case is determined by a function of the firm's capital structure, as well as changes in earnings and current asset values.

Third approach, proposed by Credit Suisse Financial Products (CSFP) using Credit Risk+, focuses only on probability of default. The model assumes that for a loan, probability of default remains unchanged throughout the period under consideration. For a large number of

borrowers, probability of default by each of them is small, and number of defaults in a given period does not depend on their number in any other period. Therefore, default probability distribution can be represented by a Poisson distribution.

Other risk assessment technologies include beta analysis of CAPM (Capital Asset Pricing Model), APT (Arbitrage Pricing Theory), Short Fall, Maximum Loss theories. These methods are used to analyze risky loans to legal entities. The main source of information here is the data of rating agencies on the rating of bonds, the value of assets of a particular company in the market. ("Banking risks", A.A. Kazimagomedov, 2020).

The Basel Committee on Banking Supervision is offered three main approaches to assessing credit risks recommended for use in commercial banks:

- standardized approach (Standardised Approach);
- the main IRB - approach (Foundation IRB (Internal Rating-Based) Approach);
- developed IRB - approach (Advanced IRB Approach).

Standardized approach. The current approach (The New Basel Capital Accord of 2002) requires banks to classify loan applications into control categories based on the characteristics of the loans. Each category is assigned a fixed risk weight. In this, it coincides with the new approach, which, unlike the existing method, uses external estimates to increase sensitivity of estimation to risk when determining the weights. Risk weights for corporate, intrabank and individual applications are determined based on external loan assessments. As such, you can use the estimates of both the Organization for Economic Cooperation and Development (OECD) and private rating agencies.

Next innovation concerns the increase in accepted types of collateral, guarantees and credit derivatives, which includes all major types of financial instruments. Range of possible guarantors has been significantly expanded; they can be all firms whose indicators correspond to the threshold values of external credit ratings. The new approach offers a relaxed regime for loan applications, lowering the risk weights of home equity loans. In addition, some small and medium-sized enterprises may also be included in this regime.

Internal Rating-Based methods (IRB). The most progressive aspect of The New Basel Capital Accord 2003 is the IRB approach, presented in two versions: the main IRB approach (Foundation IRB Approach) and the developed IRB approach (Advanced IRB Approach).

Essential difference between the IRB approach and the standardized one is the use of internal assessments of the main risk factors as the basis for calculating capital adequacy. Since, approach is based on intra-bank analysis, it is necessary to be able to establish more risk-sensitive criteria for capital adequacy. However, the IRB approach does not allow banks to independently determine all the elements for calculating these criteria.

Thus, calculations of risk weights and, accordingly, interest are carried out based on quantitative indicators prepared by the bank according to formulas developed by the committee. Formulas or risk functions translate input data into capital adequacy criteria. They are based on modern risk management technologies, including risk assessments. The practice

of using this method shows that it gives the most effective risk assessments in the largest banks.

The methodology for determining weighted risk assessments uses four main indicators:

- probability of default (PD);
- loss given default (LGD), which measures the proportion of the amount exposed to credit risk that could be lost in the event of a default;
- exposure at default (EAD), reflecting the amount of credit that can be lost in the event of a default;
- effective maturity (M) remaining until the repayment of the loan.

The main and developed IRB approaches differ in the first among the input data prepared by the banks themselves based on their own assessments or by specified regulatory authorities. Table 2.1 summarizes the main differences between these approaches. (The New Basel Capital Accord Issued for comment. 2003. 31 July).

Table 2.1 Differences between main and developed approaches

Incoming data	Main IRB approach	Developed IRB approach
Probability of default (PD)	Provided by the bank based on its estimates	Provided by the bank based on its estimates
Loss given default (LGD)	Set by the control committee	Provided by the bank based on its estimates
Exposure at default (EAD)	Set by the control committee	Provided by the bank based on its estimates
Effective maturity (M)	Set by the control committee	Provided by the bank based on its estimates

2.3 Limiting credit risk

In modern conditions, principles of rational lending and reliable assessment of the risk of granting a loan are very important. It becomes important to comply with the technology of lending, the rules for issuing and repaying loans, current monitoring, and analysis of credit operations.

Credit risk management in commercial banks is built on the principles of a systematic approach to financial risk management. The credit risk management system in a commercial bank consists of two subsystems: managed, or the object of management, and the manager, or the subject of management. ("Bank credit risk management" 3rd edition, S.N. Kabushkin, 2006)

There are three main technics or tools for risk management: risk avoidance, risk reduction, risk acceptance. Risk avoidance can be applied at the initial stages of organizing a credit process in bank, i.e. at the stage of assessing creditworthiness of the borrower and

determining the quality category of the future loan. This method will be analyzed in more detail, since analysis of creditworthiness is the basis for determining the limits for lending.

The assessment of credit risk for each loan is carried out based on the results of a comprehensive and objective analysis of the borrower's activities, taking into account its financial position, the quality of debt servicing on the loan, as well as all information available to a commercial bank about any risks of the borrower, including information about the borrower's external obligations, functioning of the market(s) in which the borrower operates. The financial position is assessed in accordance with the methodology (methods) approved (approved) by the internal documents of a commercial bank. ("Main principles of risk management" N.M. Yashina, 2006).

The essence of all methods is to reduce individual credit risk to one of three categories:

- standard (first category of quality);
- non-standard (second category of quality);
- doubtful (the third category of quality).

For each category of loan quality, a certain reserve is created for possible losses on loans, the amount of which should take into account the credit risk and compensate for the bank's possible losses.

Let us consider the methods of setting credit limits for borrowers (legal entities and individuals), commonly used in banking practice. With regard to loans provided to individuals of any nature, both consumer and residential, a limitation on the amount of the loan is mandatory, but this can be regulated by the choice of the loan term. The basis for determining the creditworthiness and the amount that the borrower can use to pay repayment is the amount of income of an individual as the main factor of solvency. Most often, it is customary to determine the size of the limit on payment from 30 to 50% of the borrower's income. There are variations in the definition of this share:

- as part of gross income, documented;
- as part of net income (the difference between the income of an individual and mandatory payments, including other liabilities);
- as a part of income, scaled according to the amount of income (the higher the income, the greater the limit).

Let's analyze the ways of setting limits for lending to legal entities. Limits are not set for investment loans, since in this case the term and amount of the loan are determined in accordance with the assessment of a particular investment project. It is advisable to set limits only when lending to working capital of legal entities. As practice shows, such a method as limiting loans for replenishment of working capital is not used in all commercial banks.

In the existing methods, when determining the limit on lending to legal entities, several approaches are distinguished. Thus, supporters of the traditional approach calculate the lending limit as a share of the value of the specified asset of the borrower. In various banks, this can be collateral, equity, the amount of revenue for a certain period. Supporters of the non-traditional approach use synthetic coefficients when determining the lending limit.

In addition, there is still an approach using VAR-technologies, in which "exact methods of calculation" of the limiting factor are applied, considering the timing of the loan. This method allows you to fully use the bank's credit potential and, consequently, to get the maximum interest income from lending. Unfortunately, its use is currently very limited, since in this case the bank needs historical information about the value of collateral, and, in addition, the use of the VAR calculation is not possible in poorly liquid markets.

There are several ways to determine credit limits for legal entities.

Collateral value method. In this case, the credit limit is calculated as a fraction of the cost of collateral for the specified asset of the borrower.

$$Limit = \alpha * A_0$$

where: *Limit* - credit limit; A_0 - limit factor; α - current value of the borrower's asset.

Property assets that can be used as collateral for legal entities include:

- vehicles and real estate objects;
- equipment and inventory items;
- securities and other liquid assets.

The collateral value of property, determined based on their appraised value, taking into account adjustment factors, must cover the amount of the loan and the interest due for the use of it, accrued for a certain period.

The appraised value of real estate, equipment, transportation vehicles and tools, inventory items is understood as the most probable price for which the property can be sold on a competitive and open market and can be established on the basis of the opinion of an independent appraiser who has the right to conduct an appraisal. The estimated value of the pledged property is adjusted using a correction factor: for real estate - no more than 0.85, for equipment, vehicles, inventory items - no more than 0.5-0.75 (depending on the life of the equipment and vehicles, liquidity of inventory items).

The main disadvantage of this method of calculating the limit is that the limiting factor is most often estimated by an expert method, and not calculated using accurate scientifically based methods. This method does not explicitly consider such an important characteristic of the loan, as the term of the loan and, consequently, the depreciation of the collateral for this period. Setting limits based on expert judgment may lead to an unreasonable understatement or overstatement of the lending limit. Understating the limit leads to the fact that the bank cannot fully use credit resources and, accordingly, cannot receive interest income in full. Overstating the limit leads to an increase in credit risk and an increase in possible losses from loan default.

The main advantage of this method of determining the limit is its simplicity. It is, apparently, the only possible method in conditions when the bank does not have data on the value of the borrower's collateral, but only has information on the current value of the collateral.

Equity share method. When using this method, the credit limit is calculated as a share of the borrower's equity capital. The meaning of the method is that the bank issues loans only if the

maximum loan amount does not exceed 50% of the company's equity capital. Therefore, the following formula can be used:

$$Limit = 0.5*E$$

where E is company's equity

The main disadvantage of this method of calculating the limit is the impossibility of taking into account the risk of changes in equity capital. This method also does not consider the term of the loan.

The main advantage of this method of determining the limit is its simplicity, and given the stability of equity capital, this method can be considered effective. The problem is that not all enterprises have sufficient own funds (at least 30% of the balance sheet asset).

Method of the limit dependence on revenue. This method assumes that lending limit depends on the amount of the borrower's monthly income, purpose and scope of activity. An example of setting limits depending on the average monthly revenue is given in Table. 2.2.

Table 2.2 Determining credit limit depending on the purpose the loan

Purpose	Loan limit (as a percentage of monthly revenue)
Replenishment of working capital	100
Investment in trade or production	200
Investment in service delivery	300

The advantages and disadvantages of this method are similar to the previous ones. In addition, it is necessary to consider the cost price in the amount of revenue. This method can be applied mainly to highly profitable borrowers.

Method of calculating a synthetic coefficient considering borrower's credit risk. Two most common methods are used here. According to the first method, the definition of a synthetic coefficient will depend on the credit risk group to which the potential borrower belongs. The credit risk group (client's risk level) reflects the probability of losses, while the number of groups can vary from 3 to 10. Thus, on a scale from 0 (minimum risk) to 1 (maximum risk), in absolute terms or as a percentage, each risk group corresponds to a certain indicator of the degree of risk. The second method is to calculate a synthetic coefficient as the sum of coefficients with certain weights that reflect creditworthiness of the borrower (coefficients of financial analysis, business reputation, credit history, business risk used in assessing creditworthiness). In both cases limit is calculated according to the formula:

$$Limit = I*K_r$$

where: I - basic value; K_r – synthetic coefficient.

Basic value is usually determined in traditional ways: through the cost of collateral, amount of revenue per month, amount of equity capital, amount of account turnover. Some banks also can issue a loan (one-time or opening a credit line, most often in the form of an

overdraft). With a one-time method of issuing a loan, the basic value I depends on the amount of free cash flow of a corporate client for the loan term, which is determined as follows:

$$I = \sum_{t=1}^{T} [(PP_t + PA_t - L_t - D_t) * k]$$

where: PP_t – projected (forecast) profit of the client for the planning interval (quarters, years can be considered as planning intervals, depending on the required degree of calculation detail); PA_t - predicted depreciation per interval t; L_t - amount of long-term loans of commercial banks, as well as loans repayable in interval t; D_t – amount of other obligatory payments (taxes, dividends, fines and penalties, the payment period of which falls on the interval t); k - discount factor for the interval t.

Forecast values of profit PP_t, depreciation PA_t, repayable credits and loans L_t of dividends and other obligatory payments from net profit D_t are determined based on the information from financial statements of a corporate client (it is recommended to use data for a period of at least the last four reporting quarters) using information about possible prospects for its activities. Forecast of PP_t is carried out by one of the following methods:

- extrapolation of data on the client's net profit. In this case, analysis of the available information carried out by the expert contains conclusions about the persistence of the identified trends in the dynamics of net profit for the analyzed period of time to the term if the limit;
- factor forecast based on the indicators, determining the value of net profit (in particular, revenue, profitability and their growth rates), when expert has information about possible changes in the current trends in the production and financial activities of the client by forecasting development of relevant factors;
- predicting the growth rate of expected sales.

The value of L_t is determined by:

- breakdowns of obligations - by terms and amounts, falling on interval t;
- in other cases - in proportion to the amounts and terms remaining until the repayment of specific obligations.

To calculate D_t following information should be considered:

- expiry date of guarantees issued for obligations of third parties;
- data on the client's planned investments, decoded according to objects and terms of investments (investment program);
- data on actual payment of dividends over the past three years, information on dividend policy of the client provided for by its charter, media data;
- data on fines and penalties, if there are documents confirming possibility of their payment during the period of the limit.

It is also necessary to consider the collateral for the loan (if any), so the base value when calculating the limit may include two components: cash flow and value of collateral (taking into account depreciation and costs for its implementation). In addition, they find average value between them (or sum of certain weights of these components) since both are a

potential source of debt repayment. If a loan is issued in the form of a credit line, then it makes sense to take adjusted turnover on the client's accounts as the base value (for period for which each tranche is provided, i.e., usually for 1 month), since it is the source of loan repayment.

To determine synthetic coefficient K_r two approaches are possible:

1) dependence of the value K_r on the borrower's credit risk group;
2) dependence of the value K_r, on the coefficients of financial analysis of the borrower.

To compare the practical results of these approaches, we will use a sample of 30 corporate borrowers from one of the conditional banks.

Determination of synthetic coefficient depending on the risk group. According to this method, amount of credit provided depends not so much on collateral as on the level of credit risk, which is determined mainly by the financial condition of the borrower and the probability of repayment of received loan.

Previously, we analyzed methods for assessing creditworthiness (rating, complex analysis) and identified approaches to determine risk category and groups of these risk categories. As a rule, it is necessary to determine synthetic coefficient for each of them, or rather, possible limits of the values of the synthetic coefficient, since it is rather difficult to obtain a single accurate and reliable value of the synthetic coefficient for all borrowers of the same group. For this, either expert assessments are used, or statistical information is analyzed, which is the most reliable.

Table 2.3 shows the values of synthetic coefficients for six categories of risk (according to the rating method for assessing the creditworthiness of a bank), obtained by expert means, and in Table 2.4 - average values of synthetic coefficients according risk groups obtained by processing the statistical array of the sample for the same borrowers.

Table 2.3 Determination of limits of the value of synthetic coefficient

Credit risk category	Value of Kr
C1 (minimal risk)	1.00
C2	0.90 – 0.75
C3	0.70 – 0.55
C4	0.50 – 0.30
C5	0.25 – 0.10
C6 (default)	0.00

Table 2.4 Average values of synthetic coefficient

Risk group	1st	2nd	3rd	4th	5th	6th
Average value	0.9672	0.8566	0.6249	0.4396	0.1832	default

Calculation of the synthetic coefficient depending on financial ratios. Consider the option of calculating the synthetic coefficient in a different way - depending on values of the selected financial ratios, which are determined to measure creditworthiness of the borrower according to the following formula:

$$K_r = K_i * W_i$$

where: K_i – value of corresponding coefficient; W_i – weight of coefficient.

In this case, it is necessary to determine coefficients that are used in various methods, and their weight. The set of coefficients is different, both quantitatively and qualitatively. But mainly four groups of indicators are necessarily taken into account to analyse borrower's creditworthiness: indicators of liquidity, capital structure, profitability and business activity.

Calculation of these indicators is carried out in the following way:

1) current liquidity ratio = current assets: current liabilities;
2) financial independence ratio = equity: total assets;
3) return on sales ratio = net profit: revenue;
4) asset turnover = revenue for the period: average value of assets for the period.

And there are also two options for building a model:

- expert. In this case, the weight of each coefficient W_i calculated in the model is set by an expert. Sum of the weights of all coefficients is 1 ($\sum W_t = 1$);
- estimated. In this case, to determine the weights of the coefficients, a linear regression model is built using information about already repaid loans.

Under the first option, the model in one of the banks looks like this: synthetic coefficient $K_r = 0.5$, current liquidity coefficient (K_L) + 0.15, financial independence ratio (K_I) + 0.2, return on sales ratio (K_{ros}) + 0.15, assets turnover (K_T).

Obtained in the second variant (the same data sample on loans were processed), the coefficient differs significantly in the weight values of the analysis coefficients used: synthetic coefficient $K_r = 0.363903$, current liquidity coefficient (K_L) + 0.360640, financial independence ratio (K_I) + (-0.022674), return on sales ratio (K_{ros}) + 0.101943, assets turnover (K_T).

Dependency analysis showed that the profitability ratio is negligible, therefore, it could be excluded from the model in order to obtain more reliable values. At the same time, this is one of the main coefficients indicating financial position of the borrower, so it is not advisable to exclude it. Taking into account the accumulated statistical material, it is proposed to revise the model in the future. The results of applying the models on a sample of borrowers are presented in Table 2.5.

Table 2.4 Summary table of synthetic coefficients

№	Liquidity coefficient	Independence ratio	Return on sales ratio	Return on sales ratio	Kr, obtained by expert	Kr, obtained by	Kr, according to risk	Limits of Kr by group risk

					method	estimation	group	
1	1.546	0.354	0.001	0.174	0.852	0.708	0.82	0.90-0.75
2	1.595	0.502	0.378	0.109	0.965	0.764	0.82	0.90-0.75
3	1.654	0.075	0.270	2.063	1.202	0.833	0.82	0.90-0.75
4	1.329	0.613	0.235	0.329	0.853	0.733	0.82	0.90-0.75
5	1.261	0.013	0.001	0.178	0.659	0.482	0.61	0.70-0.55
6	1.010	0.001	0.000	0.870	0.636	0.457	0.61	0.70-0.55
7	1.209	0.129	0.004	0.135	0.645	0.500	0.61	0.70-0.55
8	1.546	0.354	0.000	0.075	0.837	0.698	0.61	0.70-0.55
9	1.012	0.007	0.002	0.568	0.593	0.429	0.61	0.70-0.55
10	1.028	0.027	0.012	1.069	0.680	0.492	0.61	0.70-0.55
11	1.452	0.064	0.053	0.442	0.812	0.595	0.61	0.70-0.55
12	1.321	0.079	0.006	0.665	0.773	0.577	0.61	0.70-0.55
13	1.670	0.094	0.054	0.186	0.888	0.660	0.61	0.70-0.55
14	1.544	0.016	0.040	0.834	0.908	0.652	0.61	0.70-0.55
15	1.329	0.288	0.089	0.156	0.749	0.601	0.61	0.70-0.55
16	1.350	0.090	0.161	0.568	0.806	0.578	0.61	0.70-0.55
17	0.975	0.268	0.121	2.069	0.862	0.660	0.61	0.70-0.55
18	1.542	0.533	0.266	0.161	0.929	0.764	0.61	0.70-0.55
19	1.196	0.699	0.004	0.407	0.765	0.729	0.61	0.70-0.55
20	0.982	0.265	0.018	0.876	0.666	0.542	0.61	0.70-0.55
21	1.014	0.423	0.193	0.175	0.636	0.535	0.61	0.70-0.55
22	1.346	0.454	0.003	0.175	0.768	0.671	0.61	0.70-0.55
23	1.722	0.130	0.011	0.288	0.926	0.703	0.44	0.50-0.30
24	1.171	0.119	0.014	0.209	0.637	0.490	0.44	0.50-0.30
25	1.013	0.047	0.000	0.012	0.665	0.489	0.44	0.50-0.30
26	0.939	0.034	0.001	0.202	0.505	0.375	0.44	0.50-0.30
27	1.211	0.141	0.009	0.144	0.650	0.506	0.44	0.50-0.30
№	**Liquidity coefficient**	**Independence ratio**	**Return on sales ratio**	**Return on sales ratio**	**Kr, obtained by expert method**	**Kr, obtained by estimation**	**Kr, according to risk group**	**Limits of Kr by group risk**

28	0.561	0.012	0.001	0.069	0.293	0.215	0.18	0.25-0.10
29	0.379	0.072	0.022	0.012	0.207	0.165	0.18	0.25-0.10
30	0.505	0.030	0.018	0.012	0.262	0.195	0.18	0.25-0.10

Based on the results obtained, the following conclusions can be drawn:

- weighting model (K_r obtained by expert means) is not always comparable with the analysis by risk groups. The results sometimes differ significantly from each other, for example, if the loan belongs to the third and fourth risk groups;
- model built on the basis of regression (K_r obtained by estimation) rarely falls within the boundaries of the synthetic coefficient, i.e., the results are more consistent with the analysis by groups;
- values of synthetic coefficients obtained by the first and second methods also differ significantly in some cases.

Advantage of synthetic coefficient determination method depending on the risk group, lies in the complexity of the analysis, i.e. risk factors are directly taken into account. This allows to vary value of the coefficient depending on changing conditions. In addition, this model can also be used to quickly assess the borrower's risk.

Advantages of methods for calculating the synthetic coefficient through financial analysis indicators are their simplicity and speed. It is only necessary to calculate values of required coefficients. The main disadvantage of these methods is that when setting a limit, only financial condition at a particular moment is considered and possible adverse changes are not taken into account. ("Banking risks", A.A. Kazimagomedov, 2020).

2.4 Improvement of credit risk management system

Risk management (regardless of its specifics) is usually understood as a process of making and implementing managerial decisions aimed at reducing negative effect and impact of losses impact on the economic entity caused by random events. Further understanding a commercial bank as an economic entity, we will consider the list and content of the tasks to be solved in relation to credit risk management, since they have the greatest impact on the financial condition of the bank when it conducts active operations.

The main principles of credit risk management include:

- compliance of credit policy developed by the bank with its tasks;
- accounting of external and internal factors when bank conducts credit operations;
- continuity of the nature of managerial decision-making.

The principle of continuity in managerial decision-making means that risk management is not a one-time decision, but a process that is complex in terms of content of decisions made and implemented. This process covers in its dynamics procedures for making managerial decisions, starting with the choice of a risk strategy within the framework of bank's credit policy and ending with the submission of a dossier on a loan agreement executed on time to

the bank's archive. This process can be conditionally divided into two phases (the initial stage and active management), highlighting a number of stages in each of them.

Analytical method is based on the use of game theory with extensive involvement of information technology.

Statistical method is based on the use of statistical data related to a particular banking operation in order to identify the frequency of occurrence of risk and losses from it. The effectiveness of this method directly depends on the duration of bank's operation in the financial market, since the required amount of initial data for a full-fledged statistical analysis requires a long time.

Insurance is a form of preliminary reservation of resources intended to compensate for possible damage from the expected manifestation of banking risks. Economic essence of insurance is to create an insurance fund. Through insurance, most of the risk is transferred from the insurant to the insurer.

Reservation involves the creation of special reserves to cover possible losses from the occurrence and unfavourable development of risk situations.

Results of the choice of methods for countering risks give rise to the next stage - the stage of risk assessment in preparation of a specific loan agreement, i.e. assessment of specific types of individual credit risk depending on the type of borrower (country, legal entity, individual). The essence of risk assessment at this stage is to analyze solvency of a potential borrower. For these purposes, there are many different methods.

Analysis should focus on five aspects of solvency: industry, financial, managerial, historical and quality of credit collateral.

Industry aspect reflects the development processes of an industry and the position that the potential borrower takes in the industry. Weak positions can significantly reduce the ability to repay a loan.

Financial aspect determines the borrower's ability to obtain sufficient cash, which is the main source of loan repayment, or the ability to resort to realizing existing collateral if necessary. The four main criteria for the solvency of a legal entity are: profitability, liquidity, turnover and financial leverage (the ratio between borrowed and own funds).

Profitability characterizes the degree of economic efficiency of a bank. In ractice of bank lending, it is customary to single out the following most common indicators of profitability:

- profitability of sales (the ratio of profit to gross income), reflecting the efficiency of work in the market;
- return on assets (the ratio of profit to assets), showing how much profit the borrower receives from his assets.

Liquidity analysis shows how a potential borrower is able to fulfil its obligations to a bank in accordance with the terms of the loan agreement. When analyzing the liquidity of balance sheet, as a rule, two main ratios are calculated:

- current liquidity ratio (the ratio of current assets to short-term liabilities), which is an indicator that characterizes the fundamental ability of an enterprise to repay short-term debt;
- quick liquidity ratio (the ratio of current assets minus inventories to short-term liabilities), which characterizes the ability of an enterprise to repay debts in the shortest possible time.

The key coefficient for assessing solvency - financial leverage - ratio between borrowed and own funds of a potential borrower.

Managerial aspect characterizes quality of management and is determined by competence, cohesion of the team of managers who manage the enterprise and the effectiveness of their leadership of the team. Shortcomings in qualified management can create difficulties not only in repaying the loan, but also in realizing the collateral.

Historical aspect involves the analysis of the credit history of a potential borrower.

Aspect of quality of the loan collateral determines level of control by the bank over collateral and possibility of obtaining the real value of the collateral when it is liquidated.

Based on the analysis of all these five aspects, bank should structure transaction in such a way as to fully assess the risks associated with lending to a particular economic entity and, if possible, minimize the identified risks.

Finally, the final stage of the credit risk management process, which takes place after risk assessment in preparation of the loan agreement, is the stage of risk assessment during execution of loan agreement. In fact, this stage means monitoring the issued credit products, and in addition to the individual credit risk, overall credit risk is also assessed here. To manage monitoring process, bank needs to develop and implement a risk classification system to rank loans according to various quality characteristics on a regular basis. Such a system helps to identify problem areas, as well as to plan, agree and implement other procedures aimed at protecting interests of bank in the event of a deterioration in the borrower's solvency.

Next step is identification and analysis of risks. It will identify all possible risks, by their specificity and nature of occurrence, accompanying activities of a bank, scheduled to carry out within the framework of credit policy. In order to achieve this goal, tasks of conducting a qualitative analysis of risks that bank may have to deal with are being solved. Qualitative risk analysis involves carrying out a detailed classification according to the accepted criteria, identifying consequences of implementation of relevant risks in the form of financial damage and disclosing source of information for each of them. Next comes quantitative risk assessment step. Its main content is processing of information obtained at the stage of identification and risk analysis. At the same time, frequency of occurrence of risk and its degree of influence on deterioration of the financial condition of a bank are determined. To do this, bank needs to solve the problem of assessing probability of risk, identifying areas of risk, and establishing the optimal level of risk for a bank. Final step in phase of credit risk management process is selection of risk countermeasures. Methods usually used to counter risk are classified according to the time of implementation and universality of application.

Then active phase of management process begins, the first stage of which is risk assessment when preparing a loan agreement. This stage involves assessment of risks in preparation of a specific loan agreement. The essence of risk assessment is to analyze solvency of a potential borrower. The main approaches to analysis of solvency involve assessing a potential borrower in context of five aspects - industry, financial, managerial, historical and quality aspects of credit collateral. Based on the analysis of all five aspects, bank must structure the transaction in such a way as to fully assess the risks associated with lending to a particular economic entity and, if possible, minimize the identified risks.

The final stage of credit risk management process is the stage of risk assessment during the execution of a loan agreement. In fact, this stage involves monitoring issued credit products, and in addition to the individual credit risk, the overall credit risk is also assessed here. To manage monitoring process, bank needs to develop and implement a risk classification system to rank loans according to various quality characteristics on a regular basis. Main directions of credit quality analysis are: reduction of credit risk for each specific loan (individual credit risk) and reduction of loan losses at the level of bank's loan portfolio as a whole (aggregate credit risk). It should be noted that management involves not only monitoring, but also taking the necessary preventive measures to overcome negative consequences. Content of the tasks solved at each stage of credit risk management process is essentially, from a formal point of view, a continuous solution to the problem of obtaining, processing and presenting reliable address information for making an appropriate management decision. This can be confirmed by the definition of the very concept of making a managerial decision, used, for example, in the theory of decision making.

According to the postulates of this theory, adoption of a managerial decision is the choice of an alternative in order to achieve goals of the organization, carried out by the manager within the framework of his official powers and competence. And the choice of an alternative just involves considering various factors related to the characteristics of tasks solved at each stage, corresponding information support and organizational structure of a bank itself. What can be represented as a kind of unified system that includes both subject of management and object (credit risks) with a certain set of management elements. This management system, both in its composition and, list and content of tasks solved by the relevant subsystems, should ensure achievement of goals set by a commercial bank within the framework of its credit policy. At the same time, effectiveness of its functioning is determined by how successfully the system allows this to be done in relation to a given conditions (type of credit product, credit and risk policy of the bank). On the other hand, during changes, for example, when expanding the range of credit products, the system should have potential to adequately respond to them. And in this regard, both increasing the efficiency of functioning of credit risk management system, and expanding its capabilities, is achievable only with improvement of the system itself.

Let's move on to considering possible ways to improve it. Obviously, improvement of credit risk management system as a whole, based on the principle of unity underlying its construction, can be ensured by improving each element included in the system. The object of management in the system under consideration are credit risks. And in relation to them, in the

context of improving management object as one of the elements of the system, development of new forms of lending should be considered in accordance with the needs of banking product market. Development of new forms of lending is a process aimed at creating so-called novelty products, consisting of the following steps:

- generating and searching for ideas;
- identifying marketing opportunities;
- development, testing and introduction of new products to the market.

In modern conditions, a commercial bank, in order to be successful, must be client-oriented. The activities of a client-oriented bank are characterized by characteristic features that determine the specifics of such an orientation. We only mention the following:

- presence of Regulations on the client policy, approved by the board of a bank and mandatory for all employees;
- creation within bank of special divisions professionally engaged in client work, and providing them with modern equipment and technologies;
- actions to develop bank's image as a customer-oriented enterprise.

One of the modern banking information technologies that have recently found wide application in solving these problems, we note the Sales Expert program, which is positioned on the market as a customer relationship management system - CRM (Customer Relationship Management). This system, focused on streamlining the process of customer relationship management, provides a solution to the following tasks:

- exclusion of duplication by employees of each other in work with clients;
- search for new markets for consumers of banking services and operations on the basis of information on customer relationships entered into the database;
- maintaining a system of accounting for potential customers;
- monitoring activities of bank employees working with clients;
- finding bottlenecks in operations with a client from composition of business processes in the course of their implementation.

Development of new forms of lending by a commercial bank is also important in terms of its survival in the face of increased competition in the banking sector. Substantive competition is typical when a bank provides homogeneous, standardized services. It is based on price competition. Specific competition, which combines both price and non-price methods, is focused on development of a new range of banking services. As an example, let us point out some of the main trends that characterize current state of competition in banking sector:

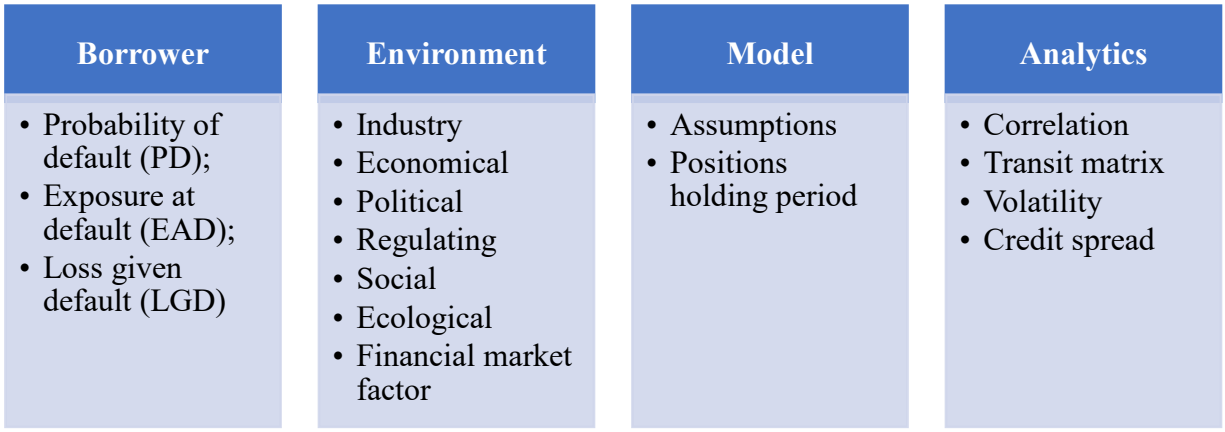
- improving quality of services and their attractiveness;
- expanding range of banking products;
- improving personnel management system and increasing requirements for the level of its professional training;
- introduction of management systems for the competitiveness of banking operations and services;

- desire of large banks to penetrate into the markets developed countries in order to gain access to cheaper financial resources. ("Banking risks", A.A. Kazimagomedov, 2020).

2.5 Stress testing of credit risk

Most risk monitoring systems, whether quantitative or qualitative, are best suited to normal business conditions because they use past behaviour of risk factors to predict their future behaviour. Therefore, commercial banks should use a dual approach to credit risk management: on the one hand, the daily use of borrower and loan portfolio risk management systems, and another, extreme risk management through stress testing. It can be argued that methodological features of credit risk stress testing are primarily due to structural composition of stakeholder groups. Lending activity of a bank assumes involvement of various groups and categories of borrowers (individuals and legal entities) in the sphere of its interests. Any commercial bank seeks satisfaction in credit resources for both individual and corporate borrowers. For this purpose, owners create a bank in order to satisfy their economic interests through implementation of commercial activities, including credit. The practice of stress testing shows that only some tests should be carried out on a regular basis in order for bank management to capture and track significant changes in the risk profile of a loan portfolio. Each test must be accompanied by a set of pre-agreed activities, which may include restructuring, selling positions or portfolios, hedging, etc. All stress testing tasks, procedures, powers, responsibilities and other aspects must be clearly defined and approved by the bank's management. Accepted stress events and scenarios should be plausible and representative of the bank's portfolio. These scenarios may include a number of factors: economic or industry crises, sharp drops in asset and collateral values, market risk events, an exacerbation of a problem or a liquidity crisis. Credit risk factors can be used to compose stress testing simultaneously or separately (Figure 2.1).

Figure 2.1 Credit risk factors considered in stress testing modelling



A stress testing policy at a commercial bank typically includes:

- frequency and procedure for holding regular meetings to assess the main risk factors affecting the loan portfolio;
- methodology for building stress testing of both single-factor and multi-factor risks;

- procedure for setting limits on stress losses (stress loss limits) and the authority to set such limits;
- process of monitoring stress loss limits.

Credit risk cannot be associated with a change in one parameter, as in the case of currency risk or interest rate risk modelling. A clear distinction should be made between the risk of an individual borrower and the risk of a loan portfolio. Most credit instruments are not traded on a market, so there is very little information about the given value of a particular instrument. Default on credit instruments is also infrequent, and defaults that occur are tracked and recorded less efficiently than, for example, changes in market prices. Distribution of returns associated with credit risk is skewed, with a high probability of small positive returns and a low probability of large negative returns. Combination of limited information, infrequent observations, and distributional skewness makes modelling credit risk extremely difficult both analytically and empirically. However, there are mechanisms for measuring credit risk. In this regard, it is advisable to note the general trends that have formed to date:

- increase in the impact of off-balance sheet financial instruments on a bank's liquidity;
- increase in the share of wholesale funding instruments in banks' liabilities compared to retail funding;
- growing influence of market factors on bank's funding opportunities;
- complication of banking credit operations.

It recommended to use following principles basic principles of stress testing of bank’s expected liquidity requires:

- stress testing should take into account both short-term and long-term changes in risk factors (usually 1-30 day(s) changes in factors are used, although liquidity problems led to bank insolvency both within days and years);
- stress testing should not be mixed (for example, a decrease in expected liquidity due to minor and significant changes in the financial market factor is the same scenario with different levels of stress);
- stress testing should be relevant (appropriate) to the specifics of a tested bank (for example, expected liquidity of a bank that operates in the financial markets of a certain country should be tested taking into account changes in the financial market factors of this particular country).

Quantitative methods of stress testing. For stress testing expected liquidity, the same methods used by banks with best practice can be applied - probabilistic and deterministic (consecutive). But each of them has disadvantages.

Probabilistic methods:

- *historical modelling of CashFlow-at-Risk* (CFaR). Disadvantage - this method is based on the assumption that past events reflect future ones. Does not take into account the "fat tails" of historical distribution of changes in the factors of financial markets;

- *Extreme Value Theory Cash Flow-at-Risk* (EVTCFaR). The disadvantage is the "black swan problem", formulated by the Scottish philosopher D. Hume "No number of observations is enough to say that all swans are white, but the observation of one black swan is enough to refute this statement";
- *Monte Carlo method*. Disadvantages of this method are the same as those of the CFaR and EVTCFaR methods. However, Monte Carlo method makes it possible to stress test expected liquidity, considering the mutual distribution of several financial market factors and taking into account expert assumptions about the parameters of these distributions. In some cases, it is possible to increase the effectiveness of the Monte Carlo method by stochastic modelling of historical changes in financial market factors.

Deterministic methods:

- *historical stress testing*. Disadvantage - the probability of an exact repetition of the historical event is small;
- *sensitivity analysis*. Disadvantage - the influence of a single market factor is taken into account without interrelation with other factors;
- *hypothetical multifactorial stress testing*, considering possibility of changing the assumptions and assumptions made. The disadvantage is subjectivity, the impossibility of assessing the probability of loss.

The last method - *hypothetical multifactorial stress testing* deserves special attention. Results of stress testing of several large commercial banks from G10 countries, given in the documents of the Basel Committee, most closely matched risks realized in the third quarter of 1998 for those banks that used in the tests simultaneous change in several risk factors, as well as correlations between them. In those banks that used the change in only risk factor in tests, they coincided to a much lesser extent. Thus, banks whose stress tests and risk management systems took into account potential interconnections between various financial markets had more realistic assessments of those events in the fall of 1998 that could have the greatest impact on them. Therefore, considering different levels of stress, it is advisable to form stress scenarios in three versions: bank's activities under normal conditions, specific ones, and under conditions of a systemic crisis. ("Banking risks", A.A. Kazimagomedov, 2020).

2.6 Credit scoring system

Credit scoring method, as a system for assessing creditworthiness (credit risks) of a borrower, is widely used to assess the creditworthiness of individuals, which is based on the analysis of the following information:

- borrower's profile;
- information about the borrower from the credit bureau;
- data on accounts operations, if we are talking about a bank client who has been served in it for at least a year.

In its most simplified form, a scoring model is a weighted sum of certain characteristics. As a result, an integral indicator is obtained: the higher it is, the higher the reliability of a client, and bank can arrange its clients in order of increasing creditworthiness. Integral indicator is compared with a certain numerical threshold, or dividing line, which, in essence, is a break-even line and is calculated from the ratio of how many customers on average need to pay on time to compensate for losses from one debtor. Clients with an integral indicator above this line are given a loan, clients with an integral indicator below this line are not. Thus, the scoring system allows diversifying credit risk. This all looks pretty simple, but the tricky part is deciding which features to include in the model and the level of weights that should be assigned to them. The philosophy of scoring is not to find explanations for why a person does not pay, but to highlight those characteristics that are most closely related to the reliability or unreliability of the client. Bank does not know whether this borrower will repay the loan, but it does know that in the past people with the same profession, level of education and the same number of dependents did not repay the loan. Therefore, bank will not give a loan to this person. This is the discriminatory nature of scoring, i.e. if a person is formally close to a group with a bad credit history, then they will not give him a loan. Therefore, even with a high degree of automation of the scoring system, subjective intervention of an inspector is carried out if he has additional information proving that a person classified as unreliable is in fact “good”, and vice versa. Let's give an example of characteristics used in the practice of UK banks: age, number of children (dependants), profession, spouse's profession, income, spouse's income, area of residence, cost of housing, availability of a telephone, how many years he has lived at this address, how many years he has been working at this job, how many years he has been a client of this bank, presence of a credit card.

After collecting information, it is necessary to build a mathematical model that will allow you to assess which information is significant and which can be neglected. To build a model, a sample of clients is made, about which it is already known whether they have proven themselves to be good borrowers or not. The sample is divided into two groups: “good” and “bad” risks. This is justified in sense that bank, when making a decision on lending, at the first stage chooses from two options: to give a loan or not to give. Despite the frivolity of the definition of “good” and “bad”, these are exactly the terms that are used by credit analysts. Bad risk criteria can be different and depend on the policy of a bank. In Western Europe, a “bad” risk is usually considered a client who is late with the next payment for three months. Sometimes this group includes clients who repay the loan too early, and bank does not have time to earn anything from them. Thus, scoring system makes it possible to reduce the uncertainty of credit process by identifying classes of similar credit histories, in each of which it is possible to determine the degree of risk. Scoring is a classic task where, based on available information, it is necessary to obtain a function that most accurately divides a sample of customers into “bad” and “good”. First, it is necessary to transform the available information into a form convenient for analysis. There are two main approaches for this:

- convert each feature into a binary variable, which increases the number of variables and creates additional difficulties in work, although it does not impose any additional relationship between dependent and independent variables;

- transform each characteristic into a variable that will take values corresponding to the ratio of the number of "bad" clients with the given attribute to the number of "good" clients with the same attribute. A more complicated option is to take the logarithm of this ratio.

Thus, each feature receives a numerical value corresponding to the level of its "riskiness". Classification methods are diverse and include: statistical methods (regression construction) - linear regression, logistic regression, various linear programming options, classification tree or recursion-partition algorithm, neural networks, genetic algorithm, nearest neighbors method. The traditional and most common are regression methods, primarily linear multivariate regression:

$$p = w_0 + w_1x_1 + w_2x_2 + \ldots + w_nx_n$$

where: p - probability of default, w - weight coefficients, x – client's characteristics

The disadvantage of this model is that on the left side of the equation there is a probability that takes values from 0 to 1, while the variables on the right side can take any value from -∞ to +∞.

Logistic regression overcomes this shortcoming:

$$log\ (\frac{p}{1-p}) = w_0 + w_1x_1 + w_2x_2 + \ldots + w_nx_n$$

Application of logistic regression requires much more complex calculations to obtain weights and, therefore, a more powerful computer base and improved computer software. But with the current level of development of computer technology, this is not a problem, and at present, logistic regression is the leader in scoring systems. The advantage of logistic regression is that it can subdivide clients both into two groups (0 - bad, 1 - good), and into several groups (1st, 2nd, 3rd, 4th risk groups). ("Scoring as credit risk assessment method", Andreyeva G., URL: http://www.cfin.ru)

There are two main problems with scoring. The first is that classification of sample is made only on clients who have been given a loan. We will never know how customers who were denied credit would behave. It is possible that some part would be quite acceptable borrowers. But, as a rule, a loan is denied on the basis of fairly serious reasons. Banks fix these refusal reasons and keep information about "refuseniks". This allows them to rebuild their original base of loan applicants. The second problem is that over time, both people and the socio-economic conditions that affect their behavior change. Therefore, scoring models must be developed on a sample of the "freshest" clients, periodically check the quality of the system and, when the quality deteriorates, develop a new model. In the West, a new model is developed on average once every one and a half years, the period between model replacements may vary depending on how stable economy was at that time.

Traditionally, the following types of credit scoring are distinguished.

Application Scoring - assessment of the borrowers' ability to obtain a loan. This type of scoring translates into a "quantitative plane" the risks of the bank, which are associated with

the correct assessment of social, demographic, financial and other data of the borrower to make a decision on issuing a loan. When deciding to issue a loan, a quick analysis of the borrower using scoring models allows to get the most objective assessment based not on subjective opinions, but on analytically verified patterns.

Behavioural Scoring - which consists in making decisions by a bank in the framework of managing individual lending operations of borrowers and bank's loan portfolio as a whole. The main task of behavioural scoring is to predict potential risks associated with borrowers that make up a loan portfolio. Risks associated with servicing loans are very diverse, so scoring models for behavioural scoring use different criteria for assessing and ranking borrowers. Main ones are: assessment of the risk of insolvency, assessment of risk of default (premature closure of the account), as well as scoring of the profitability of clients.

Collection Scoring - determination of priority cases and areas of work in relation to "bad" borrowers, whose credit account status is classified as unsatisfactory. Timely prevention of delays is very important to reduce bank's costs as part of debt collection and work with collateral. Collection scoring can optimize bank's work at all stages of a debtor relationship management process.

Fraud Scoring - is a methodology for detecting and preventing fraudulent activities on the part of potential and existing borrowers. Fraudulent scoring helps to make immediate decisions to identify borrowers whose loan applications should be rejected or sent for more detailed review.

Crises exacerbated the already sad picture of non-payments on loans. Debts must be collected, and this must be done competently and professionally. One of the most effective tools for carrying out such work is the collection-scoring system. The automated collection-scoring system makes it possible to formalize and optimally organize work with problem loans on loans, applying timely and relevant actions to each debtor of the bank. Methodology is based on optimal segmentation of credit cases, depending on the parameters of credit case (days of delay, loan amount, etc.) and on determining the types of actions that need to be applied to a particular debtor (phone call, SMS, letter, etc.). It should be noted that initially scoring was used to assess borrowers - individuals, at present it is also used to assess the creditworthiness of small and medium-sized businesses. At the same time, credit scoring system does not replace, but complements the work of a credit specialist. Practice of using scoring systems shows that the smaller the loan amount, the more decision-making powers are allocated to such a system, and the higher the amount, the more scoring is used as a "support" factor in the decision-making process. ("Banking risks", A.A. Kazimagomedov, 2020).

3. Market Risks

Market risk is the possibility of losses as a result of fluctuations in exchange rates and securities rates, interest rates, in the relevant markets. Consequently, varieties of market risk are currency, stock and interest risks.

3.1 Currency risk management methods

Currency risk - is a risk of loss of currency values associated with a change in the exchange rate of one foreign currency against another during foreign exchange and other foreign economic transactions.

Currency risk is associated with the internationalization of the market of banking products, creation of transnational banks and diversification of their activities. The most subject to currency risk are conversion transactions - transactions of foreign exchange market agents on the exchange on a certain date at an agreed rate of an agreed amounts of monetary units of one country for the currency of another country. The first attempts to manage currency risk were made in the early 1970s, when floating rates were introduced, structured as follows:

a) commercial risks, i.e. risks associated with the unwillingness or inability of the debtor (guarantor) to pay off its obligations;

b) conversion (cash) risks - risks of currency losses on specific currency transactions. The most common methods for reducing conversion risks are:

- hedging, i.e. creation of a compensating currency position for each risky transaction. In other words, there is compensation for one currency risk - profit or loss - by another corresponding risk,
- mutual offset of risks for assets and liabilities, so-called matching method, where, by deducting the inflow of currency from the amount of its outflow, bank's management has an opportunity to influence their size. Other transnational banks use netting method, which is expressed in the maximum reduction in the number of foreign exchange transactions by their consolidation;

c) translational (accounting) risks that arise from the revaluation of assets and liabilities of balance sheets and accounts "Profit and Loss" of foreign branches of clients, counterparties. These risks, in turn, depend on the choice of the translation currency, its stability and a number of other factors. Recalculation can be carried out according to the translation method (at the current exchange rate on the date of recalculation) or according to the historical method (at the exchange rate on the date of the specific transaction). Some banks take into account all current transactions at the current rate, and long-term - at the historical rate, others analyze the level of risk of financial transactions at the current rate, and others - at the historical rate, they choose one of two accounting methods and use it to control the entire set of their risky operations;

d) forfeiting risks, which arise when the forfeiter (often a bank) assumes all the exporter's risks without recourse. Otherwise, forfeiting is a discounting of client's settlement and payment documents in foreign currency, i.e. assignment to the bank of right to demand debt in foreign currency in exchange for immediate payment by the bank of the corresponding amount in national or foreign currency. Forfeiting as a method of refinancing commercial risk has its advantages, with the help of which the level of risk can be reduced by:

- simplification of balance relations of possible obligations;
- improvement (at least temporarily) of the liquidity position, which makes it possible to further strengthen financial stability;

- reducing the likelihood and possibility of losses by insuring possible difficulties that almost inevitably arise during the presentation of previously insured claims;
- reduction or even absence of risks associated with fluctuations in interest rates;
- a sharp decrease in the level of risks associated with exchange rate fluctuations of currencies and changes in the financial stability of the debtor;
- absence of risks and costs associated with the activities of credit authorities to collect money on bills of exchange and other payment documents.

To reduce currency risk, banks mainly use the following methods.

1. Issuance of loans in one currency with the condition of its repayment in another, taking into account the forward rate fixed in the loan agreement. Such measures allow the bank to insure against a possible fall in the exchange rate of the loan. Assume that a bank is lending $100,000. At the same time, counting on the weakening of the dollar against the pound sterling, the bank, in agreement with the client, can fix in the loan agreement as a condition the repayment of the loan in pounds at the forward rate of 1£ = 10$ (i.e. the borrower will need £10,000 to repay the loan). In this case, three scenarios are possible:

- if at the time of repayment of the debt on the loan, the exchange rate is 1£ = 10$, the bank will receive its 10,000£. and neither side will suffer losses;
- if at the time of repayment of the loan the exchange rate is equal to 1£ = 12$, then the bank will receive again 10,000£, while in the case of repayment of the loan in dollars, he would have 100,000$, which would amount to only 8,333.33l£ (100,000/12);
- if by the time the loan is repaid the exchange rate is 1£ = 9$, the bank will be at a loss, since it will receive back again 10,000£, while if he repaid the loan in dollars, he would have $100,000 or 1,111,111£.

2. Forward currency contracts. This is the main method of reducing foreign exchange risk. Such transactions involve conclusion of urgent agreements between bank and client on purchase and sale of foreign currency, while fixing the amount of transaction and the forward exchange rate in agreement. Mechanism of operation of forward currency contracts is basically the same as described above. Forward currency transactions are fixed or with an option. The term “fixed” means that the transaction must be completed on a strictly defined day. The option, on the other hand, implies possibility for the client to choose the date of its completion: either on any day, starting from the date of signing the contract and up to a certain deadline, or within a certain period in future. An important condition of forward contract is the obligation to perform it. However, forward currency contract itself is associated with a certain risk. For the bank, it consists in fact that client may not be able to fulfil his obligations under the contract, in which case bank will not be able to sell the currency that client, in accordance with the contract, was supposed to buy or, conversely, purchase the currency that client was supposed to sell. In this case, purchase (sale) of the corresponding amount of currency on the market may result in losses for the bank.

3. Currency futures contracts. Like forward currency contracts, futures are agreements to buy or sell a certain amount of foreign currency on a certain day in the future. However, unlike forward contracts, their terms can be easily renegotiated. In addition, these contracts can be freely traded on the exchange of financial resources (for example - London International Financial Futures Exchange). However, currency futures contracts are not yet widely used.

4. Currency options. Despite the similarity in name to forward, foreign exchange contracts with an option, they are an instrument that gives their owner the right (rather than the obligation) to buy a certain amount of foreign currency at a certain rate within a limited period of time or at the end of this period. Currency options are of two types:

- call option gives its buyer the right to purchase the currency specified in the contract at a fixed rate (in this case, the seller of the option must sell the corresponding currency at this rate);
- a put option gives its buyer the right to sell the currency specified in the contract at a fixed rate (in this case, the option seller will have to buy the corresponding currency at this rate).

5. Currency swaps. A currency swap is an agreement between two parties to exchange future series of payments in different currencies. Currency swaps can be divided into the following two types: swap liabilities and asset swaps. *Swap liability* is the exchange of obligations to pay interest and repay principal in one currency for similar obligations in another currency. The purpose of such a swap, in addition to reducing long-term foreign exchange risk, is also to reduce the cost of raising funds. *Asset swap* allows the parties to an agreement to exchange cash income from an asset (for example, an investment) in one currency for similar income in another currency. Such a swap is aimed at reducing long-term currency risk and increasing the return on assets (investments).

6. Leading and lagging - acceleration or delay of payments is used in implementation of foreign exchange transactions. At the same time, bank, in accordance with its expectations of future changes in exchange rates, may require its debtors to accelerate or delay settlements. This technique is used to protect against currency risk or gain from currency fluctuations. However, the risk of losses is still present, since it is likely that the direction of the exchange rate will be incorrectly predicted.

7. Diversification of bank funds in foreign currency. This method of reducing currency risk involves constant monitoring of fluctuations in foreign exchange rates. And since it is extremely difficult to predict likely directions of such fluctuations, banks, in order to reduce the risk of losing as a result of unfavourable changes in exchange rates, resort to diversification of assets denominated in foreign currency.

8. Currency risk insurance. Currency risk insurance involves the transfer of all risk to an insurance company.

9. A currency basket is a set of currencies taken in certain proportions. In order to reduce risk, currencies are selected into such a basket, rates of which usually "float" in opposite directions, mutually balancing changes in the exchange rate, making value of the entire basket more stable.

Thus, we have considered main methods of reducing currency risk faced by banks in the course of their foreign economic activity. Development of these measures is an essential component of the bank's management and risk analysis strategy.

3.2 Stock risk management

Stock risk is understood as the risk of losses for the bank due to unfavourable changes in the market value of securities. The amount of stock risk is determined as follows:

$$SR = SSR + CSR$$

where: *SR* – stock risk; *SSR* – special stock risk - risk of changes in the current value of securities associated with the issuer of securities; *CSR* – common stock risk - risk of changes in the current value of securities due to changes in prices in the securities market.

There are the following transactions concluded with securities on the stock market.

An option contract, according to which one of the contracting parties grants the other party the right to buy or sell a security. The most option contract is the call option. It gives buyer the right to buy, for example, a certain number of shares of a certain bank at a certain price at a certain time. An alternative to a call option is a put option, according to which one of the participants in transaction has the right to sell a certain number of securities to another at a certain price at a certain time. To overcome consequences of the risk of an option contract, parties often specifically stipulate the possibility of either liquidating transaction before its expiration date, or freely reselling their part of the transaction to third parties. This means that if, over time, the deal for some reason does not suit one of the participants and he wishes to refuse it, then he is allowed to find a third party who will take his position in the contract.

A futures contract makes it possible to buy or sell securities in the future on a certain date at a fixed price at the time of transaction. At the same time, securities are not paid up to the date of purchase, however, both parties must reinforce their intentions in the future by depositing a certain amount. Consequently, by entering into a futures contract, interested party in acquisition of securities receives not only a guarantee of stability of transaction price, but also a guarantee that such a transaction will generally be completed. Because the scope of a futures contract can be significant, amount deposited is reviewed periodically.

Swaps are contracts for the exchange of financial instruments in order to increase income by reducing potential losses. Investor constantly builds a forecast of the future profitability of one or another of securities he has at his disposal and evaluates their profitability for various periods of time. Then, based on the results of forecasting the future of profitability, he replaces some overvalued securities with others, which, in his opinion, are undervalued. At the same time, investor hopes that the market itself will correct the situation with an incorrect assessment in a short time and this will bring him income. Typically, a swap contract is between two parties that exchange flows of funds over a specified period of time (called opposite parties in swap parlance). (“Banking risks”, A.A. Kazimagomedov, 2020).

3.3 Interest risk assessment method

Interest risk involves an unforeseen change in interest rates on attracted, placed and borrowed funds of a commercial bank.

Interest rate risk assessment includes asset and liability management of the bank, which includes the following methods:

- economic value of the bank, duration (duration);

- gap of assets and liabilities by terms (GAP);
- net interest income, interest margin.

The economic value method is based on the concept of the present value of a financial instrument, calculated as the sum of all members of the payment stream generated by the instrument, discounted at market rates. This includes interest payments and debt repayments.

An important indicator that arises in such calculations is duration - the average duration of payments. Methods that reflect the possibility of earning income consider an impact of changes in interest rates on the amount of accrued interest. This is traditional approach to assessing interest rate risk used by many banks. Income fluctuations are the main objects of interest rate risk analysis, since a decrease in income or direct losses can pose a threat to the bank's financial stability. The simplest method of measuring interest rate risk is to determine the maturity gap between assets and liabilities. It was one of the first methods of its kind and continues to be widely used by banks. As an indicator characterizing the change in all interest payments of a bank, interest margin can be used - the difference between interest received and interest paid. Interest margin can be expressed in monetary units or as a percentage of earning assets. All methods of assessing interest rate risk involve forecasting future dynamics of interest rates and its impact on cash flows in the form of interest payment flows and a number of monetary financial instruments, such as, for example, a loan with a fixed rate.

To fully cover interest rate risk, it is necessary to take into account contribution of all sensitive assets and liabilities to it. Along with individual positions, it is advisable to consider their groupings (aggregates), united on the basis of one or another distinctive feature. In particular, all positions of the bank are divided into strategic, tactical and trading, forming three corresponding aggregated positions.

Typically, strategic position arises from bank's lending and deposit-taking activities. Strategic position tends to be stable and therefore requires less management activity. Changes in strategic position are usually accompanied by adjustments in the composition of loan and deposit package, often through changes in price and/or marketing strategy, to increase or decrease volumes, or change repricing dates for resources sold and bought.

Tactical positions are mainly a consequence of bank's activities related to financing and investing in money, capital and derivatives markets. These positions are largely related to working with securities. Since they tend to use liquid primary and secondary market instruments, they can be quickly adjusted in response to unexpected interest rate movements or changing expectations. Thus, tactical stance often reflects the conscious risk that bank takes in anticipating the movement of the interest rate on medium-term instruments (lasting from a week to several months). Banks also use a tactical stance to counterbalance an undesirable strategic stance for the time it takes to adjust the banking product mix. A tactical position requires daily management.

Trading position is taken in anticipation of movement of the interest rate on short-term instruments (lasting from a few minutes to one or two days). And although it exists only for a very short time, trading position can be large in size. To present a large position, trader must be sure that it can be closed within a few minutes. For this reason, trading positions are usually limited to money and securities markets in highly liquid secondary markets, as well as active derivatives markets. A trading position requires constant management. Usually at

the end of each working day, it should either close or be significantly reduced. ("Banking risks", A.A. Kazimagomedov, 2020).

3.4 Main forms of interest rate risk in accordance with classification of the Basel Committee

Repricing risk for floating interest rates. Economic value of floating rate financial instruments is less affected by changes in market interest rates than similar fixed rate instruments. The base rate serves as a kind of stabilizer, which directs change in contract rates following change in market rates. However, economic value of such instruments does not remain constant either, as the base rate may change differently than market rate. A change in economic value can also occur due to the fact that a change in the market rate does not coincide in time with a change in the base rate. As an implied rate used to calculate the change in the value of a financial instrument with a floating rate, it is natural to consider fixed rates for similar instruments. It should be noted that the use of floating interest rates by a bank serves as protection against the risk of changes in the value of financial instrument, and for borrower it is a source of liquidity risk. The fact is that borrower's interest payments are correlated with his income from sales. Uncertainty in the amount of interest payments introduces uncertainty into value of the company's current assets and threatens company's ability to pay its obligations. This is especially true for enterprises that use a large percentage of borrowed funds. Therefore, subject to expectation that interest rates will fluctuate in the future around the current level, an equivalent alternative to a fixed rate loan is a loan for an enterprise on the same terms with the replacement of a fixed rate by a slightly lower floating rate. Difference in rates, as it were, serves as compensation for the uncertainty of future interest payments. This difference can be considered when building interest rate risk management models. Depending on trend (growth, decline) of change, it is more profitable for an enterprise to take out a loan either at a fixed or at a floating rate, respectively.

Risk of a change in the yield curve. Bank's interest rate risk is determined by the structure of its assets and liabilities. A typical situation for a bank is a situation where long-term assets with a fixed rate are financed by short-term liabilities or liabilities with a floating interest rate. Since most often long-term rates exceed short-term rates, this position allows banks to receive necessary profit. But if short-term interest rate rises, then value of bank funds will rise, and at constant long-term rates, difference between interest income and expenses may not be enough to cover overhead costs. In extreme cases, this difference can even become negative. In such a situation, losses occur that reduce capital of the bank. For certain groups of financial instruments in bank's portfolio relationship between interest rates on these instruments and the time left to maturity looks like a smoothly growing curve. For example, this can be done for bonds, bills of exchange, loans, household deposits, provided that the instruments assigned to the same group are approximately the same in terms of risk and liquidity (government zero-coupon bonds of different issuance periods, loan agreements with borrowers of the same creditworthiness class, etc.).

Basis risk. Floating interest rates consist of two components: a base rate, usually in the form of the interbank offered rate, and a fixed premium, the amount of which is determined by specifics of the contract. Loan (deposit) agreement specifies procedure for adjusting floating interest rates. For example, it is stipulated that revision of the level of interest for a new interest period is made taking into account the value of a particular type of interest rate two

days before the start of a new interest period. An important source of interest rate risk (commonly referred to as basis risk) arises from imperfect correlation in adjustment of interest received and paid on various financial instruments that do not differ in all other characteristics when they are revalued. When interest rates change, these differences can cause unexpected changes in cash flows and in the margin received between the value of assets and liabilities. An important source of interest rate risk (commonly referred to as basis risk) arises from imperfect correlation in the adjustment of interest received and paid on various financial instruments that do not differ in all other characteristics when they are revalued. When interest rates change, these differences can cause unexpected changes in cash flows and in the margin received between the value of assets and liabilities.

Option risk. As indicated in the documents of the Basel Committee, option transactions, conclusion of which is typical for many types of bank assets and liabilities, are becoming an increasingly significant source of interest rate risk. Formally, an option gives its owner the right, but not the obligation, to buy or sell any financial instrument at a fixed price or at a certain date in the future. ("Banking risks", A.A. Kazimagomedov, 2020).

4. Operational risks

Operational risks are the possible losses of a commercial bank due to technical and technological errors, failures of equipment and the functioning of internal systems, including information and innovation technologies, unlawful encroachment, or civil law violation in the performance of banking operations and services.

4.1 Risks associated with settlement and payment documents

Settlement and payment risks are associated with possible failures in the technological chain of the passage of settlement and payment documents from the moment a client account is opened, documents are presented for payment until the funds are credited to the beneficiary's accounts and reconciliation of analytical and synthetic accounting materials. To prevent such risks, banks have an instruction that reflects the distribution of responsibilities and powers of a bank's operational employees. It clearly indicates duties of each responsible executor in the execution of the chain of settlement and payment documents. Responsible executors should closely monitor procedure for issuing settlement and payment documents received both from bank's clients and bank itself, the status of card indexes of unpaid settlement and payment documents, timeliness of reflecting amounts on customer accounts and correspondent (subcorrespondent) accounts.

Main settlement and payment risks include:

- risks of non-payment or violation of payment deadline;
- risks of non-compliance of chosen form of payment, method of payment and document flow with nature of transaction and content of settlement and payment transaction;
- risks of non-compliance and violation of legislative and regulatory requirements for organization of settlements;
- operational or technological risks associated with the quality of work of the relevant divisions of a bank;
- risks of interbank settlements.

The risks of non-payment or violation of payment deadline come in two forms:

1) non-receipt or untimely receipt of payment for goods supplied, work performed, services rendered due to the fault of the counterparty-buyer or the bank servicing him due to the lack of funds on the correspondent (subcorrespondent) account;

2) the impossibility of timely fulfilment of monetary obligations by the client due to the lack of funds from the servicing bank.

Risks of non-compliance of the form of payment, method of payment and document flow with adopted legislative and regulatory acts. For example, commercial banks do not interfere in contractual relations of clients in the forms they use, methods of payment (cash or non-cash). Mutual claims on settlements between payer and recipient of funds, except for those arising through the fault of banks, are resolved in manner prescribed by law.

Risks in settlements by checks for customers and banks serving them are as follows. Buyer's funds held in payer's bank are generally interest-free. With a long document flow for a payer, these are significant losses, since money in the account is diverted from economic circulation and does not generate income.

Seller also faces the problem of diverting funds from circulation, since shipped goods, work performed, services rendered are paid for after a certain time, which consists of time when checks are collected by seller's bank, sent for payment to buyer's bank, time when money returns from buyer's bank to the beneficiary's bank and crediting them to beneficiary's account. Limiting the amount of checks and limiting terms of circulation, use of checks requires additional control from a commercial bank over compliance with settlement and payment discipline, which increases cost and labour intensity of banking services and implies establishment by a bank of higher commissions, which should include, among other things, cost of strict reporting forms, cost of storage and accounting checks. Regulation on non-cash payments provides for an approach to recovering losses in the event of settlement and payment risks, in particular, risk of losses due to violation of the rules for paying checks due to exceeding check limit, incorrectly filling in details, theft, violation of the terms for crediting funds on a check, etc. In this case, one should take into account degree of guilt of each of the participants in settlements. These provisions can be detailed in internal bank documents on the organization and control of checks. (“Banking risks”, A.A. Kazimagomedov, 2020).

4.2 Illegal risks

From a legal point of view, illegal (legal) risks are crime, fraud, theft, abuse, infringement or civil violation. The main source of these risks is the absence of legislative acts regulating banking transactions and (or) the incorrectness of these acts. Study of such risks requires use of special procedures and means of minimizing them, constant study of new legal norms at the stage of their development, as well as the timely introduction of changes to the current regulations and internal documents of a bank in accordance with changes in legislation.

Criminogenic risks. In practice, such risks include encroachment on property and infrastructure of a bank. Bank's property includes own, borrowed, and borrowed funds, currency values and securities, property rights to intangible assets, information and innovative technologies, etc. Infrastructure of a bank includes elements of a property, legal,

organizational nature, and relationship between them, ensuring procedure for creation and functioning of a bank. In turn, they are divided into elements of internal and external infrastructure.

Significant internal infrastructure documents include:

- legislative and regulatory acts regulating banking activities;
- internal documents of a bank regulating banking products and technologies for conducting banking operations and services;
- accounting and reporting rules.

External infrastructure includes information, innovation and personnel support, as well as business reputation and business relations with bank's partners. In order to create optimal conditions for meeting information needs of bank's structural divisions, customers and correspondents, bank acquires and uses information and innovative technologies that ensure processing, storage and transmission of information.

Fraudulent risks are associated with various banking operations. The most common is the risk of fraud when obtaining a loan. Main methods of deception and breach of trust include providing a bank with false information about a future borrower, purpose of obtaining and form of collateral. For example, the most common types of false information about a prospective borrower - a legal entity are inaccurate information and documents about legal capacity and capacity of a borrower and his reputation, about identity of his manager or representatives, whether they have appropriate authority to obtain a loan, about financial capabilities of a borrower.

Risk of incurring losses from fraud in the field of credit transactions can be significantly reduced by implementing a number of preventive measures that should be carried out by the relevant departments of a bank, in particular:

- verify the authenticity of information and documents certifying the right of a borrower to conclude a loan agreement;
- obtain information confirming the real existence of a borrowing company by studying constituent documents, information from tax authorities, etc. Additional information about reality of existence of company-borrower can be provided by information about presence of permanent production and storage facilities, about volume of goods that company-borrower has;
- establish creditworthiness and solvency of a borrower to repay the principal and interest on it;
- check an adequacy of borrower's own capital investments in the credited transaction, which can be judged from balance sheet data, cash settlement documents and other primary accounting documentation;
- conduct a thorough legal and factual assessment of the authenticity of documents on the form of loan security;
- after issuing a loan, it conducts credit monitoring (current and subsequent control).

In order to prevent losses from fraudulent actions when making settlements for letters of credit, settlement participants should take into account:

1) the buyer needs to obtain information confirming the fact of real existence of the seller's company, reliability of proposed counterparty and the possibility of carrying out proposed delivery, using for this:

- address of the permanent executive body of a legal entity,
- surname, name, and position of a person entitled to act on behalf of a legal entity without a power of attorney, as well as passport data of such a person or other data or data of other documents proving his identity,
- information about licenses, branches, and representative offices of a legal entity, as well as information about possible presence of a legal entity in the process of insolvency (bankruptcy),
- recommendations from former partners of a company,
- visiting working, warehouse and other premises of a potential counterparty, his telephone numbers, faxes, e-mail addresses,
- verification of an actual possibility of implementing a scheme for proposed supply of goods;

2) preventive measures of the bank should include:

- procedure for concluding an agreement on settlement and cash services with a future client,
- verification of compliance of documents submitted for payment and their details with the terms of a letter of credit,
- compliance of signatures and seals of recipient of funds with samples, indicated in signature card and their authenticity,
- verification of authenticity of documents proving identity of a recipient of funds, whether he has an appropriate authority to receive money, correct execution of power of attorney,
- verification of an authenticity of identity documents of the buyer's representative (payer under a letter of credit) and his power of attorney in case of his participation in acceptance of goods, if provided for by the contract.

Fraud in letters of credit is associated with the statement of false information about the execution of the main contract. So, in one of the cases, an executing bank made a payment under a covered letter of credit, violating its following conditions. A packing list was used instead of a bill of lading. Bank was presented with a power of attorney for delivery of products, while this should be a power of attorney for the delivered products. Under the terms of a letter of credit, an act of accepted goods was required, and an act of acceptance and transfer of goods was presented. In another case, the bank paid money under a letter of credit on the basis of fraudulent documents, including a register of accounts, which did not include: indication of numbers, dates of acceptance and delivery of documents and type of transport, and signature and seal of supplier did not correspond to the declared samples. At the same time, shipping and other documents stipulated by the terms of a letter of credit were not presented at all.

Risks of theft in most cases are carried out as a result of a theft of securities, cash, currency values. For example, the main methods of fraud and breach of trust that are used to fraudulently take possession of a bill include:

- taking possession of a bill under the guise of its purchase, using forged payment documents;
- substitution of a genuine bill for a fake one in the process of exchanging documents, concluding a “deal” or other actions related to temporary withdrawal of a bill from possession with a victim;
- taking possession of a bill in exchange for non-existent goods;
- taking possession of a previously sold promissory note under guise of restoring the right to a lost promissory note.

Measures to prevent fraudulent activities in the sphere of bill circulation include:

- legal measures that are based on an internal document of an organization regulating the procedure for issuing, storing, issuing and accepting securities for payment;
- organizational measures, which include: creation of a unified information system of data on issued, issued, redeemed, lost, stolen, counterfeit bills; procedure for storing promissory notes and promissory notes themselves; delimitation of powers of employees involved in bill circulation; protection of information about unused promissory notes;
- measures of a technological nature - a description of the procedure for drawing up and conditions for issuing a bill; documenting facts of issuance and redemption of a bill; prevention of reuse of a redeemed bill; determination of order of work with presented non-payment bills;
- forensic measures include actions aimed at proactive protection of a security by performing so-called promissory notes (hidden or encrypted signs of the authenticity of a security), as well as examination of securities presented for payment.

Measures to prevent theft in the process of cash transactions include: establishment of personal responsibility for cash workers for the assignment of the assigned work with cash to other persons. To prevent errors and abuses, cashiers are prohibited from combining operational and accounting functions - directly fulfilling clients' instructions for conducting cash transactions on their bank accounts, as well as accepting documents from them for depositing money or receiving money from income and expenditure documents, bypassing operational workers. It is forbidden to keep your money and other valuables at the cash desk together with bank's money and valuables.

Abuse of authority can be committed in the form of concluding an agreement that is obviously not beneficial for the bank; entering into commercial relations with bankrupt firms or with fraudulent false firms; in the form of lending to obviously insolvent partners; illegal transfer of restricted information to third parties; in the form of using details of the bank for commission by an individual on behalf of the bank of illegal banking operations.

Prevention measures are carried out in the form of administrative and financial control. The task of administrative control is to prevent deviations from the procedure for conducting transactions, which should be carried out only by authorized persons in accordance with the powers and decision-making procedures defined by a bank. Financial control should prevent possible deviations from accepted monetary policy of a bank.

Measures to protect against abuse of authority include control over the selection and placement of personnel in order to protect a bank from persons with a dubious business and public reputation or insufficiently competent. (“Bank management”, I.O. Lavrushin, 2009).

4.3 Reputational risks

Another type of operational risk is reputational risk, which is little studied and poorly managed. It can negatively affect the business reputation of the bank, and in some circumstances - its bankruptcy. There are some indicators that warn about the business reputation of the bank:

- complication of recruitment and retention of personnel (personnel risk);
- increase in customer turnover and an increase in cost of attracting them (client risk);
- loss of market share and lower profits;
- increase in interest rates and tariffs for banking products (interest rate risk);
- worsening conditions with creditors;
- strengthening inspections by control and supervisory authorities.

The basis of the bank's business reputation can be considered risk identification, which begins with a description of the types and types of events. Analysis requires a detailed description of particularly important indicators, including the impact on stakeholders, possible promotion in the media and other key elements. Valuable information can be provided by study of risky liabilities that take place in other banks. These metrics should be integrated with actions based on threat and scenario analysis. Next stage is risk measurement and assessment, which allows the bank to improve the effectiveness of risk management. It is necessary for the careful collection, value and quantitative processing of information. This stage consists of a quantitative measurement of the impact of risk, an assessment of its probability and an assessment of management. Quantitative assessment of reputational risk involves the calculation of financial indicators from a change in the business reputation of a commercial bank. When analyzing reputational risk, simulation modeling can be used. The significance of this stage can be recommendations based on a qualitative and quantitative assessment of the costs necessary to minimize the business reputation of the bank.

Risk control and its purpose is to translate recommendations from assessment stage into practice, into the adjustment of a bank management strategy. This stage can contribute to the improvement and introduction of new banking products, reorganization of bank's departments, appropriate actions in the field of marketing and advertising activities of a bank and its public relations. Risk monitoring should be linked to experiences, perceptions, actions, media coverage. In order to mitigate reputational risk, a bank needs to promptly identify and process early warnings about changes in a risk environment and management environment and calculate and take corrective action as situation changes. Bank must have a clear idea of its mission and a clear strategy of activity, and the personnel must be the basis of bank's business reputation.

Personnel risk. Risks associated with a person can be external - the presence of unreliable customers and internal - the lack of loyalty of employees towards the bank. The following risks associated with personnel policy are distinguished:

- insufficient professional and qualification base of employees;

- irresponsibility and desire to self-assert employees;
- problem of replacing the “old” and departure of highly qualified personnel;
- general fatigue and inability to withstand stress;
- excessive competition, etc.

Risks associated with the specifics of the bank's clients. As we know, bank is a commercial enterprise. The main principle of the relationship between “bank and client” is the principle of making a profit by a bank at lower costs and the principle of minimizing all types of risk. Bank actually can risk (and it risks every day in the course of its activity) its own capital, but not the capital of a client, his profit. In order to minimize risk, bank should:

- diversify portfolio of its clients, which leads to diversification of all types of risk, i.e. its distribution;
- try to provide loans in the form of smaller amounts to a larger number of customers;
- provide consortium loans, etc.

Risk level of banks depending on the size of a client. Depending on the size of the enterprise, customers are classified into three groups - small, medium, and large. Small and medium-sized borrowers are more flexible and can quickly respond to the needs of a market and client. Their structure is lighter, which makes it possible for them to quickly change the direction of their business activity, to receive high profits. For example, in the US, the state provides subsidies and opportunities for medium-sized enterprises to engage in active scientific research and new directions. Getting results is faster. But small and medium-sized enterprises usually have a small equity capital, which leads to bankruptcy in the face of fierce competition, some unforeseen political and economic changes (risk of force majeure). Often, they have a small number of clients, control small market windows, niches and/or segments. Large enterprises, on contrary, are more inert. They do not respond quickly to changes in the needs of a market and specific consumer. They don't often change direction of their business, but they have a solid net worth and can survive some adverse economic situations. In other words, they almost always provide average profit and profitability. Such enterprises have an opportunity to create subsidiaries, branches, expand their market, turn it into an international business. (“Banking risks”, A.A. Kazimagomedov, 2020).

4.4 Information and innovation risks

One of the important components of information and innovative technologies in the market of banking products is currently the worldwide network - the Internet, which appeared in the 1990s. Prerequisites for emergence and functioning of information and innovative technologies are:

- merging telephone and computer systems of telecommunications and information processing into one model;
- replacing paper with electronic means, including electronic banking, e-mail, faxing of documents and remote banking services for clients;
- expansion of television service through cable systems with multiple channels and specialized services, allowing direct connection to consumers' home terminals;
- reorganization of information storage and computer-based query systems into an interactive information network accessible to research groups;

- direct receipt of banking information through library and home terminals;
- gradual expansion of the education system based on computer training, etc.

Thus, information risk is the risk of loss or damage as a result of the use of information and innovative technologies associated with creation, transmission, storage and use of information.

To ensure cost effectiveness of preparing databases and reducing risk of information leakage, an information and innovation technology producer must:

- focus on the presentation of high-quality, unique information;
- attract a significant number of users, provide
- various ways to access the database;
- develop together with software developers, which ultimately facilitates and simplifies use of information dissemination channels;
- justify tariffs for services provided;
- apply new technologies that reduce costs not only for dissemination, but also for its preparation, including data collection and input.

Thus, to ensure protection against information and innovation risks, following procedures are necessary. First, determine group of people who are responsible for information security. Secondly, it is necessary to ensure that any documents are created using systems centrally installed on computers. Installation of third-party programs must be authorized by the bank's management, otherwise the risk of failures and viruses increases sharply. Thirdly, it is necessary to implement controls that allow monitoring status of all corporate systems.

Bank cards risks. An extremely important point that ensures the safety of the bank and its customers when conducting operations with bank cards is to ensure the normal mode of transportation, storage and destruction of bank cards, new and used. Organization of these processes should be aimed not only at ensuring impossibility of losing the card and using it by anyone outside the bank, but also ensuring that card cannot be copied and used by bank employees. Consider basic rules, observance of which will minimize risks associated with above reasons. Storage of non-personalized bank cards must be determined by an internal document of a bank. At the same time, the person responsible for their safety and place (safe) where they will be stored must be determined. It is important to determine mode of storage of the main and spare keys to safe in order to exclude access to non-personalized cards by unauthorized persons. Similarly, storage of PIN-envelopes should be organized. At the same time, safes for storing cards and envelopes and persons responsible for their use should be different. Each safe must contain an up-to-date inventory of its contents. Production of PIN envelopes and personalization of cards should be carried out by different employees.

Features of accounting for cash withdrawals through ATMs and possible risk factors. A bank's ATMs, as a rule, allow cash withdrawal operations both with cards issued by the bank itself and with cards issued by other banks. The data for these transactions is processed differently. When issuing funds through ATMs, an authorization request is necessarily generated. After withdrawal operation, withdrawn amount is blocked on the client's account. At the end of the day, data on transactions carried out at the bank's ATMs are transferred to the back office, where transactions carried out on “inner” and “other” cards are recorded. ATM also records the transactions performed on the ATM tape.

Operations carried out at ATMs are recorded on the balance sheet account. Data on balances in each ATM are formed in the processing center based on information received from each ATM. The processing center generates checklists (in different payment systems they may be called differently). The main problem of accounting for cash withdrawal operations at an ATM is that the moment of formation of data on the balance in an ATM and the moment of formation of the balance on the corresponding bank account are different. This does not allow accurate data matching and is a potential source of error and abuse. The simplest and most reliable way to reduce the risk of error or abuse is to synchronize the balances in ATM and in the corresponding account at the time of collection. The collection protocol must contain the amount of collected balance and the exact time of collection. To carry out control procedure, the balance on the account corresponding to the ATM at the end of the day of collection is brought, using the data of the ATM tape or the checklist, to the balance at the time of collection. The balance at the time of collection, calculated in this way, is compared with the balance recorded in the protocol of collection. In the absence of abuse and errors, there should be a complete match.

Modern ATMs are devices with a sufficiently high degree of protection against external interference and from unauthorized issuance of banknotes. Issuance of banknotes is carried out, as a rule, with the help of a special device that allows you to separate sticky banknotes, control thickness of a banknote and compare it with the reference value. If thickness differs from the reference bill, it is dropped into a reject cassette. Each stage of banknote's passage along the dispensing path in the ATM is recorded by a special sensor, and in case of violation of a banknote passage along the path, banknote is also sucked into a reject cassette. In case of failure or inadequate response to commands from the processing center of nodes and control devices of the ATM, the ATM must be forcibly stopped. Command to force stop the ATM is generated: automatically by the processing center program, which must have the appropriate settings for this. (“Banking risks”, A.A. Kazimagomedov, 2020).

5. Risk of bankruptcy, insolvency, and liquidity of commercial bank

5.1 Risk of bankruptcy

The bankruptcy (insolvency) of a bank is understood as the inability of the bank to satisfy the claims of creditors for monetary obligations and (or) to fulfill the obligation to make mandatory payments. How to avoid intentional bankruptcy? How to resist a very sophisticated manifestation of deliberate bankruptcy - an unfriendly takeover by one bank of another? With such manifestations of the risk of bankruptcy, apparently, it will never be possible to fight "technical" means. What is needed here is not so much specific economic methods of struggle as firm determination and manifestation of authorities. When political will is firmly expressed at the state level and tough legal and regulatory sanctions are persistently put into practice, then economic methods will start to work. As soon as an entrepreneur-banker believes in decisiveness of authorities, he himself will immediately show his characteristic "economic" character, and the system of combating deliberate bankruptcy will immediately become self-regulating.

The risk of bankruptcy can be characterized by the following indicators:

- difference in market rates for debt securities issued by a bank and government securities with similar maturities. An increase in the margin may mean that investors see increased risk from buying bank debt;
- ratio of the price of the bank's shares and its annual profit per share;
- ratio of borrowed funds to total liabilities and a number of other characteristics.

Bank failure prevention measures include:

- financial rehabilitation of a bank (providing financial assistance to the bank, changing the structure of assets and liabilities, bringing the size of a bank's own capital in line);
- appointment of a temporary administration for management of a bank is carried out in case of failure to comply within established period of instructions to eliminate violations identified in activities of a commercial bank, as well as if these violations or operations and services performed by a bank created a real threat to the interests of its creditors (depositors);
- reorganization of the bank can be carried out by changing composition and number of employees, reducing and liquidating separate and other structural divisions of a bank, as well as in other ways that help eliminate the reasons that necessitated implementation of measures for the financial recovery of a bank.

Risk of bankruptcy (insolvency) is preceded by the risk of insolvency and liquidity of a commercial bank. ("Banking risks", A.A. Kazimagomedov, 2020).

5.2 Insolvency risk

Insolvency risk is associated with the danger that a bank will not be able to meet its obligations if the amount of accumulated losses and losses exceeds its own capital. In order to pay off obligations on time, bank always needs to have a sufficient amount of money or quickly realizable (liquid) assets. There should not be too much money in the bank vault, as they do not generate income. Too many non-performing" assets is a factor in a loss of solvency, which is quantitatively reflected in the occurrence of losses and loss of capital.

The definition formulated above allows us to conclude that only a bank whose capital is greater than zero can be considered solvent. Therefore, the measure of assessing solvency of a bank is its capital, and solvency indicator should be equal to:

$$market\ value\ of\ assets - liabilities > 0.$$

On the other hand, desire of a bank to strengthen its solvency, increase its own capital through highly profitable operations with the maximum use of its resources, can lead to a loss of liquidity due to a mismatch between the maturities of assets and liabilities, failure by counterparties to fulfill their obligations to a bank, changes in exchange rates, etc. Therefore, the restoration of liquidity requires the immediate receipt of funds. This can be done with the help of borrowed and borrowed funds. The urgent need for these operations entails a concession in interest rates and sale prices of assets, which negatively affects profits and capital, i.e. on solvency. In this regard, in many countries there is a regime of refinancing of banks by the central bank within the framework of the discount rate, which allows solvent banks to receive the necessary funds in the presence of the necessary collateral. ("Banking risks", A.A. Kazimagomedov, 2020).

5.3 Liquidity risk

In order to systematically describe banking risks, it is necessary to consider bank as a commercial organization that seeks to analyze its activities during its period of existence. Timely fulfillment of all its obligations, presented to it for execution in a certain period of time, is the liquidity of a bank. In addition, bank's liquidity is its ability to quickly and at minimal cost turn its assets into money to meet emerging obligations. Liquidity risk is associated with cash gaps, lack of funds, mismatch of cash flows coming from buyers to pay for shipped goods, cash flows necessary to pay off accounts payable and current payments.

To minimize this risk, it is advisable for a bank to take the following measures:

- assess the level of liquidity risk on a regular basis based on the results of all transactions made during the period, taking into account changes in external economic conditions;
- conduct a preliminary analysis of the possible impact on a bank's liquidity level of bank's planned major transactions.

Bank's liquidity management policy should define liquidity limits, an asset and liability management strategy in order to maintain a sufficient level of bank's liquidity, and methods for assessing the level of liquidity risk. It is advisable to build an operational analysis of bank's liquidity risk on the basis of an analysis of factors causing it, in particular, correspondence between the structure of claims and liabilities, degree of liquidity of assets and liabilities.

For the purposes of such an analysis, can be used the table of gaps between assets and liabilities by maturity and results of all transactions made during the period, taking into account changes in the external monetary and stock markets. Comparison of data in the liquidity table at the beginning and end of the period makes it possible to assess the impact of transactions performed during the day on the bank's liquidity position. The asset-liability gap analysis method by maturity allows the bank's management to immediately see mismatches between assets and liabilities maturing over different periods of time and predict likely mismatches in cash inflows and outflows in the future, which is the time to take corrective measures to maintain liquidity.

Thus, liquidity risk is the possibility that in a certain period of time a bank will not have enough liquid assets in order to fulfill all obligations presented to it in this period of time in a timely manner. Consequently, after which the risk of insolvency will follow, as mentioned above, bank cannot fulfill its obligations if the volume of accumulated losses and losses exceeds its own capital. A bank that has a sufficiently large capital, but has issued many long-term loans at the expense of short-term deposits and is not able to raise the necessary funds in a short time, may turn out to be illiquid, while remaining solvent. (“Banking risks”, A.A. Kazimagomedov, 2020).

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