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Graduate School of Management

Master in Corporate Finance

BANKRUPTCY RISK OVER THE BUSINESS CYCLE: FACTORS IDENTIFICATION

Master's Thesis by the 2nd year student
Concentration – Corporate Finance
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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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АННОТАЦИЯ

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Факультет	Высшая школа менеджмента
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Описание цели, задач и основных результатов	Макроэкономическая среда существенно влияет на результативность деятельности отдельных компаний и, следовательно, на вероятность банкротства фирм в различных отраслях экономики. Однако существующие модели оценки и прогнозирования риска банкротства в основном учитывают только финансовые показатели деятельности компании, при этом упуская влияние макроэкономических факторов. Поэтому представляется интересным проанализировать проблему оценки риска банкротства с учётом макроэкономических показателей, динамика которых демонстрирует циклический характер и отражается в деловых циклах. Цель магистерской диссертации – определение факторов, влияющих на риск банкротства компаний на протяжении делового цикла в российской макроэкономической среде. Главные задачи исследования: определить факторы и причины банкротства; проанализировать существующие модели оценки риска банкротства, основанные на показателях отчетности и включающие макроэкономические переменные; разработать регрессионные модели, связывающие риск банкротства с показателями деловых циклов. Результаты проведенного исследования показали, что макроэкономические показатели делового цикла влияют на риск банкротства компаний, и степень их влияния меняется в зависимости от фазы делового цикла: более сильное воздействие макроэкономических показателей на риск банкротства проявляется на восходящей фазе цикла. В свою очередь, воздействие финансовых показателей компании на риск банкротства тоже зависит от фазы делового цикла. Финансовые коэффициенты, характеризующие прибыльность компании, сильно связаны с риском банкротства на протяжении всего делового цикла, в то время как показатели структуры капитала проявляют более значительное влияние на риск банкротства в нисходящей фазе цикла.
Ключевые слова	Риск банкротства, модели прогнозирования банкротства, деловые циклы, макроэкономические показатели, финансовые показатели, логистическая модель

ABSTRACT

Master Student's Name	Lisetskaia Anfisa
Master Thesis Title	Bankruptcy risk over the business cycle: factors identification
Faculty	Graduate School of Management
Main field of study	Corporate Finance
Year	2016
Academic Advisor's Name	Anna E. Loukianova
Description of the goal, tasks and main results	External macroeconomic environment strongly affects performance of separate companies and, consequently, influences probability of going bankrupt for enterprises in different industries. However, existing bankruptcy risk estimation approaches are mainly based on financial ratios of an enterprise, omitting the influence of external macroeconomic factors. Therefore, it is interesting to analyze the problem of bankruptcy risk estimation in the light of macroeconomic environment, which is characterized by cyclical dynamics and reflected in the business cycles. The goal of the master thesis is determination of factors influencing bankruptcy risk over the business cycle in Russian macroeconomic environment. The main objectives are to identify factors and reasons of bankruptcy; to analyze existing accounting-based models and models with macroeconomic variables for bankruptcy risk diagnostics; to develop models that associate bankruptcy risk with business cycle indicators. Results of the conducted research showed that corporate bankruptcy risk is affected by business cycle indicators. However, the power of influence varies depending on the business cycle phase: macroeconomic indicators demonstrate stronger relation to bankruptcy risk during the upward phase of the business cycle than during the downward phase. In turn, influence of financial indicators on bankruptcy risk also depends on the business cycle phase. Profitability ratios are found significant for bankruptcy risk explanation over the whole business cycle, while financial structure indicators express stronger relation to bankruptcy risk in the descending phase.
Key words	Bankruptcy risk, bankruptcy prediction models, business cycles, macroeconomic indicators, financial ratios, logit model

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INTRODUCTION

Thematic justification. External macroeconomic environment strongly affects performance of separate companies and, consequently, influences probability of going bankrupt for enterprises in different industries. Economic booms and recessions, in particular, recent global financial crisis, emphasize the importance of understanding the link between economic state in the country and corporate bankruptcy probability in order to timely initiate appropriate measures on company's level. To mitigate negative external risk factors, companies should regularly monitor them and adapt to them.

Beginning from 1960s, a wide variety of bankruptcy risk estimation models was developed (the most known of them were suggested by Altman, Ohlson, Fulmer, and others). However, these approaches are mainly based on financial ratios of an enterprise, omitting the influence of external macroeconomic factors. Detailed consideration of bankruptcy risk components allows assuming that bankruptcy risk is influenced by both financial and macroeconomic indicators. Development of bankruptcy risk diagnostics models with macroeconomic variables is a relatively new field of the recent research. Therefore, it is interesting to analyze the problem of bankruptcy risk estimation in the light of macroeconomic environment, which is connected with the business cycle. In the current study the relation of macroeconomic factors to corporate bankruptcy risk is analyzed via the concept of medium term Juglar business cycles.

The goal of the current study is determination of factors influencing bankruptcy risk over the business cycle in Russian macroeconomic environment.

To achieve this goal the following **research objectives** were set:
1) to identify factors and reasons of bankruptcy;
2) to specify the role of bankruptcy risk in the system of financial risks;
3) to analyze existing accounting-based models and models with macroeconomic variables for bankruptcy risk diagnostics;
4) to describe the emergence of business cycles in the Russian economy;
5) to identify indicators of business cycles in Russian economy;
6) to relate dynamics of bankruptcy in Russia to the Russian economic business cycles;
7) to develop models that associate bankruptcy risk with business cycle indicators.

The **object** of the research is influence of macroeconomic indicators on corporate bankruptcy risk.

The **subject** of the research – business cycle factors that affect corporate bankruptcy risk in Russian macroeconomic environment.

The theoretical foundation of the current thesis consists of studies and ideas of foreign and Russian researchers. The most significant were papers of Altman E.I., Ohlson J.A., Zmiewski M.E., Giordani P., Jacobson T., Haydarshina G.A., Totmyanina K.M., Juglar C., Kondratiev N.D. and others.

Thesis structure. The goal and research objectives determined the structure of the current study.

The first chapter is devoted to the category of bankruptcy risk and its place in the system of financial risks. Main corporate bankruptcy factors and reasons are highlighted. Analysis of existing accounting-based models for bankruptcy risk estimation allows selecting a number of financial ratios, which are potentially essential estimators of bankruptcy risk and significant for the purposes of the current study.

The second chapter concentrates on business cycles in Russian economy and their relation to frequency of bankruptcies in the real sector. Business cycle influence on macro and micro levels is discussed. This part ends with the overview of several foreign and Russian models with incorporated macroeconomic variables, which form the basis for our further research.

The third chapter presents the research methodology, data description and research findings. Logistic regression analysis, which is the core part of the methodology, is based on data of Russian enterprises from manufacturing industry.

Theoretical implication of the research is an improved understanding of factors influencing corporate bankruptcy risk. In addition, directions for further research are formulated in conclusion. Practical implication is mainly concerned with purposes of internal managers of a company, suggesting a set of indicators affecting bankruptcy risk, which should be monitored in order to prevent negative consequences and financial losses.

CHAPTER 1. BANKRUPTCY RISK AND APPROACHES FOR ITS ESTIMATION

1.1. Bankruptcy as a stage of crisis processes in a company

One of the key objectives of company's management is to prevent company's transition into bankruptcy. In order to prevent adverse consequences, company's system of financial management requires elaborate mechanism of bankruptcy risk diagnostics, quickly responding to any changes in financial and economic activity.

In general, bankruptcy occurs when a firm is not able to cover its obligations to creditors, suppliers, shareholders, employees, etc (Achim and Borlea 2012).

In Russia, according to laws in action (the Federal Law No.127-FZ dated October 26, 2002 "On Insolvency (Bankruptcy)" with amendments) bankruptcy is defined as "recognized by a court of arbitration, an inability of a debtor to meet in full the claims of creditors relating to financial liabilities, payments of severance benefits and/or remuneration to employees and/or to settle the mandatory payments."

At the same time, the Federal Law "On Insolvency (Bankruptcy)" distinguishes between definitions of bankruptcy and insolvency. Insolvency means "caused by the lack of funds, termination by a debtor firm to fulfill financial obligations and compulsory payments".

According to the Russian legislation, an enterprise is considered to be a bankrupt if the following two criteria are fulfilled:

- Financial liabilities, mandatory payments and other obligations have not been paid within three months after their due date;
- Claims in respect of an indebted entity represent, in total, not less than three hundred thousand Rubles.

Bankruptcy is aimed, on the one hand, to help business to survive, protecting indebted company from creditors, and, on the other, to defend the interests of creditors, ensuring full or partial repayment of provided funds (Nikolaeva and Paluvina 2014). Bankruptcy proceedings are intended to restore company's solvency and overcome financial distress via restructurisation of the company. Furthermore, launch of bankruptcy proceedings implies replacement of executives, who do not perform their duties.

However, bankruptcy also entails some negative consequences, which include partial loss of creditors' funds, job cuts, and the possibility of criminal bankruptcy associated with property redistribution. A large number of bankruptcies in national economy result in higher unemployment rate and decreasing effective demand. At the same time, the increase in budget expenditures related to social payments is in evidence, while tax revenues decline.
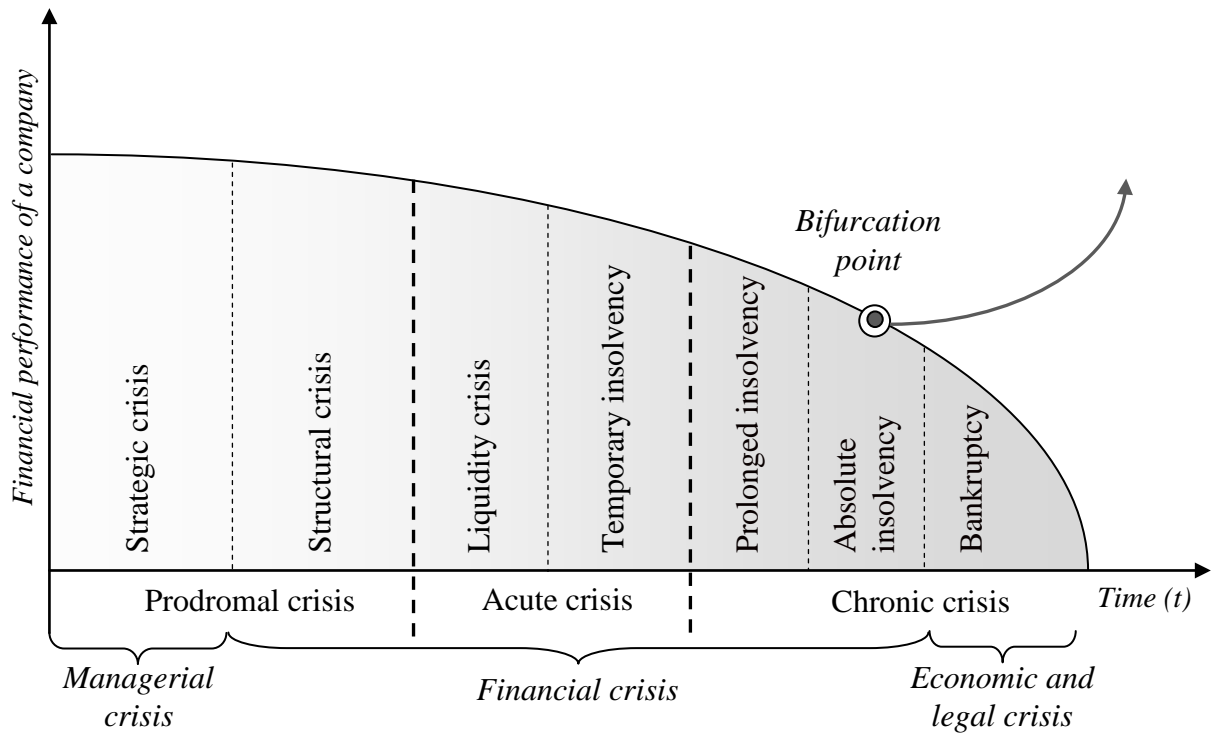
Figure 1. Phases of crisis processes in an enterprise

Source: Zhdanov (2011).

The inevitable consequence of Russia's transition to the market economy was a development of such concepts as "crisis", "insolvency" and "bankruptcy". To analyze and distinguish among such close but essentially different terms, we refer to the crisis theory.

Crisis can be defined as "an unstable time or state of affairs in which a decisive change is impending – either one with a distinct possibility of a highly undesirable outcome, or one with a distinct possibility of a highly desirable and extremely positive outcome" (Darling, Seristö and Gabrielsson 2005, p.347). According to the definition, crisis is not necessarily a bad event, but it is clearly accompanied by a certain degree of risk and uncertainty.

Crisis is an integral phase of company's life cycle and can be divided into three distinct periods: prodromal crisis, acute crisis and chronic crisis. Additionally, the progression of crisis process can be described as transformation of managerial crisis to financial distress and, finally, to economic and legal crisis. These phases include seven stages of crisis development: strategic crisis, structural crisis, liquidity crisis, temporary insolvency, prolonged insolvency, absolute insolvency, bankruptcy. Suggested classification assumes that bankruptcy appears to be the end point of the crisis, when the company is totally unable to cover its debts.

Awareness of the main phases of crisis process facilitates recognition of crisis at an earlier stage. It reduces the development speed and intensity of crises processes, time of their occurrence, severity of the crisis and its consequences.

Prodromal crisis. Crisis processes start with a strategic crisis, which is triggered by insufficient development of a strategic management system in a company. Expansion of the strategic crisis leads to a structural crisis. This stage is characterized by decrease of company's activity, market share and profits, staff reduction.

Acute crisis begins with a liquidity crisis, which is marked by increasing debts to creditors and deteriorating liquidity indicators. If no measures are taken at this stage, the situation may worsen and transform into a temporary insolvency. Temporary insolvency is caused by the lack of funds due to the fact that receivables are not fully recovered.

The last phase of crisis processes in a company is a **chronic crisis**. If no administrative measures to resolve the crisis have been taken, the company enters a period of chronic or unsurmountable crisis, which is marked by the absence of internal liquid resources in the company. Prolonged insolvency occurs when a company cannot repay financial liabilities due to the lack of assets and to restore the solvency, company has no other choice but to attract external funding. If things get worse, company moves from prolonged insolvency to bifurcation point of company's development, after which a firm either overcomes the crisis and continues its activity, or launches bankruptcy proceedings. There are two possible outcomes of the situation when the company faces absolute insolvency – either merger, acquisition and restructuring procedures without arbitration, or filing for bankruptcy (Vorotnikova and Pshipiy 2015).

It is necessary to distinguish between concepts of "bankruptcy" and "insolvency", because insolvency is a result of liabilities excess over assets value and takes place without recognition by a court of arbitration. Court of arbitration only confirms signs of insolvency and recognizes a firm to be a bankrupt. Therefore, while the term "insolvency" has economic meaning, "bankruptcy" is both economic and legal category.

It is reasonable to state a causal link between insolvency and bankruptcy. On the one hand, the bankruptcy cannot be confirmed without the fact of insolvency. On the other hand, insolvency is the main reason to apply bankruptcy law. It is worth mentioning that insolvency is not the fact of company's bankruptcy, but only a prerequisite, a turning point in development of a firm (Zhdanov 2011).

Bankruptcy has a variety of modifications. The following classification of bankruptcy types is the most frequently used:

- *Real bankruptcy* involves actual loss of capital employed. As a consequence, company is unable to restore solvency and financial system in subsequent periods. The company starts legal bankruptcy proceedings, because unsurmountable level of capital losses does not allow the firm to effectively continue its business activities.

- *Technical bankruptcy* occurs as a result of significant delays in collection of receivables. However, the amount receivable exceeds accounts payable, and company's assets significantly exceed its financial obligations. That is why it is possible to avoid legal bankruptcy through successful crisis management.

- *Intentional (deliberate) bankruptcy* is deliberately created insolvency of a company, which is aimed at infliction of economic damage to the company. This type of bankruptcy is a consequence of poor management, which pursues personal interests or interests of individual groups. According to the Russian legislation, deliberate bankruptcy is a criminal offence.

- *Fictitious bankruptcy* occurs when a company gives knowingly false information about its insolvency in order to mislead creditors and obtain a delay in payments or debt discounts. Fictitious bankruptcy is also illegal way to terminate business activity.

- *Latent bankruptcy* takes place when a company intentionally hides the fact of bankruptcy. If latent bankruptcy incurs tangible damage to creditors, such activity is a subject to legal prosecution (Nikolaeva and Paluvina 2014).

In Russia the problem of fictitious and intentional bankruptcy identification is of high importance. Despite the fact that the fictitious and intentional bankruptcy is part of economic crime, the trend in this area shows a growing tendency. The use of bankruptcy institute for personal purposes impedes the implementation of main functions of this institute – improvement of the economy and creation of effective competitive environment.

Today some factors prevent effective control after fraudulent bankruptcy, and one of the main problems is the absence of clear description of components of fictitious bankruptcy in legislation. Other difficulties connected with identification of fictitious and intentional bankruptcy are connected with concealing assets or financial liabilities, concealing information about property, transfer of property to other owner, property destruction, falsification of accounting and other registration documents (Abdullaev 2014).

The main learning point for our research is that existence of such types of fraudulent defaults may distort bankruptcy statistics, which we use for modeling. However, for the purposes of the current study we assume all enterprises under consideration to file for real bankruptcy.

1.2. Factors and reasons of bankruptcy

In many cases difficulties in the macroeconomic environment, accompanied by general decline in production and rise in cost of capital, trigger crisis process in business units. Economic crises may lead to mass bankruptcies, because economic agents are closely related to each other. As market economy is a complex system of interactions among various entities, which are connected by contractual relationships, financial difficulties of companies may be transferred to their business partners and take significant scale. Thus, contractual relationships strengthen interconnection and interdependence of market participants, when insolvency of one of the parties and its default on obligations causes adverse financial and economic consequences for its counterparties.

However, economic crisis is not the only period when it is possible to observe bankruptcies. Some entities may file for bankruptcy during economic expansion, and explanation may be in increasing competition. Period of economic growth is characterized by favorable external conditions, which usually facilitate intensive production expansion and fierce competition. In such a situation, many companies are unable to compete due to an inefficient development strategy and management.

It should be realized that cyclical development is inherent for the market economy. In large part because of the bankruptcy process, periods of economic decline and crises facilitate the renewal of the economy. Bankruptcy is a necessary mechanism to get rid of inefficient enterprises, clearing markets for other potentially more effective economic entities.

Therefore, market mechanism entails failures of inefficient economic agents. Competition, cyclical development, market uncertainty and information asymmetry create conditions, in which sustainable economic development of a company cannot be guaranteed.

The issue of bankruptcy factors and reasons has been widely discussed in literature. However, usually the difference between the bankruptcy factors and reasons is not clearly stated. Lvova O.A. distinguishes between bankruptcy factors and reasons, claiming that bankruptcy factors exist due to changes in external and internal conditions of company's operating environment and exert negative impact only when bankruptcy reasons occur (Lvova and Peganova 2014).

Bankruptcy factor can be defined as a disturbing event or trend, which indicates the possibility of crisis with subsequent insolvency and bankruptcy of a company. Bankruptcy factors affect all areas of business activity. In general, bankruptcy of firms results from the development of crisis processes due to the influence of macroeconomic and microeconomic factors.

The majority of researchers highlight the following macroeconomic factors, influencing bankruptcy risk:

- crisis state of the real sector;
- high interest rates;
- structural imbalances in the economy;
- high barriers for entering the capital market;
- instability of the tax and customs system;
- dependence on export of raw materials;
- high volatility of the exchange rate;
- reduction of the innovative capacity in the national economy;
- lack of funds available for long-term investments;
- decline in consumer demand;
- deterioration of the investment climate;
- high inflation rate.

External factors affecting bankruptcy also include political factors:

- weak government support of home producer;
- undeveloped legal and regulatory framework.

Macroeconomic factors influence the whole economic environment, but only some companies become insolvent and leave the market. The existence of microeconomic factors explains this situation. Among the most significant internal factors researchers state as follows:

- production of goods and services with low market demand or of noncompetitive quality;
- existence of substitute goods;
- lack of strong relationships with customers, inability to develop customer loyalty that ensures constant income;
- absence of stable relationships with suppliers that impedes continuous production;
- low level of corporate culture and social capital;
- ineffective advertising.

Thus, a combination of different external and internal, macroeconomic and microeconomic factors influences company's bankruptcy. We also need to consider that for Russian companies possible bankruptcy factor is noncompetitiveness with European companies on a global scale.

In addition to the abovementioned factors, there are some specific trends causing bankruptcy, which are unique for the Russian market due to the historical heritage.

The transition from the state-controlled to market economy in Russia still has some impact on the current economic environment. Even if it might seem that Russia has almost completely implemented market economic structure, a period of a little more than 20 years historically is not enough for entire economic transformation. For many years Russian emerging economy showed problems connected with difficulties after privatization, high militarization, inflexible large enterprises, managers who got used to receive production plans.

As operating in market environment is relatively new practice for Russian managers, one of the possible factors for emergence of bankruptcy risk is the lack of experience of business operations in the market-driven economy. Consequently, it entails poor management control and increasing likelihood of insolvency and bankruptcy.

Many authors mention institutional factors as leading determinants of bankruptcy risk in Russian economy. Such institutional factors include flaws in current bankruptcy legislation, which facilitate growth of illegal situations involving bankruptcy. In particular, cases of fictitious and intentional bankruptcy often occur, although these actions are criminally liable. Bankruptcy institution in Russia is vulnerable to criminal purposes and may be used for property redistribution and legalization of illegal property appropriation (Nikolaeva and Paluvina 2014).

One more factor influencing business operations is limited access to lending resources because of imperfections in the Russian credit system. From the year 2005 Russian banking sector can not satisfy domestic demand for financial resources from the private sector. This tendency is reflected in the dynamics of *domestic credit provided by financial sector* to *total domestic credit received by private sector*. While developed European economies have this ratio higher than 1, for Russian situation during the last 10 years this indicator was below 1 (The World Bank Database). Such statistics demonstrate that national financial sector does not provide sufficient funds for the corporate sector, and Russian enterprises are forced to raise funds from abroad. Moreover, due to high domestic interest rates, lending in foreign banks is significantly cheaper than in Russian financial institutions. However, despite many incentives for companies to attract additional financial resources through foreign banks, high country risks make it difficult for national enterprises to obtain loans in foreign markets.

If some bankruptcy factors exist, appearance of bankruptcy reasons may trigger crisis processes in an enterprise. Thus, bankruptcy reasons are events resulting in rapid emergence of bankruptcy risk factors.

There are different approaches to the classification of bankruptcy reasons. It is also necessary to keep in mind that bankruptcy reasons may include certain combination of bankruptcy reasons, which is unique for each separate company. The combination of internal problems connected with company's business activity may include:

1. Operating reasons:
- high degree of depreciation of fixed assets, low level of used technologies;
- ineffective management of cash flows;
- high proportion of work in progress in current assets, which entails capital turnover slowdown;
- growth of receivables for goods delivered but not paid;

- uncontrolled growth of the business, violation of balanced growth rates, leading to unplanned expenses;

- inefficient use of operating resources and, as a consequence, high cost of goods sold;

2. Managerial reasons:

- undeveloped crisis management program;

- unprofessional management, entailing inaccurate assessment of risks and making wrong decisions;

- risky and aggressive development program, suggesting a large borrowings;

- lack of effective audit control;

3. Financial reasons:

- investments in fixed assets, while working capital is managed inefficiently;

- high borrowing costs;

- negative financial leverage;

- underestimation of financial risks;

- inefficient budgeting system and financial strategy (Vorotnikova and Pshipiy 2015).

Under the economic crisis that influenced the whole world economy, the reasons of business bankruptcies became more and more diverse and complex. Numerous studies mention many other causes of companies' bankruptcy, among which are:

- Company age. Established companies which have been in business up to five years have lower risk of bankruptcy than new entrants.

- Sector of activity. Russian and foreign researchers reveal that the probability of failure depends on the sector of company's operations. Haydarshina G.A. (2009) justifies that adjustment of financial ratios to the industry facilitates predictive accuracy.

- Company size. Evidence shows that bankruptcy is more common phenomenon for small companies than the big ones. Ohslon (1980), Fulmer (1984), Evstropov (2008), Fedorova and others (2013) incorporate size variable in their models, because it demonstrates high significance for bankruptcy analysis.

It is unlikely that the appearance of only one cause will necessarily lead to the inevitable bankruptcy. Usually a combination of various bankruptcy factors and reasons leads to unfavorable consequences. It is difficult to determine which particular causes are the most significant for Russian enterprises. But we should take into account that the level of business activity in Russia is still not sufficiently high, and therefore the primary role play external factors - political, economic, financial instability (Monea 2014).

1.3. Bankruptcy risk in the system of financial risks

Business activity is associated with many risks, which have strong impact on companies during financial and economic crises in the national economy. Instability of the economic situation and high market volatility increase financial risks, accompanying business activities of both large and small enterprises and associated with financial losses. Adverse external factors in conjunction with ineffective internal risk-management system lead to crisis situations and later to financial insolvency and bankruptcy of an enterprise (Y. Sitnikova 2012).

"Depending on the specificity of the economic activity performed, the major risks possible to affect an entity are: the operational risk, the financial risk, the commercial risk, and bankruptcy risk. From the multitude of risks the most important to be considered is the bankruptcy risk, which can be caused by the appearance of all the others types of risks" (Monea 2014, pp.150-151).

The bankruptcy risk is a part of internal business risks and expresses the possibility of failure to meet timely payments. A comprehensive definition of bankruptcy risk was given by Haydarshina G.A. (2009, p.86): "The risk of bankruptcy is an economic category, which can be measured quantitatively and which reflects company's probability of inability to fully satisfy creditors' claims, as well as to settle mandatory payments in the course of decision-making under external environment uncertainty". The bankruptcy risk of enterprises is closely connected to the financial risks. Many authors observe that financial risks could lead a company to the loss of solvency and reduction of financial stability, which in the worst case result in bankruptcy. Thus, bankruptcy risk can be divided into two components – risk of insolvency and risk of financial
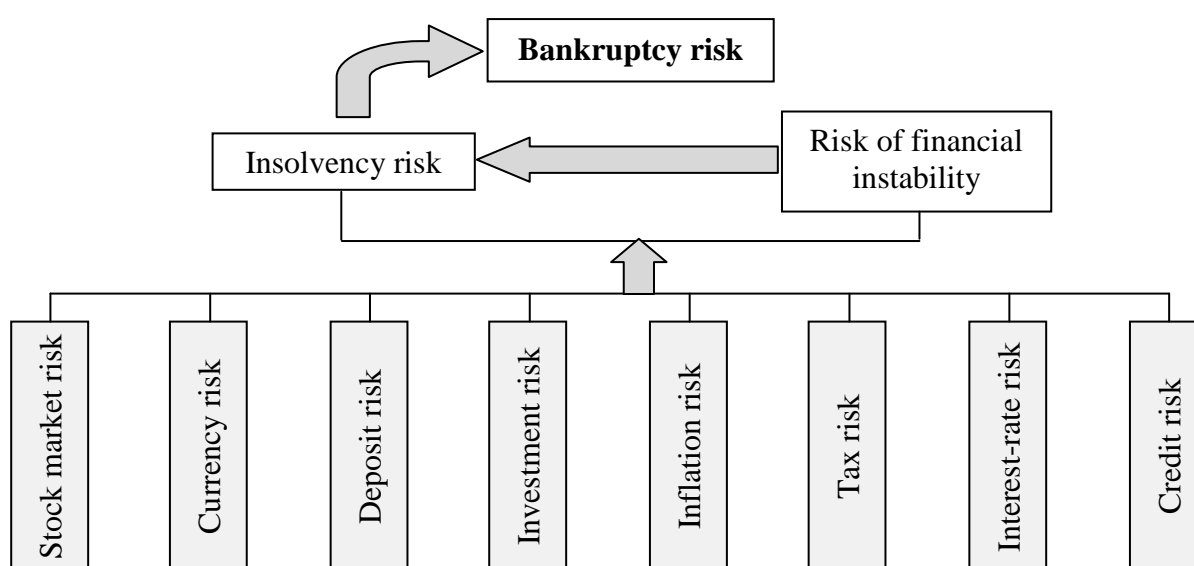
Figure 2. Bankruptcy risk as a consequence of financial risks

Source: Frolov (2010, p.98).

instability. The system of financial risks, which together lead to increase of bankruptcy risk, can be presented as in the Figure 2.

Financial risk means the risk of adverse financial consequences, loss of income or capital, as a result of company's business activity under uncertainty. According to the Figure 2, the following financial risks may cause insolvency and financial instability of an enterprise:

- *Stock market risk* characterizes the possibility to lose assets and funds due to unfavorable change in stock market rate of securities or implementation of margin trading.

- *Currency risk.* Companies are subject to currency risk if they are engaged in international business and receive foreign currency revenue, purchase raw materials or equipment in foreign currency, have funds or investments denominated in foreign currency. This type of risk leads to income shortfall or increase of planned expenditures.

- *Deposit risk* is defined as the risk of non repayment/underpayment of deposit or interest on it during the contract period.

- *Investment risk* occurs when a company faces financial losses due to decreasing investment attractiveness of the undertaken project.

- *Inflation risk* arises from the possibility of deterioration in capital value and expected income as a result of inflation. In more detail, this risk may be connected with loss of accounts receivable value due to delayed payments, increase in cost of goods and services due to increasing energy prices, transportation costs, wages, etc.

- *Tax risk* reflects the probability of introduction of new taxes and levies, increase in existing tax rates, change in terms and conditions of tax payments and repeal of tax benefits.

- *Interest-rate risk* is the risk of adverse changes in both deposit and credit interest rates.

- *Credit risk* takes place when a company provides commodity (commercial) loan and sales goods and services on a deferred-payment basis (Frolov 2010).

It may be noted that many financial risks are strongly connected with macroeconomic and market factors – interest rate, inflation, stock market. Thus, it is fair to assume that consideration of macroeconomic and market indicators may facilitate bankruptcy risk assessment.

Bankruptcy risk is an integrated risk, because not only the impact of financial risks may lead to the thread of bankruptcy. It is also necessary to take into account other types of risk such as strategic, structural, operational, technical, technological, innovative and commercial, which are able to bring a company to such a catastrophic result (Y. Sitnikova 2012).

Exposure to the bankruptcy risk is closely related to the state of solvency of the company, "reflecting the possibility that an entity will no longer be able to honor its payment obligations" (Bogdan 2014, p.20). Analysis of the bankruptcy risk is based on the idea that bankruptcy is a

phenomenon, which does not occur suddenly or unexpectedly; bankruptcy is a result of crisis processes, which develop in the course of time and influence financial indicators. Degradation of financial situation, reflected in entity's financial indicators, denotes increasing bankruptcy risk that threatens the smooth running of a business.

To link the assessment of bankruptcy risk with company's financial indicators, it is reasonable to refer to the concept of "solvency" as a combination of statical and dynamical stability. In this case, financial stability is defined as equilibrium characterized by the company's adaptability to changeable external factors. It is implied that in equilibrium externally influenced parameters of a firm fluctuate insignificantly and have a tendency to return to the original state. This approach assumes an enterprise is deemed to be "a system that constantly seeks to maintain a balance between internal capabilities and external forces (i.e. a self-stabilizing system) in order to keep steady state" (Makarov and Rakhimova 2014, p.37).

For further measurement of bankruptcy risk, we need to identify the most important elements of solvency assessment. To analyze solvency structure, Makarov A.S. and Rakhimova O.S. (2014) suggested the following scheme:
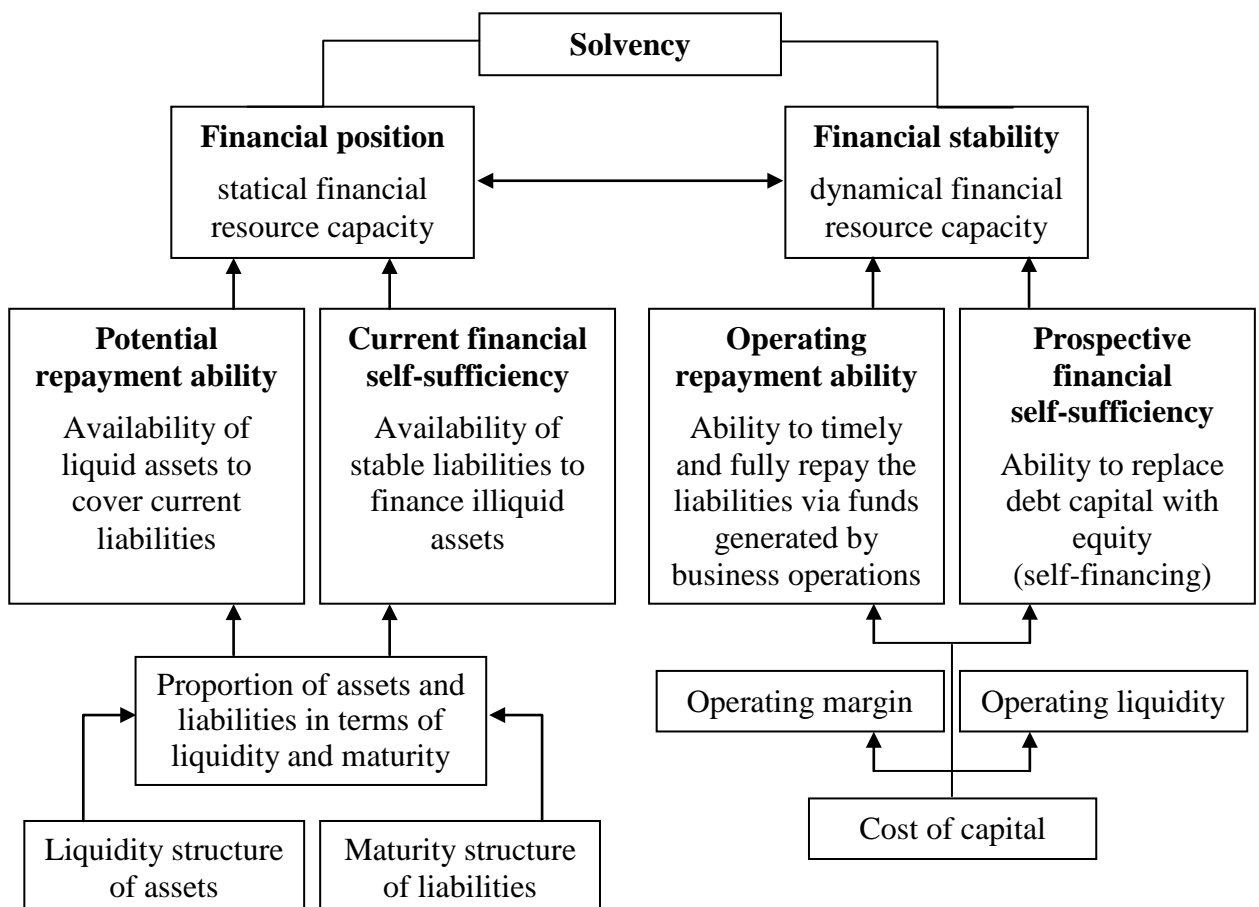
Figure 3. Elements of enterprise's solvency

Source: Makarov and Rakhimova (2014, p.36).

Solvency of a company is associated with financial resource capacity, necessary for achievement of company's goals. Financial resources have a form of cash, liquid assets and expected income at the disposal of the company. From this point of view, financial position, as a component of solvency, reflects current financial resource capacity, while financial stability is related to available financial resources over time.

Company's financial position reflects the level of insolvency risk. Insolvency risk is determined by decreasing liquidity of current assets, causing an imbalance of positive and negative cash flows of the company in time terms. To assess insolvency risk, indicators of liquidity structure of assets and maturity structure of liabilities should be analyzed.

Risk of financial instability refers to dynamical financial state of the company. Financial instability risk is determined by the imperfection of capital structure (overreliance on borrowed funds), which causes imbalance of positive and negative cash flows of the enterprise in volume terms. This type of risk is characterized by the following financial ratios: equity to total assets ratio, total debt to equity, assets coverage ratio, equity plus long-term debt to total assets ratio, earnings to interest and principal expenses. For financial instability risk evaluation, it is also necessary to consider cash flow and profitability ratios such as operating margin (operating income to net sales) and operating liquidity (operating cash flow to sales). One more indicator of financial stability, suggested by Gadanecz and Jayaram (2008), is net foreign exchange exposure to equity: high levels of this ratio may signal difficulties in the corporate sector arising from negative currency moves.

1.4. Approaches for bankruptcy risk estimation: accounting-based models

Modern research literature suggests a huge number of models and approaches for bankruptcy risk assessment. Applying different methods, qualitative and quantitative indicators, many authors have tried to develop bankruptcy prediction models, basing on the smallest possible number of parameters but with high predictive power. The most common models for bankruptcy risk analysis are:

- *Accounting models*, which use separate financial ratios – liquidity ratio, profitability, cash ratio etc.

- *Theoretical models,* based on qualitative criteria: gambler's ruin theory, option-priced theory, credit risk theories etc.

- *Statistical models*, which include univariate analysis, multiple discriminant analysis, survival analysis, logit and probit models. Statistical models are the most frequently used for bankruptcy risk analysis and include both financial and non-financial variables such as company size, sector of activity, country risk etc. Using statistical models for corporate bankruptcy prediction provides calculation of synthetic risk indicator, which characterizes the financial state of the company (Achim and Borlea 2012).

- *Artificial intelligence models*, using soft computing techniques (decision trees, neural networks, rough sets theory, and genetic algorithm). Although these methods are relatively new, soft computing techniques have already demonstrated high predictability results. Soft computing models process and interpret data in a variety of capacities, generalize knowledge and classify object into one of the previously observed categories (Korol 2013).

According to the research conducted by Aziz and Dar, 64 per cent of case studies on bankruptcy prediction used statistical models, 25 per cent - artificial intelligence methods, and 11 per cent - other types of bankruptcy risk analysis (Aziz and Dar 2006).

The main difference between statistical and artificial intelligence models is based on characteristics of included variables. Statistical methods require precise, reliable, and accurate parameters, while artificial intelligence models tolerate inaccurate data, uncertainty, and approximation (Korol 2013).

Among all the techniques, the most frequently applied are multiple discriminant analysis (more than 30 per cent of studies), logit model (21 per cent of studies) and neural networks (9 per cent of models). The average overall predictive accuracy of logit and neural network models (one year before actual bankruptcy) is of 87 per cent, multiple discriminant analysis – 85 per cent (Aziz and Dar 2006).

As part of bankruptcy risk prediction, an important issue is the selection of an optimal set of financial and economic indicators, which have the best predictive ability. The complexity of this issue is reflected in the absence of generally accepted methodology and theoretical approaches for determination of such measures. For this reason, studies devoted to the bankruptcy issue highlight a wide range of predictive indicators. It is worth mentioning that financial and economic variables, which have weak dependence on macro factors and are essential for any company as an economic entity, are supposed to provide more promising predictive results (Kopelev 2014).

The first step in our research is to review existing risk assessment methods. We compared the most frequently applied methods of bankruptcy prediction models, starting with classical approaches, which are used as the background for contemporary research.

Beaver

More comprehensive analysis on corporate bankruptcy prediction has started in the 1960s. In 1966 William H. Beaver raised the question of applicability of accounting data (i.e., financial statements) for corporate default prediction. His univariate study proved that the financial ratios of bankrupt firms generally differ from those of non-bankrupt firms. In his study, Beaver revealed that one year before failure the non-failed firms continue to grow while the total assets of the bankrupt firms decline. During the research, the author tested several financial ratios, including cash flow to total debt, working capital divided by total assets, current ratio, total debt divided by total assets, net income to total assets. Beaver concluded that the best predictor among the analyzed indicators was cash-flow to total debt ratio, where cash is calculated as net income plus depreciation, depletion and amortization. Classification accuracy of the cash-flow to total debt ratio was in the range from 87 per cent (one year before bankruptcy) to 78 per cent (five years prior to failure) (Beaver 1966).

Altman Z-score

In 1968, Edward I. Altman, Professor of finance at New York University, continued Beaver's research and introduced multivariate discriminant technique for predicting firms' bankruptcy (MDA). Altman conducted his research, basing on data of 66 (33 bankrupt and 33 non-bankrupt) listed manufacturing corporations. Having tested 22 variables, the author selected five financial ratios as demonstrating the highest prediction ability of corporate bankruptcy. The following discriminant function was derived as the result of Altman's research:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5 \qquad (1)$$

where X_1 = Working capital / Total assets

X_2 = Retained earnings / Total assets

X_3 = Earnings before interest and taxes / Total assets

X_4 = Market value of equity / Book value of total debt

X_5 = Sales / Total assets

All firms having a Z-score of greater than 2.99 clearly fall into the "non-bankrupt" sector, while those firms having a Z below 1.81 are all bankrupt. The area between 1.81 and 2.99 is defined as the "zone of ignorance", because of the susceptibility to error classification.

Altman's model was highly accurate one year before bankruptcy - 95 per cent of the analyzed firms were correctly classified. As the lead time increases, the overall effectiveness of the discriminant model reduces to 72 per cent for two years preceding bankruptcy, 48 per cent as of three years before the actual event, and 36 per cent as of five years prior to bankruptcy. Thus, the predictive ability of the discriminant model deteriorates substantially as the prediction time period is extended. Altman states that after the second year the model becomes unreliable in its predictive ability. Trying to investigate the possible reasons for this finding, Altman analyzed the dynamics of five predictive variables and concluded that "the most serious change in the majority of these ratios occurred between the third and the second years prior to bankruptcy" (Altman 1968, p. 606).

Springate S-score

It is also worth mentioning about the study of Gordon L.V. Springate conducted in 1978. Using multiple discriminant analysis, the researcher selected the following four financial ratios with the highest predictive ability, which he included in his model:

1) Working capital / Total assets

2) Net profit before interest and taxes / Total assets

3) Net profit before taxes / Current liabilities

4) Sales / Total assets

The model showed an accuracy rate of 92.5 per cent (Springate 1978).

Ohlson O-score

In 1980, James A. Ohlson, Professor of accounting at New York University, contributed to the research with his logistic regression model for corporate bankruptcy prediction. Ohlson based his model on a larger sample of companies than Altman. The data sample consisted of listed industrial companies - 2058 individual non-bankrupt and 105 bankrupt enterprises. To amplify model quality, Ohlson included two dummy variables and company size variable.

Ohlson's score is given by the equation with nine independent variables:

$$O = -1.32 - 0.407X_1 + 6.03X_2 - 1.43X_3 + 0.0757X_4 - 2.37X_5 -$$
$$-1.83X_6 + 0.285X_7 - 1.72X_8 - 0.521X_9$$

(2)

where statistically significant variables can be divided into five groups:

1) size:

X_1 = log (Total assets / GNP price-level index)

2) financial structure as reflected by a measure of leverage:

X_2 = Total liabilities / Total assets

3) measures of current liquidity:

X_3 = Working capital / Total assets

X_4 = Current liabilities / Current assets

4) performance measures:

X_5 = Net income / Total assets

X_6 = Funds provided by operations / Total liabilities

$X_9 = \frac{NI_t - NI_{t-1}}{|NI_t| + |NI_{t-1}|}$, where NI_t is the net income for the most recent period.

5) dummy variables:

X_7 = One if net income was negative for the last two years, zero otherwise

X_8 = One if total liabilities exceed total assets, zero otherwise

The probability of bankruptcy can be obtained using logistic transformation: $\frac{\exp(O-score)}{1 + \exp(O-score)}$. If the result is larger than 0.5, there is a high probability of default within two years. The prediction accuracy of the model is 95 per cent two years prior failure and 92 per cent as of three years before the bankruptcy (Ohlson 1980).

We also should note here the studies of Taffler R.J. (1983), Zmijewski M.E. (1984) and Fulmer J.G. (1984). The explanatory variables that researchers found significant for bankruptcy risk diagnostics are:

Taffler model: 1) Profit before tax / Current liabilities, 2) Current assets / Total liabilities, 3) Current liabilities / Total assets, 4) No-credit interval. The last ratio determines how many days for the company would be able to finance its continuing operations in case that it stops generating revenue (Taffler 1983).

Zmijewski Score: 1) Net income / Total assets, 2) Total debt / Total assets, 3) Current assets / Current liabilities (Zmijewski 1984).

Fulmer H-score: 1) Retained Earnings / Total Assets, 2) Sales / Total Assets, 3) EBT / Total equity, 4) Cash flow from operations / Total debt, 5) Total debt / Total assets, 6) Current liabilities / Total assets, 7) Log (Tangible assets), 8) Working Capital / Total debt, 9) Log (EBIT / Interest expense) (Fulmer, et al. 1984). This model showed considerably accurate results, when it was tested on Russian manufacturing companies (Fedorova, Gilenko and Dovzhenko 2013).

Pang-Tien, Ching-Wen and Hui-Fun

Using logit regression analysis, Pang-Tien et al. (2008) established financial early-earning models that enable to predict the probability of impeding financial distress. The study was based on the data of 116 business groups[1] from Taiwan that experienced financial distress during the years 2002-2007.

Having tested 37 independent variables (28 financial and 9 non-financial), researchers concluded that "financial ratio variables remain the primary variables for predicting corporate financial distress". However, authors found that the combination of explanatory variables changes depending on the remaining time before bankruptcy. Financial ratios make good work with predicting financial problems one and two years prior to bankruptcy. But the longer the time that remains before occurrence of financial distress, the less explanatory power financial indicators have. To explain bankruptcy three years before the fact, researchers included ownership structure and corporate governance variables in the model. As a result, three equations with the following explanatory variables were developed:

- One year prior to the occurrence of financial distress, the predictor variables include:

  1) Debt ratio = Total debt / Total assets

  2) Times interest earned = EBIT / Interest expenses

  3) Interest expense ratio = Cash from operating activities before interest and tax / Interest expenses.

- Two years prior to bankruptcy:

  1) Debt ratio = Total debt / Total assets

  2) Operating expense ratio = Operating expenses / Net sales

  3) Net income ratio = Net profit after tax / Net sales

  4) Retention ratio = Earnings after distribution / Net profit after tax.

- Three years prior to the occurrence of financial distress:

  1) Cash flow ratio = Net cash flow from operating activities / Current liabilities

     Ownership structure variables:

  2) Establishment of independent directors and supervisors = One if the company has no independent directors or supervisors, zero otherwise

  3) Pledge ratio for shares held by directors and supervisors = Shares pledged by all directors and supervisors / Shares held by directors and supervisors.

Generally speaking, the logarithm regression model has significant predictive accuracy above 90 percent over all three time frames (Pang-Tien, Ching-Wen and Hui-Fun 2008).

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[1] The term "business group" refers to a group that assembles independent firms under common management and financial control.

As mentioned many Russian authors, foreign forecasting models of default do not demonstrate satisfactory accuracy when applied to Russian companies' data and need to be adjusted for national conditions. While some authors attempted modification of Western and American models, others are of the opinion that peculiarities of Russian economic conditions do not allow to use foreign models and require the development of national models with different set of explanatory variables. The main reasons of low accuracy of foreign models in Russian conditions are:

- differences in data used to establish models. Foreign and Russian models are based on noncomparable normative parameters of the balance sheet structure and performance indicators of enterprises.

- various macroeconomic conditions. Due to diverse economic development level, coefficients of bankruptcy risk assessment models, designed for enterprises in countries with developed market economies, as a rule, do not apply to countries with transition economies.

- multicollinearity of factors that causes distortion of coefficients estimates;

- specificity of industries is not taken into account. Most foreign models are originally developed as "universal" for businesses of all industry segments. However, optimal values of the key financial variables vary greatly for different industries (Haydarshina 2009).

The main difficulty with development of Russian bankruptcy models is connected with short history of bankruptcy institute in Russia and lack of bankruptcy statistics. The most known methods of bankruptcy risk diagnostics for Russian enterprises were developed in 1998-1999 by Zaitseva, Davydova and Belikov (R-score), Saifullin and Kadykova. However, existing Russian models show unsatisfactory prediction accuracy, which is sometimes even lower than that of foreign analogues (Fedorova, Gilenko and Dovzhenko 2013). This fact explains the necessity to develop effective methods for bankruptcy risk valuation for Russian enterprises. Further we consider a couple of Russian models that are notable for significant forecasting ability.

R-score (Irkutsk model)

In 1999 one of the first Russian bankruptcy risk estimation models was developed by Davydova G. and Belikov Yu. To select appropriate explanatory variables, researchers have conducted a survey among managers of 80 commercial enterprises in Irkutsk. Basing on the results of the survey, official regulatory methodology and Altman model, authors applied discriminant analysis for development of the following equation, which is called R-score:

$$R = 8.38X_1 + X_2 + 0.054X_3 + 0.63X_4 \tag{3}$$

where X_1= Working capital / Total assets

X_2 = Net income / Shareholders' equity

X_3 = Revenue / Total assets

X_4 = Net income / (Cost of goods sold + Operating expenses)

The rule for bankruptcy risk estimation is stated as follows: the higher the R-score, the lower bankruptcy risk. If R-score is negative, the probability to become bankrupt is the highest – 90-100%. If R-score is more than 0.42, there is minimum bankruptcy risk (Davydova and Belikov 1999).

The main drawback of the model is that it is efficient only when time period prior to bankruptcy is very short – less than 3 quarters. Hence, R-score model have low potential to be used for bankruptcy risk diagnostics. However, this model demonstrated the highest predictive accuracy (of 71.8 per cent) among other Russian models, when it was tested on manufacturing companies' data (Fedorova, Gilenko and Dovzhenko 2013).

Evstropov

In 2008, Evstropov M.V. was the first Russian researcher who applied logit regression analysis to national companies' data for bankruptcy prediction. Russian manufacturing enterprises were an object of the study. The main drawback of the model is the limited sample, which consists of only 16 companies.

Evstropov developed two models. The first model is designed to predict default state four years prior to the actual fact, using the following explanatory variables: 1) Book value of stock shares / Total debt, 2) Current assets / Total assets, 3) ln(Total assets/GDP price-level index), 4) Net sales / Average fixed assets. The second model, which forecasts bankruptcy two years before the event, includes five financial ratios:

1) EBIT / Total assets

2) Net sales / Average accounts receivable

3) Revenue / Long-term debt

4) Annual revenue growth rate

5) Cash and cash equivalents / Current liabilities.

The last model demonstrated a high accuracy rate of 90.5% (Evstropov 2008).

Fedorova, Gilenko and Dovzhenko

One of the recent bankruptcy studies was conducted by Fedorova, Gilenko and Dovzhenko in 2013. For the research 3056 Russian enterprises from the manufacturing industry were chosen. Among 134 explanatory variables, the authors selected eight financial ratios and estimated the following logit-model:

$$FGD = 10.3 - 6.2X_1 - 5.649X_2 - 0.818X_3 - 1.08X_4 -$$
$$-0.638X_5 - 1.932X_6 - 0.928X_7 - 2.249X_8$$

(4)

where X_1= Cash and liquid assets / Current assets

X_2 = Net income / Total liabilities

X_3 = lg (Tangible assets)

X_4 = Inventory / Current liabilities

X_5 = Revenue / Total liabilities

X_6 = Noncurrent assets / Total assets

X_7 = Gross profit / Cost of goods sold

X_8 = Current assets / Total liabilities

The interpretation of FDG index is as follows: if $FGD1 > 0$, then there is a high probability of bankruptcy of a company and if $FGD1 < 0$, the company is recognized financially stable. The overall forecasting accuracy of the model is 87.14 per cent (Fedorova, Gilenko and Dovzhenko 2013).

Shirinkina and Valiullina

In 2015 Shirinkina E. and Valiullina L. summarized existing foreign and national models of risk estimation and highlighted six the most frequently used coefficient, among which are:

1) Return on assets = Net income / Assets

2) Assets turnover = Sales / Total assets

3) Current ratio = Current assets / Current liabilities

4) Return on equity = Net income / Shareholders' equity

5) Current assets / Total assets

6) Profit margin = Net income / Net Sales

Authors also provide bankruptcy risk model with abovementioned explanatory variables, but there is no any information about model's prediction accuracy (Shirinkina and Valiullina 2015).

Financial ratios, which were used in the previously discussed accounting-based bankruptcy risk models, are summarized and presented in Table 1.

In general, solvency, liquidity, efficiency and profitability ratios constitute the basis for both Russian and foreign bankruptcy prediction modeling. But also some differences in groups of variables used can be noticed. In particular, financial structure and cash flow indicators are not frequently considered by Russian researchers for bankruptcy risk modeling, while these variables showed high significance in foreign equations. In addition, asset structure and operational efficiency ratios demonstrate satisfactory predictive ability in national models, while variables of these groups are rarely included in American and Western models.

To choose appropriate variables for bankruptcy models, which we are going to construct in the third chapter, two criteria were used. The first criterion was frequency – common   use   in

Table 1

Financial ratios used in foreign and Russian accounting-based bankruptcy models

Financial ratios	Altman (1968)	Springate (1978)	Ohlson (1980)	Taffler (1983)	Fulmer (1984)	Zmiewski (1984)	Pang-Tien et al. (2008)	R-score (1999)	Evstropov (2008)	Fedorova et al. (2013)	Shirinkina et al. (2015)
Const			+	+	+		+		+	+	+
Financial structure indicators											
Total debt / Total assets					+	+	+				
Equity / Total debt	+								+		
Total liabilities / Total assets			+								
Current liabilities / Total assets				+	+						
Solvency and liquidity indicators											
Current assets/Current liabilities			+			+					+
Current assets / Total liabilities				+						+	
Absolute liquidity ratio									+		
Working capital / Total assets	+	+	+					+			
Working capital / Total debt					+						
EBIT /Current liabilities		+		+							
Net income / Total liabilities										+	
Revenue / Total liabilities										+	
Revenue / Long-term debt									+		
EBIT / Interest expenses					+		+				
Operational efficiency ratios											
Net sales / Average receivables									+		
Net sales / Average fixed assets									+		
Revenue / Total assets	+	+			+			+			+
Gross profit / COGS										+	
Net income /(COGS + Oper. exp.)								+			
Profitability ratios											
Operating expenses / Net sales							+				
Net income / Revenue							+				+
Earnings after distrib./Net income							+				
Retained earnings / Total assets	+				+						
EBIT / Total assets	+	+							+		
EBT / Equity					+						
Net income / Total assets			+			+					+
Net income / Equity								+			+
Cash flow indicators											
CFO / Current liabilities							+				
CFO / Total liabilities			+								
CFO / Total debt					+						
CFO / Interest expenses							+				
Assets structure indicators											
Current assets / Total assets									+		+
Noncurrent assets / Total assets										+	+
Cash & liq. assets /Current assets										+	
Inventory / Current liabilities										+	
Other variables											
Size variable			+		+				+	+	
Total liabilities > Total assets			+								
Net income < 0			+								

Note: CFO – Cash from operating activities, EBIT – Earnings before interest and taxes, COGS – Cost of goods sold
Source: The present study.

the literature. The ratios advocated in the literature are perceived by many authors to reflect the important relationships. The second criterion was that the ratios performed well in one of the previous studies. This criterion will enable the study to examine the consistency of its findings with those of the previous studies.

A large number of various financial ratios were considered for modeling bankruptcy risk in the observed studies. As the result of the previous analysis of bankruptcy risk assessment techniques, several accounting-based variables are selected to be tested for significance in the third chapter of the current study.

First of all, we refer to Russian models, because they are supposed to be more accurate when applied to the data of Russian companies. From the previous Russian research we choose the following variables:

1) Revenue to total assets;

2) Net income to equity;

3) Share of current assets in total assets;

4) Share of noncurrent assets in total assets;

5) Company size variable.

In foreign literature the most common indicators are:

1) Total debt / Total assets;

2) Working capital / Total assets;

3) Net income / Total assets;

4) Current liabilities / Total assets;

5) Retained earnings / Total assets;

6) Current assets / Current liabilities;

7) Equity / Total debt;

8) Current assets / Total liabilities;

9) EBIT / Current liabilities;

10) EBIT / Interest expenses;

11) Net income / Net sales;

12) EBIT / Total assets.

For convenience these financial ratios are divided into five groups: 1) Financial structure indicators, 2) Solvency and liquidity indicators, 3) Operational efficiency ratios, 4) Profitability ratios, 5) Assets structure indicators.

Incorporating the financial structure indicators, we account for economic distress - events when firms demonstrate balance-sheet-based insolvency if the value of the liabilities exceeds assets value. The earnings and liquidity ratios provide significant information related to whether a firm is at risk of financial distress, reflected in a lack of liquid assets to cover debt payments and current expenditures. Hence, abovementioned financial ratios are potentially important estimators of corporate bankruptcy risk.

CHAPTER 2. INFLUENCE OF THE BUSINESS CYCLE
ON CORPORATE BANKRUPTCY RISK

2.1. Dynamics of business cycles in Russia: macro and micro levels impact

Economists revealed that market economy develops cyclically. Cyclicality of economic development is reflected in continuous fluctuations of production and business activity – periods of growth give way to recessions and vice versa. Bankruptcy is usually associated with the downward phase of a cycle, when economy moves from the boom to crisis. As many researchers argue that the number of bankruptcies is connected with the state of economy and fluctuations in macroeconomic variables, we refer to the business cycle theory, which helps to understand determinative processes in Russian economy, causes for transition from economic expansion to recession periods and whether cyclical changes in Russian economy facilitate explanation of bankruptcy frequency.

The comprehensive definition of a business cycle was given by Burns and Mitchell (1946, p.3) in one of the basic papers devoted to this issue: "Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle".

As a result of numerous attempts to explain mechanisms responsible for economic dynamics, various concepts justifying the cyclicality of the economy were created. Existing economic cycles are different in its duration (long-, medium- and short-term) and generating factors. The most common is the typology of the world economy business cycles by the periodicity:

- the Kondratiev long technological waves of 50 to 60 years. Kondratiev analyzed interest rates and prices, having noticed that the ascending part of an economic cycle is associated with low interest rates and rising prices, while downward phase assumes high interest rates and lower prices. He connected the existence of long wave with changes in capital investments and technological innovations.
- the Kuznets building cycles of 18 to 22 years. Kuznets explained these waves by demographic processes, which caused changes in construction intensity or infrastructural investments.
- the Juglar cycles lasting for 7-11 years and associated with fluctuations of investments in fixed assets.

- the Kitchin inventory cycles lasting from 3 to 5 years. These cycles exist due to surplus or scarcity of goods in warehouse, which appear because of delays in getting business information and time needed for decision-making (Kuzmenko 2012).

Approximately each half of a century Kitchin, Juglar, Kuznets and Kondratiev economic cycles simultaneously enter into the downward phase, causing a resonance effect. This period is usually marked by severe economic and financial crises. Such a situation occurred in the 1870s, 1920s, 1970s and in 2007-2008 (Aivazov 2013).We can assume that these periods are characterized by the higher number of bankruptcies in the national economy. Due to the lack of data, we can analyse only the period during and after the last global economic and financial crisis. This analysis is provided in the next section of this chapter.

Business cycles (or economic cycles) reflect the fluctuations of activity in an economy and are usually measured by the growth rate of gross domestic product (GDP). Many researchers proved that GDP growth rates of developed economies and world economy in total demonstrate cyclical fluctuations, which support the existence of business cycles (Tsirel 2012).

To understand how business cycles emerge in the Russian economy, we analyze the dynamics of national real GDP growth rate for the XX-XXI centuries (Figure 4). It can be noticed that this indicator demonstrates cyclical trend, but its direction is not clearly associated with Kondratiev waves in the world economy. For example, during the descending phase of the Kondratiev wave in 1914-1946, the average annual rate of global GDP growth fell from 2.57 per cent to 1.5 per cent, while in Russia this period is marked by the highest rate of economic development for the whole XXth century (from 1923 to 1940 the average GDP growth rate
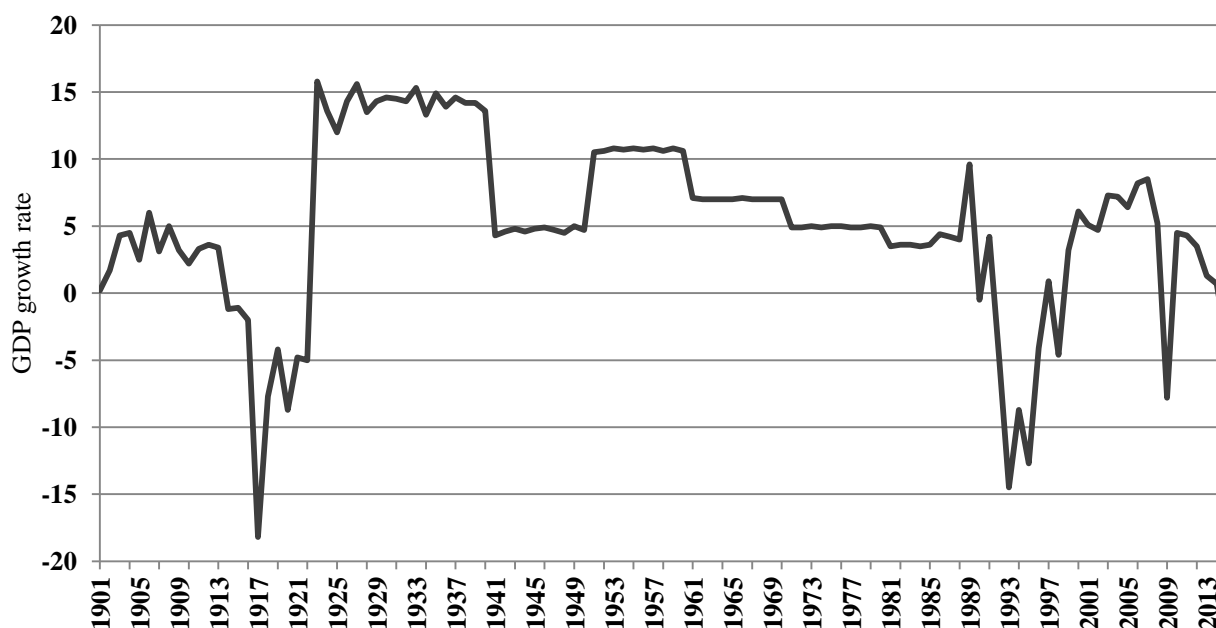
Figure 4. Dynamics of the annual real GDP growth rate in Russia in 1900-2015

Source: Simchera (2007); Federal State Statistics Service.
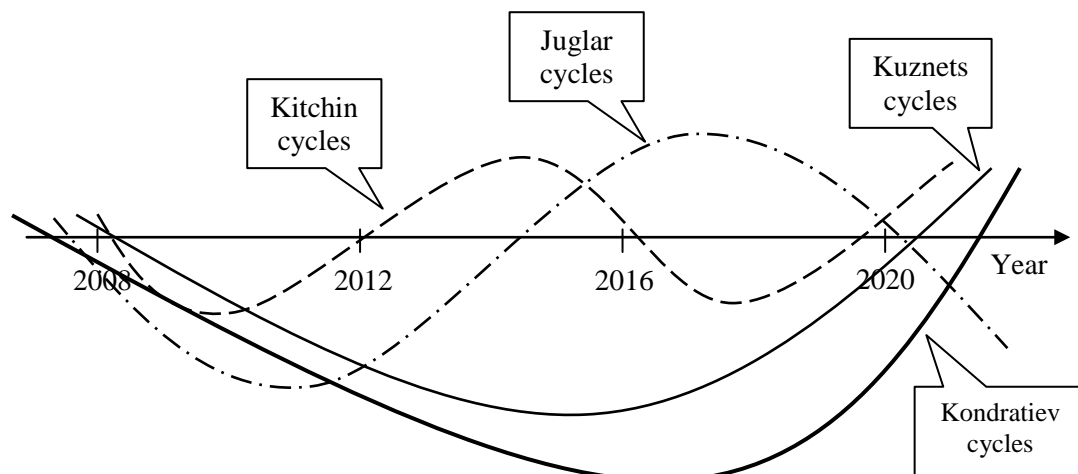
Figure 5. Russian economic cycles

Source: Tyapkina, Mongush and Akimova (2014, p.12).

was 14.25 per cent). Thus, till 1990s cycles of the Russian economy are mainly connected with change of rulers and methods of economy management. Only after establishment of the market economy, some relation of economic fluctuations in Russia with the Kondratiev cycle is noticed. Ascending trend in Russian GDP growth rate from 1993 to 2007 coincides with the upward phase of Kondratiev cycle in the global economy.

Figure 5 exhibits projected dynamics of business cycles in the Russian economy. Now Russian economy is in the ascending phase of Juglar investment cycle, moving to the turning point. Kitchin short-term inventory cycle is in the downward state, but Kuznets cycle should have positive impact in the current upward phase. As for Kondratiev waves, Russian economy is in the transition period between descending and ascending stages of long cycles.

Except GDP growth rate, other macroeconomic variables may be considered as indicators of economic cycles. For example, dynamics of *stock market capitalization* to *GDP* and *volume of financial assets* to *GDP*. In USA dynamics of these two indicators is closely related to ascending and descending Kondratiev waves. In turn, fluctuations on the Russian stock market, which was relatively recently involved in the world's financial processes, correspond to external shocks.

In general, Russian economy is vulnerable to external fluctuations in the world market conditions. For Russia the world's economic cycles are external factors, and Kondratiev waves arise endogenously in the national economy. Russian economists conclude that Russian economic development is exposed to the global Kondratiev waves and corresponds to their dynamics. However, national internal economic processes support mid-term and short-term

business cycles. Detailed analysis of the recent Kitchin and Juglar cycles in Russian economy is provided by Tyapkina M.F. and others (2014).

For our further analysis we concentrate on Juglar cycles, because this type of business cycles describes development of macroeconomic environment in the medium term, and that is why easily observable in the dynamics of macroeconomic indicators.

In the literature on business cycles several macroeconomic variables are highlighted as business cycle indicators, among which are profits, investments, unemployment rate, money, credit and interest rates (Zarnowitz 1997).

The National Bureau of Economic Research, American research organization that monitors economic cycles, suggests the following macroeconomic indicators as determinants of business cycles:

1) GDP;

2) unemployment rate;

3) industrial production growth rate;

4) consumer price index;

5) investments in fixed assets.

Figure 6 shows the dynamics of abovementioned economic indicators in Russia. It can be noticed that all indicators, except the unemployment rate, move in the same direction. Unemployment rate changes in the opposite direction, because it goes up in recession periods.
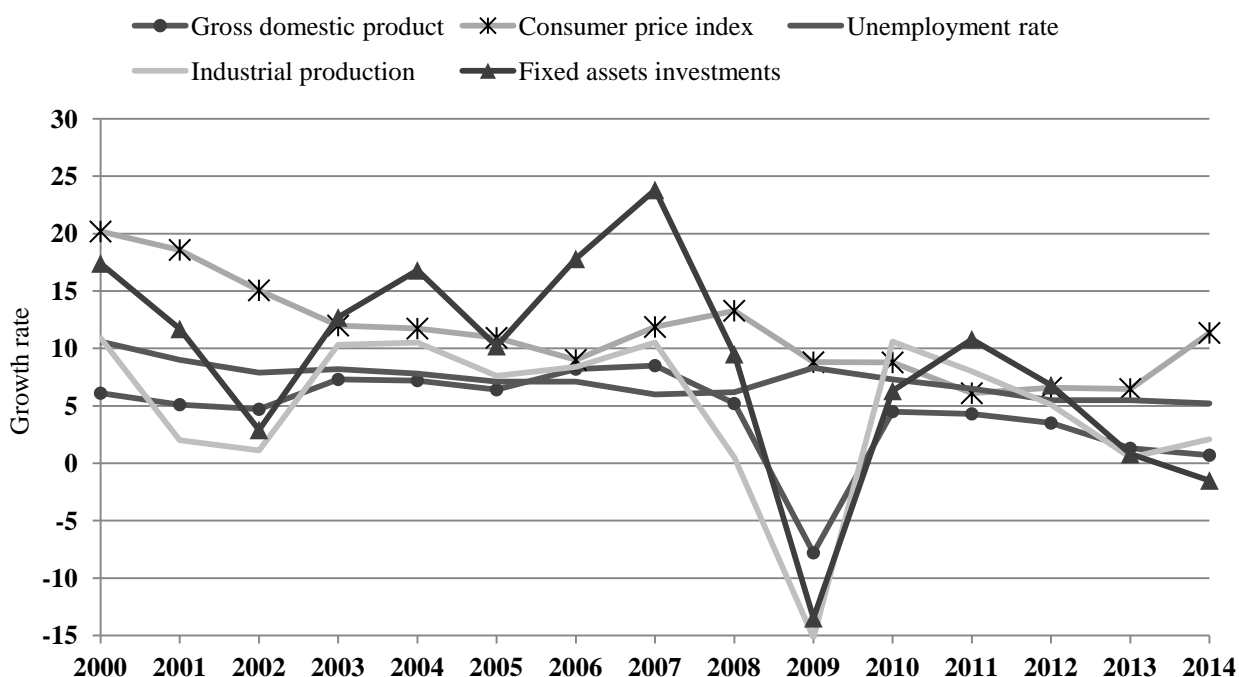
Figure 6. Growth rate dynamics of the main cyclical indicators of Russian economy development for years 2000-2015

Source: Federal State Statistics Service.

GDP growth rate, industrial production, consumer price index growth rate and investments in fixed assets demonstrate rather simultaneous fluctuations. However, the most significant drop during the global financial crisis was noticed in the growth rate of fixed assets investments (Tyapkina, Mongush and Akimova 2014).

There is a distinct medium-term cycle, starting from 2002 and ending in 2009. This is the evidence of Juglar cycle, driven by fluctuations in fixed assets investments and lasting for 7-8 years. In year 2009 the next medium-term cycle began, and it lasts till now.

The cyclical character of economic development demonstrates different impact on various industries. Economic decline dramatically influences industries, producing manufacturing equipment and durable goods (cars, furniture, and household electronics). The reason is that in periods of economic crises people tend to postpone purchases of durable goods in order to save money and spend them on current needs. In this case decrease of demand for expensive products causes drop in production and employment in the relevant industries.

Each stage of economic cycle significantly influences industries' state, companies' level of output and profitability.

Early-cycle phase. This stage is associated with the economic recovery and lower prices on factors of production. Production and employment, having reached minimum value during slump, start to revive. Interest rates go down, creating favorable environment for production expansion and investments in new enterprises, technologies and equipments. When relatively cheap credit is readily available, many enterprises tend to increase their personnel, equipment, inventories (Zarnowitz 1997).

Mid-cycle phase. Usually the longest stage of the business cycle. Production growth rate is moderate, getting slower than that in the previous phase. New enterprises develop, unemployment reduces, wages and volume of fixed assets investments increase. Due to fast expansion of production and demand for credit, interest rates rise. On the firm level, this phase is marked by growing inventories, sales and profit. Because of high demand, business has many opportunities to profit and, thus, default probability is low.

Late-cycle phase. The distinctive attribute of this stage is above-trend inflation rate and restrictive monetary policy. Shrinking credit availability limits investments in fixed assets. On the firm level, companies' profit margins and sales growth deteriorate. Economy gradually slips into recession.

Recession phase. Crisis is accompanied by reduction in economic activity, declining profits and increasing costs. To launch investments and economic recovery, more favorable credit conditions are created. During slump, it is more difficult to keep business profitable and that is why filing for bankruptcy is more likely.

Changes on the macroeconomic level

	EARLY	MID	LATE	RECESSION
GDP, Industrial production	↗	↑	↘	↓
Unemployment	↘	↓	↗	↑
CPI	↓	↗	↑	↘
Credit availability	↗	↑	↘	↓
Interest rates	↓	↗	↑	↘

+

Economic growth

-

	EARLY	MID	LATE	RECESSION
Sales	↗	↑	↘	↓
Profit	↗	↑	↘	↓
Inventory	↓	↗	↑	↘
Credit	↗	↑	↘	↓

Changes on the company level
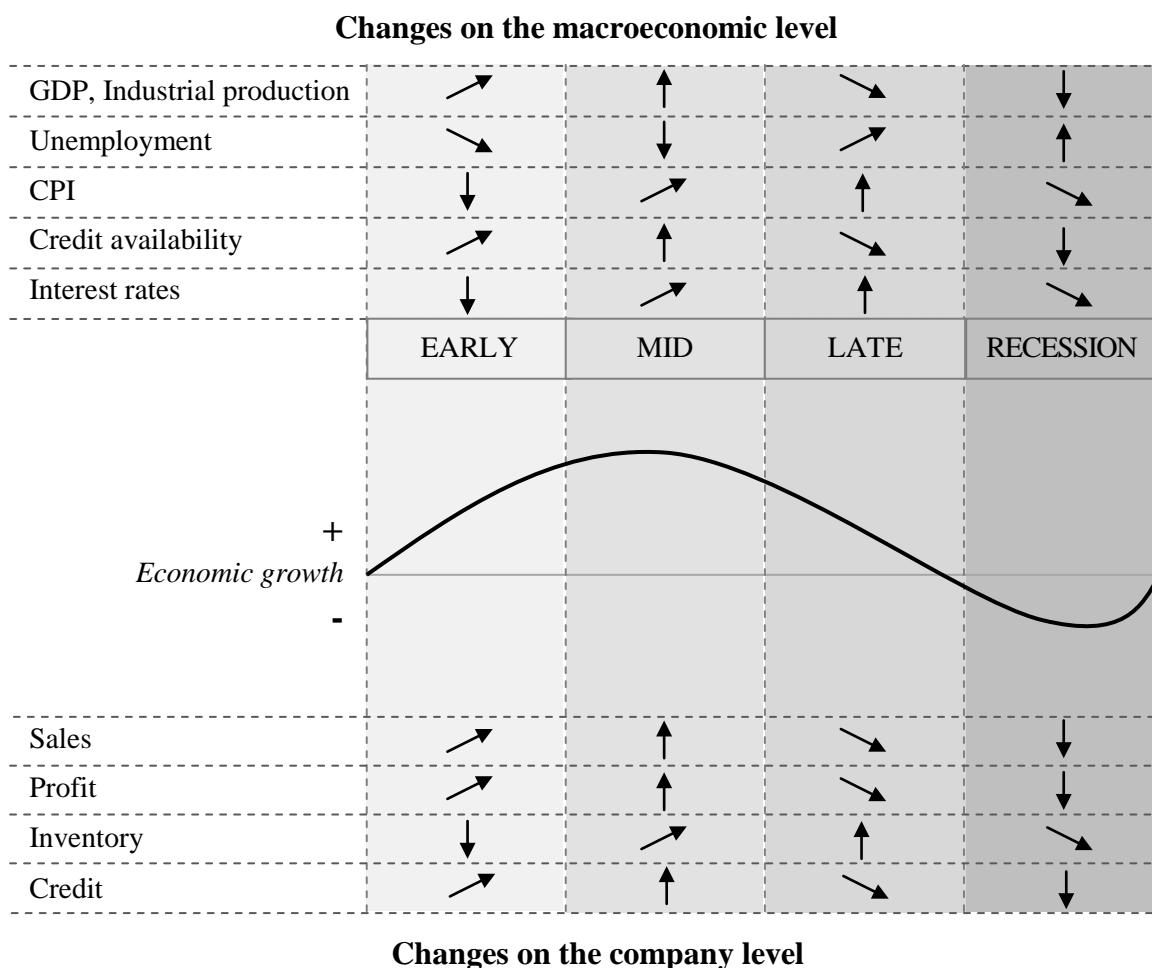
Figure 7. Changes in main macro and micro level indicators over the business cycle

Source: based on Emsbo-Mattingly, Hofschire and Betro (2014).

The information about macroeconomic and company indicators dynamics over successive business cycle phases is summarized in Figure 7.

Among macroeconomic indicators, consumer price index and prime interest rates are lagging indicators, which reach maximum and minimum points behind business cycle trend (Loznev 2006).

Thus, there exists relationship between business cycles and corporate performance. On the company level, three cycles correspond to macroeconomic fluctuations - corporate profit cycle, credit cycle and inventory cycle (Emsbo-Mattingly, Hofschire and Betro 2014).

2.2. Bankruptcy of Russian enterprises: dynamics and sectoral structure

The next question we need to address for our research purpose is whether the number of bankrupt firms in Russian economy moves counter cyclically: decreases in periods of economic prosperity and moves up during recession.

First of all, it is necessary to analyze statistic data on bankruptcy dynamics in Russian economy for the whole period of bankruptcy institute existence (Figure 8).

It can be noticed that peaks in 2002 and 2006 are not associated with macroeconomic fluctuations. In general, the graph does not show any correlation of bankrupt firms' number in the whole Russian economy with Juglar cycle, discussed in the previous section of this chapter. Now it is curious to understand the reasons for such a discrepancy between theoretical and practical perspectives. Some authors suggest that the changes in the number of bankruptcies are rather explained by institutional reasons, than macroeconomic variability (Selevich 2013).

To explain dramatic rise in corporate defaults in 2002 and 2006, we need to briefly review the development of bankruptcy legislation in Russia. The First Bankruptcy Law was put into effect in 1992 - the Federal Law No.3929-1-FZ "On Insolvency (Bankruptcy)". While this law was in action (1992-1998), default growth rate was very low. In 1998 the Second version of the law was introduced, changing criteria of bankrupt firms. It loosened barriers to file for bankruptcy that led to growing number of defaults in 1998-2002. In practice, this period is characterized by active property redistribution through bankruptcy institute. At that time bankruptcy institute allowed to quickly, cheaply and reliably change the owner, providing the legality of process and legitimacy of new owner's rights. For this reason bankruptcy statistics of
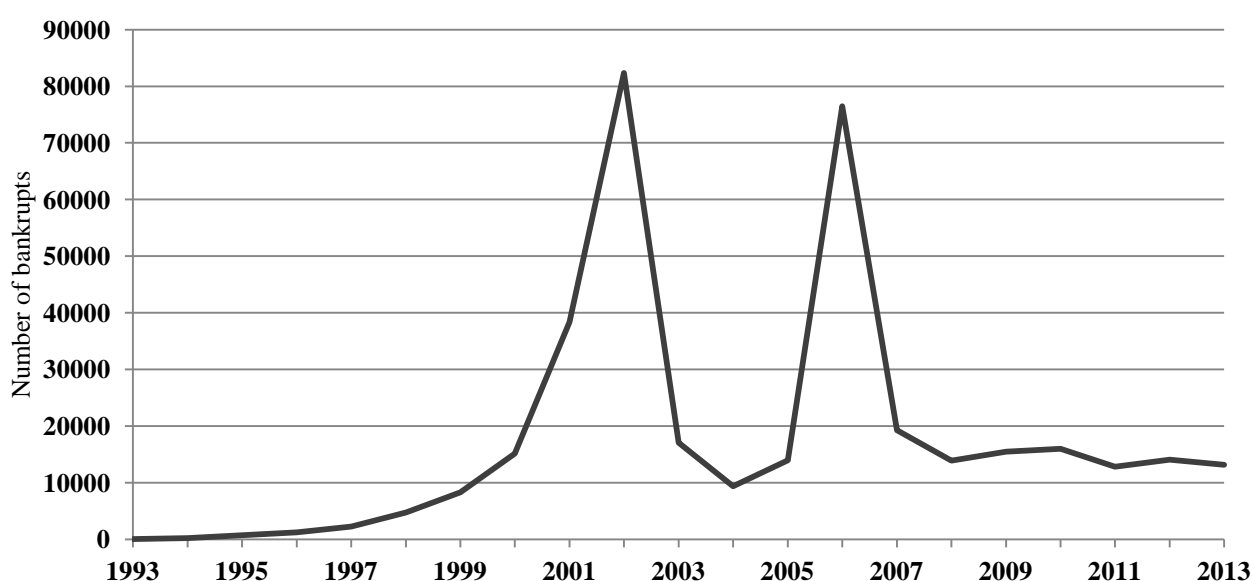
Figure 8. Number of bankrupt enterprises in Russian economy

Source: Supreme Arbitration Court of the Russian Federation.

years 1998-2002 is significantly distorted. Furthermore, in 2002 the adoption of new Bankruptcy Law, aiming to impede property redistribution schemes, was expected. That is why all bankruptcy processes were intensified in order to accomplish bankruptcy procedure according to the less strict Second Law.

For the sharp increase of bankrupt companies in 2006, Selevich O.S. (2013) suggests the following explanation. Until 2004 bankruptcy procedures were conducted by the Federal Bankruptcy Service, which had no interest and money to bankrupt absent debtors. Appointed to the authorized body for bankruptcy in 2005, the Ministry for Taxes and Levies (currently the Federal Taxation Service) was more interested in absent debtors' bankruptcy, because it had an opportunity to get uncollected taxes. Moreover, additional budget funds were allocated for bankruptcy procedures (in 2006 — 964 mln. Rub, in 2007 — 2.5 bln. Rub). Active work of the Federal Taxation Service in 2006 resulted in a high number of firms declared bankrupts. In the next years bankruptcy procedure became more expensive, and the number of absent bankrupt companies decreased.

Therefore, the period from 1992 to 2006 is a developing stage of bankruptcy institute in Russia, characterized by institutional changes. For the reasons mentioned above, bankruptcy statistic data for this period cannot be reliable and does not show real number of companies, filing for bankruptcy because of poor financial state. Only starting from 2007 figures probably reflect the real bankruptcy level, because institutional reasons are no more dominant.

Excluding the most distracting values from the trend (2002 and 2006), we get smoother figures and conclude that the current level of 14-20 thousand bankruptcies per year (or about 0.5% of the total number of registered enterprises) is normal for the economy (Selevich 2013).
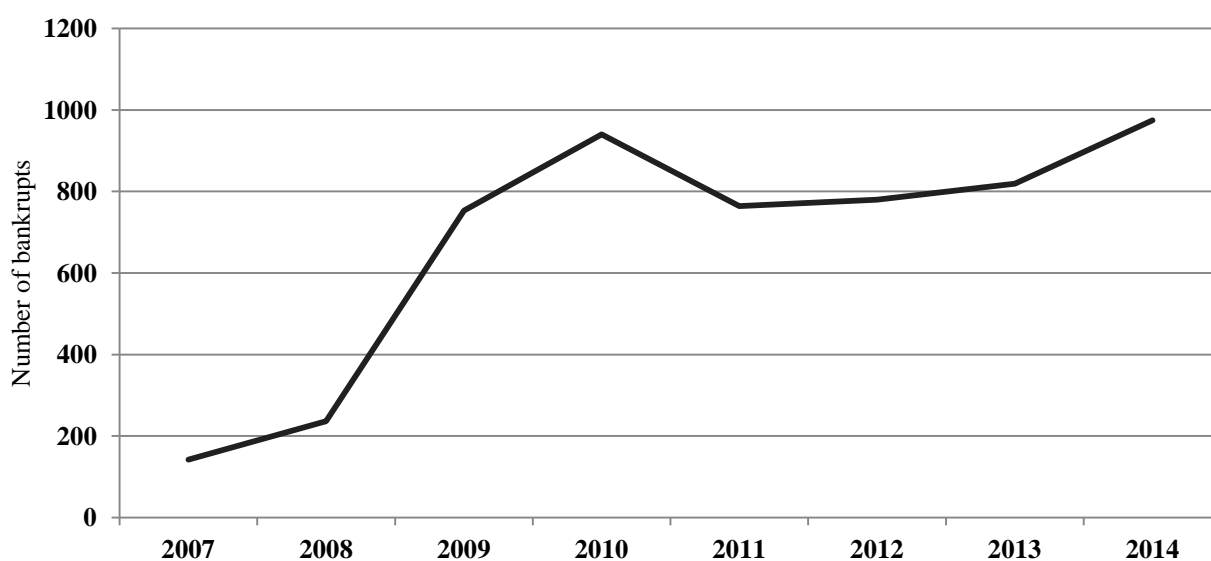
Figure 9. Bankruptcy dynamics in the real sector of Russian economy in 2007-2014

Source: Mogilat (2015, p.160).

As aggregate bankruptcy dynamics does not demonstrate obvious link with macroeconomic fluctuations, further we consider only the real sector of Russian economy (Figure 9).

For our analysis under the real sector of economy we assume the following industries: industrial sector (includes extractive industry, electrical energy industry and manufacturing industry), fishing industry and agricultural sector.

Figure 9 shows the number of enterprises in the real sector of Russian economy, for which supervision (the first stage of bankruptcy proceedings) or simplified bankruptcy procedure is opened.

Statistic data of Russian enterprises show increasing number of companies filing for bankruptcy. This is a direct consequence of worsening economic state, slowdown in economic growth in Russia and high volatility on the global markets (Matrosova 2015).

The period from 2007 to 2014 is very heterogeneous, considering the number of bankruptcies in Russian real sector. A sharp rise in the number of bankrupt companies after the global financial crisis is observable.The whole period from 2007 can be divided into three stages:

1) pre-crisis period (2007-2008): due to favorable economic conditions the number of bankruptcies did not exceed 250 enterprises annually;

2) crisis "splash": sharp increase of number of bankruptcies - for 2009-2010 almost in 4.5 times in comparison with the pre-crisis period;

3) slight decrease in 2011 and the subsequent steady growth, significantly accelerated in 2014 (the average number of bankruptcies in 2011-2014 was about 800 enterprises annually). The number of bankruptcies in 2014 even exceeded the peak level of 2010 (a consequence of crisis 2008-2009).

Noticeable trend for the period under consideration is that the number of companies, conducting simplified bankruptcy procedure, is growing. The main characteristic of simplified bankruptcy procedure is that it omits some essential stages of ordinary bankruptcy proceedings - "supervision", "financial sanation", and "external management"- and moves strait to the "receivership" stage. That means that there is no possibility to restore the solvency for the company under simplified bankruptcy procedure. The tendency of increasing number of companies, conducting simplified bankruptcy procedure, is potentially driven by two factors:

- systematically growing number of companies regarded as "hopeless bankrupts" (in fact, these enterprises has already ceased their business activity);

- increasing number of legal entities, which started the liquidation procedure but, due to the insufficient assets to fulfill existing commitments, switched to bankruptcy proceedings (Mogilat 2015).
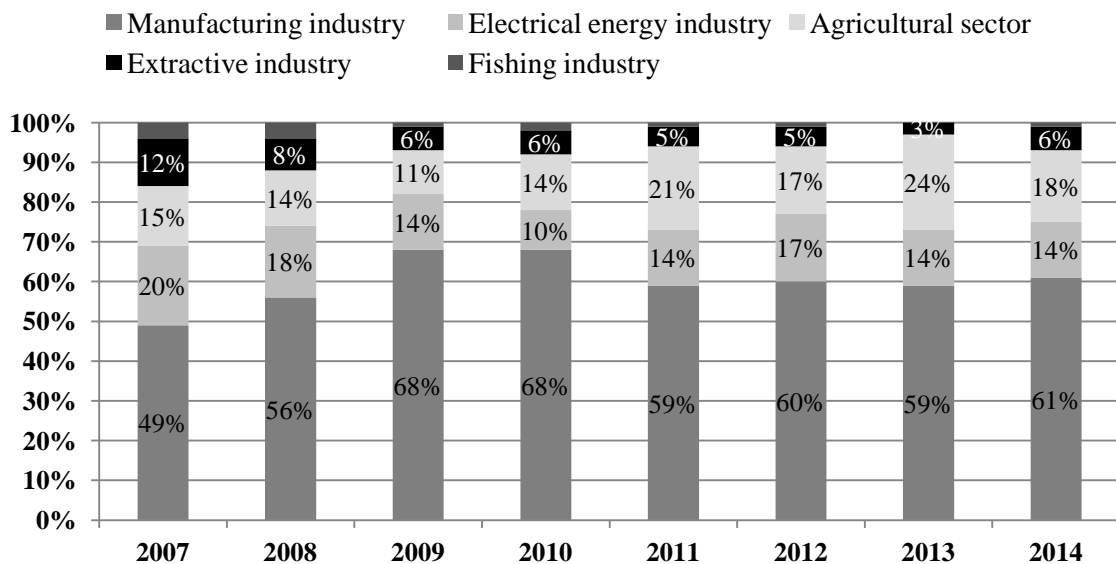
**Figure 10. Sectoral structure of bankrupt companies
in the real sector of Russian economy in 2007-2014**

Source: Matrosova (2015, p.88).

These tendencies indicate unstable state of economy and sensitivity of real sector to macroeconomic environment.

Now we consider the sectoral structure of the Russian real sector (Figure 10). As shows statistics, for years 2007-2014 sectoral structure of bankrupt enterprises in Russian real sector is rather stable, although the crisis of 2008-2009 had some impact. Bankruptcies in manufacturing industry prevail - their share is 60% on average from the whole number of bankrupt companies in the real sector. It can be noticed that the share of manufacturing enterprises bankruptcies increased from 49% in 2007 to 68% in 2010. At the same time decline in share of defaults in such industries as electrical energy, extractive and fishing sectors is observable.

As manufacturing industry dominates in the number of bankruptcies, we consider it in more detail. The average bankruptcy rate in manufacturing industry was 1.6% in 2009-2010, 1.3% in 2011-2012 and 1.5% in 2013-2014. Despite the fact that generally manufacturing industry has relatively low bankruptcy level, in the context of certain subsectors the situation is more alarming. Manufacturing subsectors with the highest intensity of bankruptcies include food industry (2.4%), wood-processing industry (2.3%), production of other non-metallic mineral products (1.7%) and machinery manufacturing (1.3%) (Mogilat 2015). In addition, these four subsectors account for more than 60% of the total number of bankruptcies of manufacturing enterprises (Matrosova 2015).

Main factors, which impede production growth in manufacturing sector and influence bankruptcy rate, include macroeconomic factors such as lack of demand in the domestic market

and economic uncertainty (Federal State Statistics Service). Other factors are high tax rates, lack of financial resources and high loan interest rates. Thus, manufacturing industry is very vulnerable to macroeconomic situation. That is why in the third chapter for our further analysis we focus on companies from this economic sector.

2.3. Approaches for bankruptcy risk estimation: models with macroeconomic variables

As shows statistics, it is very likely that not only internal factors, reflected in financial ratios, but also external factors influence the bankruptcy probability. Apart from the management problems and other firm specific issues that would cause a loss in its profitability, changes in market and economic conditions (such as changes in interest rates, GDP growth, exchange rate, unemployment rates, and industry specific shocks, etc) may affect the overall profitability of the enterprise.

Business cycles have great impact on the profitability of individual firms. Therefore, they influence the risk profile of a given company or industry. The incorporation of variables that capture changes in macroeconomic environment is important, because such variables add a dynamic component that adjusts probability of insolvency in relation to changing macroeconomic conditions.

There exists small but growing number of studies investigating the importance of business cycle variables for corporate default probability. However, due to the last global economic crisis in 2008-2009 this field of research is currently of high interest both in the world and in Russia.

The relationship between macroeconomic factors and the probability of default on an industrial level was analyzed by Qu Y. (2008). He showed that in European countries changes in macro factors such as industrial production, interest rate spread and exchange rate influence the probability of default on the industry level. However, the impact of different macroeconomic variables varies. In general, Qu Y. concluded that exchange rate demonstrates higher importance for the level of default rate than other macroeconomic factors.

If talking about the exchange rate, its effect on the probability of default depends highly on industries. Indeed, when the exchange rate goes up, importing becomes more expensive, exporting becomes easier, and then fewer competitors in an international arena will result in a decrease of default of national companies.

One more important finding is that sensitivity to macroeconomic fluctuations varies with the quality of the company. The better the company is, the less its probability of default will vary with the macro factors changes (Qu 2008).

One of the ways to approach the effect that macro economy has on the default probability is to analyze it directly from the relationship between business cycle and individual firms. Now we refer to the recent studies devoted to the relationship between macroeconomic fluctuations and corporate defaults.

Hernandez Tinoco and Wilson

Using a sample of listed companies in United Kingdom during the period 1980-2011, Hernandez Tinoco M. and Wilson N. (2013) combined accounting, market-based and macro-economic data to explain corporate financial distress. The final model included three types of variables:

1) Accounting ratios: Total funds from operations / Total liabilities, Total liabilities / Total assets, No credit interval, Interest coverage ratio.
2) Macroeconomic variables: the Retail Price Index (measure of consumer inflation in UK) and the real short term Treasury bill rate.
3) Market variables: equity price, past stock excess returns, market size of the company (company's market capitalization relative to the total market capitalization), market capitalization to total debt.

The study showed that incorporation of all three types of explanatory variables provides the highest bankruptcy prediction accuracy of 91.9% (Hernandez Tinoco and Wilson 2013).

Giordani et al.

Modeling default risk, Giordani and others (2014) argue that "financial ratios remain the important information source" in case of private companies. At the same time, macroeconomic variables clearly contribute to the improvement of predictive accuracy.

The research was based on the data of all incorporated Swedish businesses over the period 1991-2008. The following explanatory variables were chosen:

1) Macroeconomic variables: annual gross domestic product (GDP) growth rate, repo rate (a short-term interest rate set by the Central Bank of Sweden);
2) Accounting variables: Total liabilities to total assets, EBIT to total assets, Cash and liquid assets to total liabilities;
3) Control variables: firm size, firm age.

The main finding of the research was nonlinear relationship between firm's bankruptcy and leverage, liquidity and profitability. For example, threshold effect for the relation between

the leverage ratio and default probability was observed. One conclusion of the research is that debt level demonstrates moderate impact on default risk, when leverage ratio is within 30–60 per cent region. However, the bankruptcy risk increases fourfold for leverage values of 60–100 per cent. Other observation is connected with relationship between EBIT to total assets ratio and bankruptcy risk. The bankruptcy risk decreases until the earnings ratio is less than 15 per cent and increases thereafter. Firms reporting earnings ratios above 15 per cent are associated with higher failure risk, and authors find evidence suggesting that this is driven by high cash-flow risk in combination with limited and costly external financing.

To take into account these nonlinear relationships, researchers applied new technique – they introduced spline functions into a logistic regression. As they claim, this approach improved the quality of default forecasting (Giordani, et al. 2014).

Haydarshina

Russian analog of bankruptcy prediction logit-model with incorporation of macroeconomic variable was developed by Haydarshina G.A. (2009). The research sample consisted of 350 companies from three different industries – trade, agricultural and manufacturing sectors. The author intentionally based the model on enterprises with various characteristics – company's size, annual revenue and operating sector. The model is represented by the logarithm function with eleven explanatory variables, among which accounting ratios are still core elements:

1) Macroeconomic variables: refinancing rate of the Central Bank of Russian Federation;

2) Accounting variables: Return on company's assets, Growth rate of assets, Return on equity, Growth rate of equity, logarithm of equity value, EBIT / Interest expenses, Current ratio;

3) Binary variables: "age" of the company, credit history, region.

The model allows taking into account the most important aspects of bankruptcy risk assessment, which include the macroeconomic situation in the country, efficiency, liquidity, financial stability of the enterprise, as well as level of company's activity and industry specifics. These factors characterize company's business activity from different perspectives that facilitates comprehensive assessment of bankruptcy risk. According to the author, model's accuracy in bankruptcy risk assessment was 85.6 per cent.

However, inclusion of eleven explanatory variables makes the model cumbersome. In world practice, the optimum number of the indicators is from five to seven (Haydarshina 2009).

Totmyanina

One more example of Russian model with macroeconomic variables was developed by Totmyanina K. M. (2014) for Russian construction industry.

Choosing the macroeconomic variables for the model, Totmyanina states that the combination of this type of indicators may differ depending on the country and time period under observation. The author made a list of macroeconomic variables that account for business cycle phase and are potentially valuable for bankruptcy risk valuation:

- GDP indicators: nominal and real GDP, investments in fixed assets, volumes of export / import, consumption;
- Foreign exchange market: bi-currency basket, exchange rates of main currencies;
- Money market and banking sector: money supply, volume of loans to nonfinancial sector, loans to individuals, volume of loans to GDP;
- Price level: Consumer price index, Producer price index, GDP deflator;
- Other indicators: oil price, unemployment rate, capital inflow / outflow, government expenditures.

The following five indicators were selected as having the strongest relation to default rate in Russian construction industry:

- Oil price;
- Export of goods and services;
- Import of goods and services;
- Unemployment rate;
- Loans to individuals.

The model with incorporated variable *Import to GDP* demonstrated the highest explanatory ability basing on determination coefficient (Totmyanina 2014).

Jacobson, Linde and Roszbach

In a recent paper, Jacobson, Linde, and Roszbach (2013) analyze the impact of macroeconomic factors on corporate bankruptcy risk.

The authors estimate multiperiod logistic regressions on firm-level default data. The model is estimated for Swedish businesses from ten industries covering years 1990–2009. In addition to an extensive set of financial statement variables, four standard macroeconomic variables are included:

- output gap (i.e., the deviation of GDP from its trend value);
- yearly inflation rate;
- repo interest rate (a short-term nominal interest rate);
- real exchange rate.

The researchers compared indicators from different industries and concluded that the influence of the macroeconomic factors appears to be more important in industries that are more

cyclical. For instance, the output gap is more significant in the construction and in the real estate sectors in comparison with other industries, while the nominal interest rate is very important for the financial services and the real estate sectors. Inflation and the real exchange rate in general demonstrated weaker relation to bankruptcy risk. In turn, depreciating real exchange rate (i.e., a higher value for the variable) is connected with a significantly lower bankruptcy probability in the manufacturing sector, which is the most export-oriented industry in Sweden.

The model with microeconomic variables works both for listed and privately held firms. This is important because privately held businesses typically account for over half of GDP in developed economies.

Suggested model at the aggregate level is very effective and accurate in explaining the extreme default frequencies observed during the Swedish banking crisis of the early 1990s as well as the considerably lower default frequencies in the late 1990s. Thus, macroeconomic fluctuations play an important role in understanding the absolute level of firm default risk. The results show that "macroeconomic factors shift the mean of the default risk distribution over time" and thus are significant determinants of fluctuations in the average level of corporate default (Jacobson, Lindé and Roszbach 2013).

Nam et al

The sample used in this empirical study consists of 367 companies listed on the Korea Stock Exchange over a period from 1991 to 2000.

The novelty of the research was in specification of the baseline hazard rate with macroeconomic variables. To directly estimate the baseline hazard rate with macroeconomic variables, the authors examined two macroeconomic indices: volatility of foreign exchange rate and change in interest rates.

From a theoretical perspective, all macroeconomic indices reflecting the market condition might directly or indirectly affect each firm's hazard rate. Moreover, the mechanisms affecting the firm's hazard rate are considerably diverse because the intensity or time lag of certain economic shocks differs. Intuitively, the macroeconomic variables, highly correlated with hazard rate, can be regarded as variable with the highest explanatory power.

Both variables, volatility of foreign exchange rate and change in interest rates, show a pattern very similar to the change of average unconditional hazard rates for all firms. Because the two macroeconomic variables that share a similar pattern have a high degree of collinearity, a serious multicollinearity problem can occur if the model includes both of those variables. The volatility of foreign exchange rate was chosen as the main explanatory macro-variable considering the high currency exposure of the Korean economy (Nam, et al. 2008).

Table 2

Macroeconomic variables used in foreign and Russian bankruptcy estimation models

Macroeconomic variables	Nam et al (2008]	Qu Y. (2008)	Hernandez Tinoco, Wilson (2013)	Giordani, Jacobson et al. (2014)	Linde, and Roszbach (2013)	Haydarshina (2009)	Totmyanina (2014)
GDP indicators							
GDP growth rate				+			
Output gap					+		
Industrial production index		+					
Interest rate indicators							
Short-term government bonds rate			+				
Change in interest rates	+						
Interest rate spread		+					
Repo interest rate				+	+		
Refinancing rate						+	
Inflation indicators							
Consumer price index			+				
GDP deflator					+		
Exchange rate indicators							
Exchange rate		+					
Real exchange rate					+		
Volatility of foreign exchange rate	+						
Export/Import indicators							
Import of goods and services to GDP							+
Export of goods and services to GDP							+
Other macroeconomic indicators							
Oil price							+
Unemployment rate							+
Loans to individuals							+[2]

Source: The present study.

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[2] Totmyanina created several models. Each model included only one macroeconomic variable because of the strong correlation between variables. The best result showed the model with import of goods and services to GDP.

From the business cycles theory, for our further research the following cyclical indicators should be examined for significance in bankruptcy risk estimation:

- GDP and industrial production;
- Consumer price index;
- Interest rates;
- Investments in fixed assets;
- Unemployment rate.

The main indicator of medium term Juglar cycles, which we take as the basis for our further research, is growth rate of investments in fixed assets. However, other abovementioned macroeconomic indicators also demonstrate medium term fluctuations associated with Juglar cycles, and that is why should be tested for significance in corporate bankruptcy estimation.

Then we have compared existing approaches for bankruptcy risk estimation. Macroeconomic variables, which were used in the previously discussed bankruptcy risk models, are summarized in Table 2.

Currently there is no general approach for macroeconomic variables selection, and we can notice that each model incorporates its unique macro indicators.

Foreign models include wider range of macroeconomic variables than Russian models. In Russian theory and practice the research field of macroeconomic influence on bankruptcy probability is relatively new and only recently started developing. The reason for this is that Russian bankruptcy institute is young, and earlier insufficient bankruptcy statistics was available.

Having analyzed existing foreign and Russian bankruptcy prediction models with macroeconomic variables, it is possible to highlight the most informative and potentially effective macro indicators for bankruptcy risk analysis.

First of all, the group of interest rate indicators showed significance in both national and foreign approaches. However, the particular variables taken for prior modeling are various; among them are real short-term government bonds interest rate, repo and refinancing interest rates and interest rate spread. All these different types of interest rates will be tested for significance in the next chapter of the current study.

GDP, inflation and exchange rate indicators till now were omitted in national models, while incorporated in foreign models. At the same time, one Russian model includes such unique macro variables as export, import, oil price, unemployment rate and loans to individuals. The indicators from abovementioned macroeconomic categories will also be checked for importance in corporate bankruptcy estimation.

CHAPTER 3. DETERMINATION OF BANKRUPTCY RISK FACTORS

The general idea of the current research is to analyze the relationship between corporate bankruptcy risk and business cycle indicators, which reflect macroeconomic fluctuations, in order to find out how macro factors contribute to explain the probability of bankruptcy on the firm level. The study focuses on Russian large and medium private companies of manufacturing industry.

We start with detailed description of data taken for the modeling. Financial statements information is obtained from Spark-Interfax database. Macroeconomic data was gathered from several sources - Federal State Statistics Service, the World Bank and Central Bank of Russian Federation databases.

3.1. Data description

Conducted research is based on financial data of bankrupt and non-bankrupt companies from Russian manufacturing industry.

First of all, it is necessary to clearly define what we assume under the bankrupt enterprise. For the purpose of the current research a firm is defined to have bankrupt status if it is legally declared bankrupt, and the receivership procedure was introduced concerning this company. Receivership is the last stage of bankruptcy proceedings, meaning that there is no more chance for financial recovery for the company. All prior bankruptcy stages ("supervision", "financial sanation" and "external management") allow for restoring of company's solvency by implementation of special measures under external manager supervision.

Enterprises, which undertook other ways to terminate business activity (merging with other enterprise or liquidation of business) or restored their solvency, were excluded from the current research.

The year of bankruptcy is deemed to be the year, in which the company was declared bankrupt by court of arbitration, and the receivership was introduced concerning this company. Information about the year of bankruptcy is taken from Spark-Interfax and Federal Register on Bankruptcy information.

For the bankruptcy prediction modeling balance sheet and income statement data on bankrupt and operating enterprises was taken. All financial data used in the current analysis are got from financial statements prepared according to Russian Accounting Standards. The final data sample consists of 1000 firms – 250 bankrupts and 750 non-bankrupts.

Table 3

Number of bankrupt and healthy companies in the research sample by year

Year	Number of bankrupt companies	Number of healthy companies
2007	5	15
2008	24	72
2009	55	165
2010	78	233
2011	43	129
2012	22	66
2013	9	26
2014	14	44
Total	*250*	*750*

Source: The present study.

Very few companies provided financial data on and after the year of bankruptcy. That is why our analysis concentrates on financial ratios one, two and three years prior to bankruptcy. All companies, selected for the research, operate or operated in Russian manufacturing industry, which includes the following subsectors: food products including beverages; tobacco products; textile industry; wearing apparel; leather, leather products and footwear; wood processing, products from wood and cork; production of pulp and paper; publishing and printing; chemical industry; production of coke, oil products and nuclear materials; rubber and plastic articles; production of other non-metallic mineral products; metallurgical production; production of finished metal products; machinery manufacturing; office facilities and computer machines; electrical machinery and equipment; manufacture of electronic components, radio, television and communication equipment; automobiles, trailers and semi-trailers production; production of crafts, aircrafts, spacecrafts and other vehicles; production of furniture; recycling of secondary raw materials. Sample structure by subsectors is provided in Appendix 1.

Data includes non-operating companies, which were declared bankrupts during the period from 2007 to 2014. Number of healthy companies is proportional to bankrupt companies for each particular year. Additionally, for each company financial data three, two and one year prior to estimation period was collected. Thus, research sample includes data for the period 2004-2014.

The next criterion for sample selection was private ownership; government-owned enterprises were excluded from the sample. Government enterprises are not taken into account,

because they may receive additional financial support or benefits, which can disturb final results of the model.

One more restriction is connected with company's size – at least 250 employees should work in the company. This filter excludes micro and small enterprises from the sample, because they have specific factors influencing their financial risks. Thus, the current research focuses only on medium and large enterprises.

In addition, we put additional constraint on the period company operates in the market. Final sample includes only companies existing at least ten years in the market, because newly established firms have additional risks and demonstrate higher probability of insolvency and bankruptcy.

Thus, for company's selection the following criteria were applied:

- company operates or operated in Russian manufacturing industry;

- privately held company;

- average annual number of employees is not less than 250;

- company's age is at least 10 years. Maximum company's age in the sample is 23.

Dependent variable

The dependent variable bankrupt is a binary variable. It equals 1 if the company filed for bankruptcy in a particular year and 0 if not.

Further we describe independent variables that were considered during the research. Two types of explanatory variables are taken for the current study: financial ratios and macroeconomic variables. Both financial and macroeconomic variables are taken on the annual basis.

Independent variables: Financial ratios

Having analyzed existing models for bankruptcy risk estimation, the following groups of financial ratios were selected in the first chapter of the paper to be tested for significance in bankruptcy risk prediction:

- **Financial structure indicators:**
    1) Total debt / Total assets;
    2) Equity / Total liabilities;
    3) Total liabilities / Total assets;
    4) Current liabilities / Total assets;
- **Solvency and liquidity indicators:**
    5) Current assets / Current liabilities;
    6) Current assets / Total liabilities;

7) Working capital / Total assets;

8) EBIT / Current liabilities;

9) EBIT / Interest expenses;

- **Operational efficiency ratios:**

    10) Revenue / Total assets;

- **Profitability ratios:**

    11) Net income / Revenue;

    12) Retained earnings / Total assets;

    13) EBIT / Total assets;

    14) Net income / Total assets;

    15) Net income / Equity;

- **Assets structure:**

    16) Share of current assets in total assets;

    17) Share of noncurrent assets in total assets;

- **Control variables:**

    18) Company's size variable = ln (Total assets / GDP deflator);

    19) Company's age.

For further analysis, from asset structure variables we choose *Share of current assets in total assets*. Firstly, this indicator is a determinant of Kitchin inventory cycle. Secondly, variables *Share of current assets in total assets* and *Share of noncurrent assets in total assets* are perfectly correlated as they express the same balance sheet relation and cannot be incorporated into the model together.

Thus, 18 variables, including 16 financial ratios and two control variables – firm's size and age, are selected as potential bankruptcy predictors. Among these financial indicators we will pick several variables with the highest forecasting ability.

The next issue we encountered with is the absence of Earnings before Interest and Taxes (EBIT) indicator in financial statements prepared according to Russian Accounting Standards. Thus, we needed to derive the Russian analogue of EBIT based on International Financial Reporting Standards.

Calculation of EBIT in Russian practice is based on such items as income tax reimbursement, extraordinary income/expenses and interest paid/received. Due to the lack of financial data, we take the following approximation for calculation of EBIT:

$$\text{EBIT= Earnings before Taxes + Interest paid – Interest received} \qquad (5)$$

Many abovementioned models of bankruptcy risk estimation include company size variable. Various models suggest two main approaches for calculation of company size: through logarithm of tangible assets or logarithm of total assets. In the current research we calculate size of a firm as logarithm of total assets adjusted for inflation. Firm size and age are generally associated with less volatile income and cash flows, and thus lower default probability.

Independent variables: Macroeconomic indicators

The main concern of the current research is to assess contribution of macroeconomic factors to bankruptcy risk level. For this purpose several macroeconomic indicators will be tested for explanatory ability. Partly, these indicators selected basing on the previous approaches for default probability estimation. Other macro indicators are taken from the business cycle theories, which were discussed in detail in the previous chapter.

Several groups of macroeconomic indicators are deemed to be business cycle determinants:

- GDP indicators;
- Inflation indicators;
- Interest rate indicators;
- Other macroeconomic indicators.

In the current study we consider several macro variables in each abovementioned group as potentially significant factors of corporate failure probability:

- **Gross Domestic Product indicators:**
  1) Real GDP growth rate;
  2) Industrial production index growth rate;
- **Inflation indicators:**
  3) Producer prices index in manufacturing industry;
  4) Consumer price index;
  5) GDP deflator;
- **Interest rate indicators:**
  6) Repo interest rate;
  7) Refinancing interest rate;
  8) Moscow prime offered rate (six month rate);
  9) Short-term interest rate on federal loan bonds;
  10) Long-term interest rate on federal loan bonds;
  11) Interest rate spread;
- **Other macroeconomic indicators:**

12) Investments in fixed assets in manufacturing industry;

13) Oil prices;

14) Unemployment rate;

15) Money supply M2 growth;

16) Effective exchange rate.

All in all, 16 macroeconomic variables are selected for testing in the model.

3.2. Applied methodology

Many Russian researchers agree that logistic regression for bankruptcy prediction has shown significant efficiency in foreign countries, and it can be assumed that the use of the same technique on the sample of Russian companies will have high predictive potential.

Logistic regression is given by the formula:

$$P = \frac{1}{1 + e^{-Y}} \tag{6}$$

where P is the probability of bankruptcy, and

$$Y = a_0 + a_1 X_{1+} a_2 X_2 + \cdots a_n X_n \tag{7}$$

This implicates that the probability for a firm to go bankrupt in a certain year is given by the logistic distribution function which argument is a linear function of a constant, several financial explanatory variables, control variables of firm characteristics and macroeconomic indicators.

Logistic regression model has some very important advantages, which support application of this kind of model for bankruptcy prediction purposes:

- the logit-model assumes nonlinear relationships between factors, that is the case of bankruptcy factors;
- the logit-model does not require normal distribution of variables. In practice, financial indicators of insolvent firms are rare normally distributed. According to Shapiro-Wilk test, none of the financial variables taken for the current analysis is normally distributed;
- the logit model is easily interpreted, because it can take values from 0 to 1 and determines the nominal value of the probability of bankruptcy;
- there is no "grey areas" as in discriminant analysis models.

According to the suggested methodology, P value intervals are associated with different bankruptcy risk levels (Table below).

Table 4

P value intervals and characteristics of bankruptcy risk in logistic model

P value intervals	Characteristics of bankruptcy risk
$0 < P < 0.2$	Minimum risk
$0.2 < P < 0.4$	Low risk
$0.4 < P < 0.6$	Moderate risk
$0.6 < P < 0.8$	High risk
$0.8 < P < 1$	Critical risk level

Source: The present study.

3.3. Descriptive statistics

As our research includes data on two separate types of enterprises – bankrupt and operating companies – we provide descriptive statistics for these groups separately. Tables 5 and 6 show mean, minimum and maximum values of financial ratios in both bankrupt and healthy firms one year before estimation. Here significant differences in mean values can be noticed.

Unlike healthy companies, bankrupts demonstrate mostly negative values of solvency, liquidity and profitability ratios.

As insolvent companies actively accumulate debt, the huge discrepancy is noticed in leverage ratios. Debt to total assets ratio is on average 2.7 times higher in non-operating companies than that of healthy companies. Total liabilities related to total assets increase on average more than three times in case of bankrupt enterprises, while the most significant rise is observed in short-term liabilities. Mean value of equity to total liabilities ratio is negative for bankrupts and highly positive in case of operating companies.

Among solvency and liquidity indicators the greatest difference is noticed in interest coverage ratio (- 39.96 in bankrupt vs. 181.46 in operating companies). On average current assets are more than twice higher in relation to total and current liabilities in healthy enterprises. For default companies these indicators drop to 0.797 and 0.567 respectively. Mean value of EBIT / Current liabilities is negative in case of non-operating companies and positive for healthy enterprises.

When it comes to operational efficiency ratios, asset turnover ratio (Revenue / Total assets) is 1.3 times higher for healthy firms than that for bankrupts.

Table 5

Descriptive statistics on bankrupt enterprises

Variable	Obs.	Mean	Std. Dev.	Min	Max
Financial structure indicators					
Total debt / Total assets	250	0.5352	0.9789	0	9.9569
Equity / Total liabilities	248	-0.1821	0.4002	-0.9870	2.0598
Total liabilities / Total assets	249	1.6617	1.2976	0.1996	8.4153
Current liabilities / Total assets	250	1.4663	1.2011	0	8.4153
Solvency and liquidity indicators					
Current assets / Current liabilities	249	0.7969	0.9539	0.0111	7.8183
Current assets / Total liabilities	248	0.5666	0.3230	0.0111	1.7995
Working capital / Total assets	250	-0.7931	1.2999	-7.8519	1
EBIT / Current liabilities	249	-0.2333	0.3944	-4.3163	1.4222
EBIT / Interest expenses	152	-39.9581	115.3152	-793.1000	3.5127
Operational efficiency ratios					
Revenue / Total assets	250	1.4683	2.0131	0	9.7298
Profitability ratios					
Net income / Revenue	245	-2.2917	7.9305	-58.0693	0.0837
Retained earnings / Total assets	250	-0.8663	1.3941	-7.8149	0.3447
EBIT / Total assets	250	-0.4020	0.6726	-3.9298	0.3907
Net income / Total assets	249	-0.4444	0.7403	-4.9276	0.1024
Net income / Equity	249	0.4066	2.2454	-8.9307	8.5685
Assets structure					
Current assets / Total assets	250	0.6972	0.2560	0.0315	1

Source: The present study.

Table 6

Descriptive statistics on healthy enterprises

Variable	Obs.	Mean	Std. Dev.	Min	Max
Financial structure indicators					
Total debt / Total assets	750	0.1970	0.2319	0	1.0434
Equity / Total liabilities	750	2.5746	4.0226	-0.2293	27.5471
Total liabilities / Total assets	750	0.4989	0.2836	0.0222	1.2725
Current liabilities / Total assets	750	0.3893	0.2491	0.0222	1.1541
Solvency and liquidity indicators					
Current assets / Current liabilities	750	2.8497	3.4804	0.0607153	34.3120
Current assets / Total liabilities	750	2.2485	3.0129	0.058668	34.3120
Working capital / Total assets	750	0.2439	0.2623	-0.6887	1.1079
EBIT / Current liabilities	748	0.8433	1.3766	-0.8673	9.8746
EBIT / Interest expenses	527	181.4627	858.0081	-4.5178	8577.041
Operational efficiency ratios					
Revenue / Total assets	750	1.9004	1.237	0.0928	9.2822
Profitability ratios					
Net income / Revenue	750	0.0549	0.0851	-0.7903	0.4464
Retained earnings / Total assets	750	0.3639	0.2902	-0.3839	1.0624
EBIT / Total assets	748	0.1467	0.1407	-0.2682	1.2454
Net income / Total assets	750	0.0927	0.1111	-0.1584	0.6919
Net income / Equity	750	0.2447	0.7127	-1.7610	7.8380
Assets structure					
Current assets / Total assets	750	0.6329	0.2035	0.0521	1.1839

Source: The present study.

Average profitability indicators are negative in case of default companies. The only exception is Return on equity (Net income to Equity), which demonstrates positive mean value because mostly both net income and equity have negative values. The largest discrepancy is noticed in profit margin (Net income / Revenue), which is deeply negative for default companies (-2.29) and higher than zero for operating enterprises (0.055). Other significant indicator, which varies between two types of companies, is Retained earnings to total assets. Descriptive statistics shows that in our research sample Retained earnings of healthy enterprises comprises 36 per cent of total assets, EBIT – around 15 per cent, Net income – 9 per cent of total assets. All three indicators are negative in case of bankrupts: - 0.87, - 0.4, and -0.44 respectively.

On average, the share of current assets in total assets is higher for insolvent enterprises than for operating companies.

When building models, we need to consider correlation between explanatory factors. Correlation matrix of all financial ratios under consideration is presented below (Table 7).

Table 7

Correlation matrix of financial variables

	DebtTA_1	ETL_1	TLTA_1	CLTA_1	CACL_1	CATL_1	WCTA_1	EBTCL_1
DebtTA_1	1.0000							
ETL_1	-0.2727	1.0000						
TLTA_1	0.7178	-0.4446	1.0000					
CLTA_1	0.6180	-0.3575	0.9397	1.0000				
CACL_1	-0.1675	0.7517	-0.3621	-0.3870	1.0000			
CATL_1	-0.2595	0.9341	-0.3959	-0.3033	0.7835	1.0000		
WCTA_1	-0.6416	0.3305	-0.9154	-0.9465	0.4126	0.3501	1.0000	
EBTCL_1	-0.2406	0.7021	-0.4046	-0.3438	0.6123	0.6086	0.3258	1.0000
EBITInt_ex~1	-0.1198	0.2422	-0.1698	-0.1344	0.2110	0.2454	0.1443	0.2991
RevTA_1	-0.1728	0.0091	-0.1139	-0.0454	-0.0183	0.0446	0.1034	0.0779
NIRev_1	-0.2558	0.0718	-0.2695	-0.2605	0.0667	0.0693	0.2553	0.0916
RETA_1	-0.7372	0.3940	-0.9616	-0.9150	0.3548	0.3756	0.9143	0.3937
EBITTA_1	-0.6130	0.2750	-0.7923	-0.7737	0.2481	0.2555	0.7752	0.4620
NITA_1	-0.6499	0.2661	-0.7804	-0.7645	0.2396	0.2459	0.7611	0.4049
NIE_1	-0.0124	-0.0329	0.0889	0.0666	-0.0172	-0.0234	-0.0506	0.0171
CATA_1	-0.0871	-0.0741	0.0543	0.1419	0.0878	0.1507	0.1846	-0.0471

	EBITIn~1	RevTA_1	NIRev_1	RETA_1	EBITTA_1	NITA_1	NIE_1	CATA_1
EBITInt_ex~1	1.0000							
RevTA_1	0.0496	1.0000						
NIRev_1	0.0268	0.1254	1.0000					
RETA_1	0.1538	0.1531	0.2888	1.0000				
EBITTA_1	0.1558	0.1415	0.2610	0.8274	1.0000			
NITA_1	0.1368	0.1019	0.2618	0.8165	0.9502	1.0000		
NIE_1	0.0186	0.1061	-0.0045	-0.0578	-0.0663	-0.0897	1.0000	
CATA_1	0.0333	0.1805	-0.0108	0.0167	0.0205	0.0047	0.0468	1.0000

Source: The present study.

Bankrupt companies
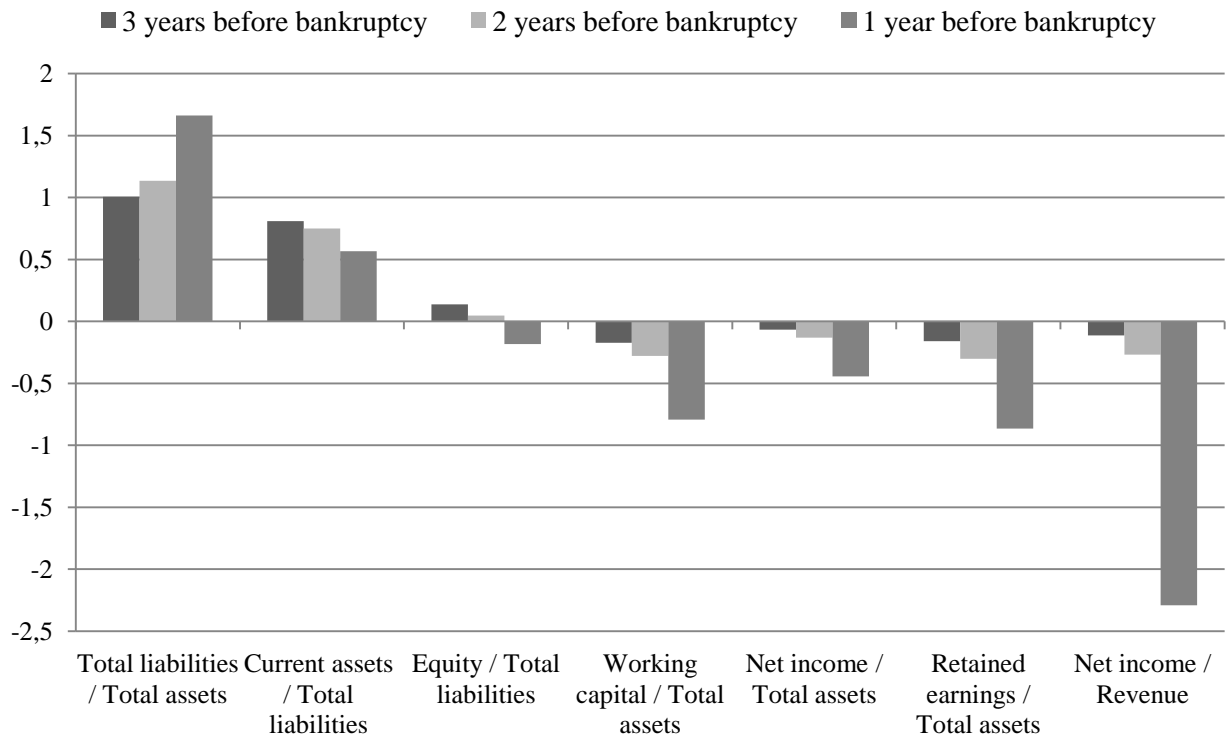
Operating companies
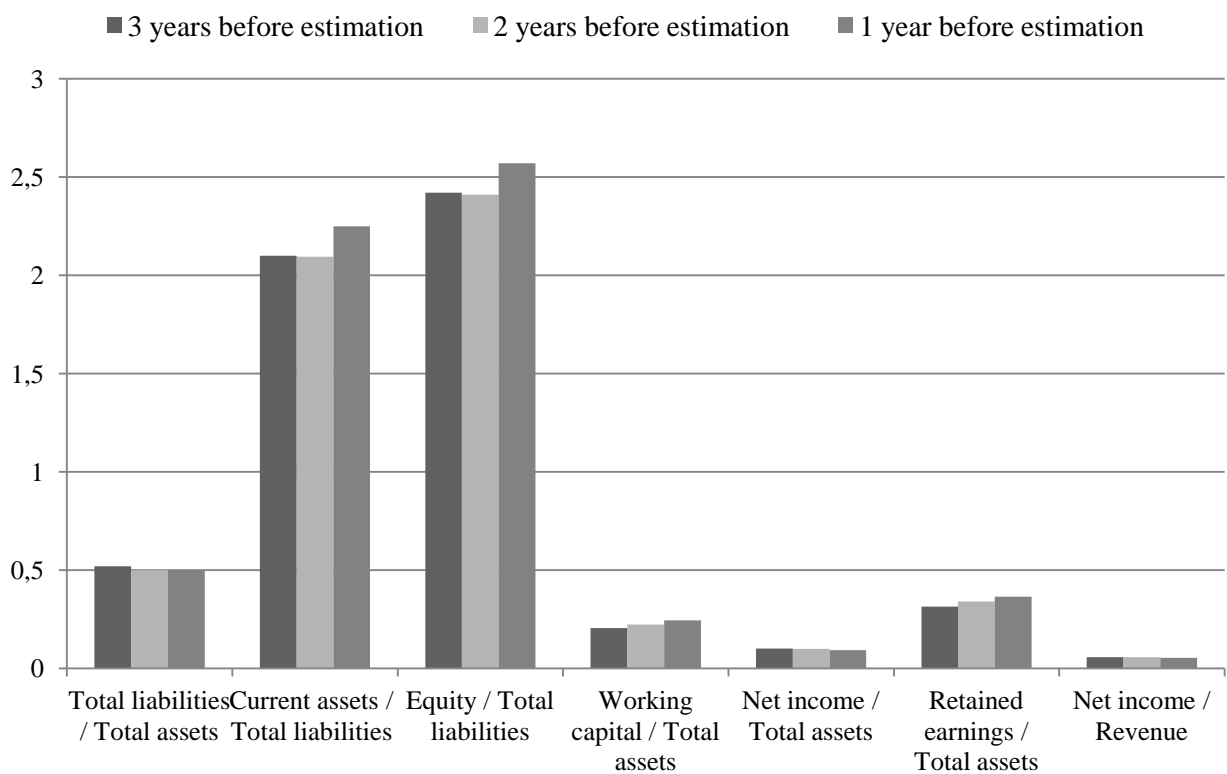
Figure 11. Dynamics of mean values of financial indicators for operating and bankrupt enterprises during 2007-2014

Source: The present study.

Correlation matrix demonstrates that variables within one group (financial structure, solvency and liquidity, and profitability ratios) are, in general, highly correlated. For modeling only variables with low and moderate correlation coefficients may be incorporated together in one equation. Under factors with low and moderate correlation we assume those variables that have correlation coefficients of more than -0.5 and lower than 0.5. Further each considered model will be tested for factors correlation.

Correlation matrix of macroeconomic variables can be found in Appendix 2. In general, many macroeconomic indicators are highly correlated with each other. For example, GDP growth rate and investments in fixed assets, inflation indicators and interest rates. To avoid multicollinearity problem, further we include business cycle variables one at a time into logistic regression model.

Figure 11 exhibits seven the most varying variables between bankrupt and non-bankrupt enterprises. Financial ratios are taken for one, two and three years before bankruptcy or estimation period. Dynamics of the financial ratios shows that already three years before failure indicators of insolvent companies differ significantly from those of healthy enterprises. Operating firms demonstrate rather stable performance indicators, while financial ratios of insolvent companies deteriorate rapidly with the course of time. On average, profitability ratios already three years before bankruptcy have negative values. In case of default companies, total liabilities tend to grow in relation to total assets, while current assets to total liabilities ratio decreases with the course of time.

3.4. Regression analysis and empirical results

To associate bankruptcy risk with the business cycle, we compare factors influencing bankruptcy risk over two distinct business cycle phases: ascending and descending periods. For this purpose all companies in the research sample are divided into two groups:

- The first group includes enterprises which filed for bankruptcy during the upward phase of the business cycle. Data on operating firms is also taken for the same period. This group consists of 590 companies.
- The second group consists of enterprises, which were declared bankrupts during the downward phase of the cycle. Data on operating firms for downturn period is also included. 410 enterprises are in this group.

Table 8

Dating of turning points in the Russian business cycle

	Trough	**Peak**	**Trough**	**Peak**
Investments in fixed assets	4Q 1998	2Q 2008	3Q 2009	3Q 2012
GDP	3Q 1998	2Q 2008	2Q 2009	-

Source: Dubovsky, Kofanov and Sosunov (2015).

The separation of an upward trend from downward period of the business cycle is made according to the dynamics of Juglar medium term cycle, which is reflected in the growth rate of investments in fixed assets. In this case GDP is a secondary business indicator; however, its dynamics closely corresponds to the trend of investments in fixed assets. Troughs and peaks for both indicators are presented in Table 8. Currently Russian economic is on the descending phase of the business cycle.

Thus, basing on dynamics of investments in fixed assets and GDP growth rate, we refer years 2007, 2010, 2011, and 2012 to the upward phase of the business cycle. In turn, 2009, 2013, and 2014 refer to the downward phase. As the peak of Investments cycle in 2008 took place in the beginning of the second quarter, the most part of this year was characterized by recession. That is why we associate year 2008 with descending business cycle phase.

Further we create separate bankruptcy risk models for economic downturn and economic growth periods. All regression analysis calculations were conducted in Stata 12.1 software.

To understand how the macroeconomic variables contribute to bankruptcy risk, firstly we need to consider models with accounting variables only.

Models with financial ratios

Upward phase of the business cycle

Univariate analysis showed that 15 variables out of 16 financial ratios under consideration are statistically significant (at the 1 per cent confidence level) for bankruptcy prediction one year before the event. An exception is Net income to equity ratio, which is not significant at this level of confidence. The following ratios showed the highest predictive ability (basing on Pseudo R^2) in univariate analysis (Table 9).

All four ratios, which demonstrated the highest explanatory power for one year before bankruptcy, are classified as profitability ratios. Thus, we conclude that profitability ratios demonstrate the best forecasting ability one year prior to corporate bankruptcy (with exception of Net income to equity). It is also worth mentioning that Total liabilities to total assets ratio and

Table 9

Financial ratios with the highest Pseudo R^2 on the upward phase
of the business cycle (with coefficients in univariate analysis)

1 year before bankruptcy	2 years before bankruptcy	3 years before bankruptcy
Net income to total assets (-27.137)	Retained earnings to total assets (-6.9946)	Retained earnings to total assets (-5.4265)
Net income to revenue (-16.9688)	Net income to total assets (-20.3476)	Total liabilities to total assets (5.1452)
Retained earnings to total assets (-9.2983)	Total liabilities to total assets (6.4994)	Equity to Total liabilities (-2.1733)
EBT to total assets (-20.4359)	EBT to total assets (-15.447)	Net income to total assets (-12.36380)

Note: all coefficients are significant at the 1 per cent confidence level
Source: The present study.

interest coverage ratio (EBIT / Interest expenses) are also effective bankruptcy predictors, coming next after profitability ratios.

Received signs of coefficients are logical and expectable. Profitability ratios are inversely related to bankruptcy probability: the higher company's net income to assets and revenue to assets ratios are, the lower the bankruptcy risk is.

According to conducted univariate analysis, the most important determinants two years prior to bankruptcy with the highest Pseudo R^2 are: Retained earnings to total assets, Net income to total assets, Total liabilities to total assets, Earnings before taxes to total assets. It can be noticed that still the best predictors are profitability ratios.

For three years before bankruptcy still Retained earnings to total assets indicator remained the strongest explanatory variable. However, financial structure indicators (Total liabilities to total assets and Equity to total liabilities) also show significant relation to bankruptcy risk. Total liabilities to total assets ratio is positively related to bankruptcy probability: the higher the ratio is, the more a company is exposed to bankruptcy risk. In turn, Equity to total liabilities ratio is negatively related to bankruptcy risk: higher share of equity is associated with stronger financial position of a company.

In general, for the upward phase of the business cycle, profitability ratios demonstrate the strongest link to bankruptcy risk in all three periods – one, two and three years before company's failure. However, financial structure indicators - Total liabilities to total assets and Equity to Total liabilities – reveal their influence two and three years prior to bankruptcy.

Table 10

**Financial ratios with the highest Pseudo R^2 on the downward phase
of the business cycle (with coefficients in univariate analysis)**

1 year before bankruptcy	2 years before bankruptcy	3 years before bankruptcy
Retained earnings to total assets (-11.954)	Retained earnings to total assets (-8.9004)	Total liabilities to total assets (7.4873)
Total liabilities to total assets (8.00)	Total liabilities to total assets (7.156)	Equity to Total liabilities (-3.837)
Net income to total assets (-26.0246)	Equity to Total liabilities (-3.4842)	Retained earnings to total assets (-7.3603)
EBT to total assets (-22.0216)	Net income to total assets (-18.38)	Current liabilities to total assets (5.2627)

Note: all coefficients are significant at the 1 per cent confidence level
Source: The present study.

Downward phase of the business cycle

For the downward phase of the business cycle we can notice that financial structure indicators express stronger relation to bankruptcy risk than in the upward phase. Total liabilities to total assets ratio is already one and two years before bankruptcy positively related to bankruptcy risk. Three years prior to bankruptcy this ratio demonstrates the strongest correlation with bankruptcy risk than other variables. Then comes equity to total liabilities ratio, which also from financial structure indicators group.

For one and two years before bankruptcy, Retained earnings to total assets ratio shows the strongest relation to bankruptcy risk. On the downward phase of a business cycle Retained earnings to total assets and Total liabilities to total assets ratios reveal strong link to bankruptcy risk during all three periods – one, two and three years before bankruptcy.

In general, according to conducted unvariate analysis, it turns out that first signs of insolvency appear in financial structure indicators already three years prior to bankruptcy. During the course of time, profitability ratios start worsening and become dominant explanatory variables one year before failure. Other groups of financial indicators – solvency, liquidity and assets structure variables – also deteriorate as bankruptcy event approaches. Their coefficients are also significant in univariate equations; however, Pseudo R^2 is lower than that of abovementioned dominant explanatory ratios.

Having compared two phases of the business cycle, we also conclude that financial structure indicators express stronger relation to bankruptcy risk in the downward phase than in the upward phase.

Table 11

**Coefficients of logistic regression models for bankruptcy risk estimation
over ascending and descending phases of the business cycle**

	Bankruptcy risk models					
	Ascending phase			Descending phase		
	(1)	(2)	(3)	(4)	(5)	(6)
Const	20.8276	12.9722	10.6960	7.3276	-2.8572	-8.7842
Size	-1.3033	-0.9121	-0.8571	-0.7634		
Retained Earnings / Total assets		-6.5478	-8.8537			
Net Income / Total assets	-21.9516			-19.1325		
EBT / Total assets						-21.2576
Net Income / Revenue		-10.3647			-26.2556	
EBIT / Interest expense			-0.4990			
Revenue / Total assets	-0.6165			-0.9150		
One year lagged variables						
Current assets / Total assets		4.6097	7.3271	4.0438	3.4023	3.3206
Equity / Total liabilities					-3.8891	
Total liabilities / Total assets	5.0253			6.1285		6.3858
Pseudo R^2	*0.7628*	*0.7619*	*0.7562*	*0.7866*	*0.7443*	*0.7563*

Note: all coefficients are significant at the 1 per cent confidence level
Source: The present study.

In our further multiple factor analysis we take financial indicators with the highest explanatory power as a basis for logistic equations. Inserting remaining variables one after another, we select several equations, which better explain changes in bankruptcy risk.

The results of models selection are presented in Table 11. All six models under consideration are significant (basing on the likelihood ratio chi-square, which has p-value of 0.0000 for all models). For each phase of the business cycle three equations with the highest Pseudo R^2 were chosen. Then two models, which better explain variation in bankruptcy risk over the business cycle periods (according to Pseudo R^2), were picked for the further analysis with macroeconomic variables.

All three regression models, developed for the ascending phase of the business cycle, include company's size variable, which is negatively related to bankruptcy probability, while this variable showed significance only in one equation in case of downward stage.

Variable of company's age did not demonstrate close relation to bankruptcy risk during all phases of the business cycle. It can be explained by the fact that the research sample includes only companies, operating 10 or more years in the market. Basing on the results of regression analysis, we can conclude that for mature companies age is not important determinant of bankruptcy risk level.

One year lagged indicators of financial structure and assets structure (Current assets to total assets) add explanatory power to the models. While assets structure is significantly related to bankruptcy risk over the whole business cycle, financial structure indicators demonstrate greater relation to bankruptcy risk during the downward phase.

Upward phase of the business cycle

In the upward phase of the business cycle the following model demonstrated the best explanatory ability:

$$Y = 20.8276 - 1.3033 * Size_t - 21.9516 * \frac{Net\ income_t}{Total\ assets_t} - 0.6165 * \frac{Revenue_t}{Total\ assets_t} +$$
$$+ 5.0253 * \frac{Total\ liabilities_{t-1}}{Total\ assets_{t-1}}$$

(8)

Thus, in the upward phase the most significant ratios come from profitability and financial structure groups. According to the coefficients, Net income to total assets ratio shows the strongest negative relation to bankruptcy risk.

Downward phase of the business cycle

Changes in bankruptcy risk during the downward business cycle phase are better described by the following equation:

$$Y = 7.3276 - 0.7634 * Size_t - 19.1325 * \frac{Net\ income_t}{Total\ assets_t} - 0.9150 * \frac{Revenue_t}{Total\ assets_t} +$$
$$+ 6.1285 * \frac{Total\ liabilities_{t-1}}{Total\ assets_{t-1}} + 4.0438 * \frac{Current\ assets_{t-1}}{Total\ assets_{t-1}}$$

(9)

During the downward phase assets structure indicator expresses higher influence on the corporate bankruptcy risk. It is positively related to the risk: the larger share current assets comprise of total assets, the higher the default probability is.

As in the upward phase, according to the coefficients, Net income to total assets and Total liabilities to total assets ratios (lagged one year) demonstrate the strongest relation to the bankruptcy risk.

For both phases of the business cycle profitability indicators show the strongest relation to bankruptcy risk one year before the bankruptcy. Two years prior to bankruptcy assets structure indicator (Current assets to total assets) is significant for both business cycle phases. Financial structure indicators have greater relation to bankruptcy risk during the downward phase, while company's size stronger influences default probability during the upward phase.

Models with business cycle variables

The next step in our analysis is incorporation of macroeconomic variables into developed equations. It will show whether macro indicators add some explanatory value or not.

Upward phase of the business cycle

We add macroeconomic indicators into the basis equation (Formula 8). As it was discussed earlier, many macroeconomic variables are highly correlated with each other. That is why we incorporate them into the model one at a time. Significant macroeconomic variables are presented in Table 12 with corresponding coefficients. It should be mentioned that all models with incorporated business cycle variables have Pseudo R^2 higher than 0.7700, which is better than that of the initial model with financial indicators only.

Macroeconomic variables, which are closer related to bankruptcy risk on the upward phase of the business cycle, include Industrial production index, Repo rate, and GDP deflator growth rate.

The example of the model with business cycle indicator can be found in Appendix 5.

Thus, we conclude that during the ascending phase of the business cycle, macroeconomic variables contribute to more accurate explanation of changes in corporate bankruptcy risk.

Downward phase of the business cycle

Firstly, we incorporate business cycle variables into the initial equation (Formula 9). The result is that none of the macroeconomic variables is important for bankruptcy risk estimation. Only if Current assets to total assets ratio is excluded from the equation, one macro variable - Industrial production index – becomes significant at the 3 per cent confidence level.

Then we proceed with the second best model with financial ratios for downward phase of the cycle (model №6 in Table 11). And again, Current assets to total assets ratio should be excluded to make macroeconomic variables significant. Macroeconomic variables with significant coefficients are shown in Table 12. The example of the model with business cycle variable for the descending phase is presented in Appendix 5. In this case, macroeconomic variables that add more explanatory power are Industrial production index and Producer price index.

Table 12

Coefficients of macroeconomic factors influencing corporate bankruptcy risk over ascending and descending phases of the business cycle

Bankruptcy risk factors						
	Ascending phase			Descending phase		
	1 year before bankruptcy	2 years before bankruptcy	3 years before bankruptcy	1 year before bankruptcy	2 years before bankruptcy	3 years before bankruptcy
Industrial production index growth rate	0.0488	Non-signif.	-0.0600	Non-signif.	0.2742	Non-signif.
GDP growth rate	9.8313	-7.6683	Non-signif.	Non-signif.	24.5767	31.0019
Producer prices index	0.0997	Non-signif.	-0.0804	Non-signif.	0.0952	Non-signif.
CPI	-0.2682	-0.2059	0.2463	Non-signif.	0.3483	Non-signif.
GDP deflator	0.0967	-0.0701	Non-signif.	0.0998	Non-signif.	Non-signif.
Ivestments in fixed assets	0.0556	-0.0460	-0.0411	Non-signif.	0.0783	Non-signif.
Refinancing rate	-1.1077	-0.2737	Non-signif.	0.2391	Non-signif.	Non-signif.
Repo rate	-1.2814	-0.3225	Non-signif.	Non-signif.	Non-signif.	Non-signif.
Short-term interest rate	-0.2536	-0.3861	Non-signif.	Non-signif.	Non-signif.	Non-signif.
Long-term interest rate	-0.9203	Non-signif.	0.4964	Non-signif.	-1.0016	Non-signif.
MosPrime Rate	-0.1224	Non-signif.	Non-signif.	Non-signif.	Non-signif.	Non-signif.
Lending rate	-0.2247	Non-signif.	0.2938	Non-signif.	Non-signif.	Non-signif.
Unemployment rate	-0.8710	0.5969	Non-signif.	1.6606	Non-signif.	Non-signif.
M2 growth rate	16.995	13.9107	-4.8418	Non-signif.	5.0667	Non-signif.
Oil prices	0.0532	0.0284	-0.0206	Non-signif.	Non-signif.	-0.0292
Effective exchange rate	0.0829	Non-signif.	Non-signif.	0.3522	Non-signif.	Non-signif.

Note: all coefficients are significant at the 3 per cent confidence level.
Source: The present study.

However, in the downward phase macroeconomic variables demonstrate weak relation to corporate bankruptcy risk. In addition, none of the models with business cycle variables showed better Pseudo R^2 than that of the initial model with financial variables only.

Thus, inclusion of macroeconomic variables into the downward phase model does not add explanatory value. All information, which is necessary for bankruptcy risk estimation, is already included into financial indicators of an enterprise.

It is observable that the influence of the business cycle on the bankruptcy risk is more noticeable during the ascending phase. The following relations between bankruptcy risk and macroeconomic indicators can be described regarding to the upward period:

- Investments in fixed assets are positively related to bankruptcy risk in the short-term period (one year prior to bankruptcy) and negatively in the long-run. This indicator shows significance for the whole three-year estimated period. Change of the sign for one and two years before estimation may be explained by the fact that the effect of investments in fixed assets can be observable in medium and long term. Consequently, investments in fixed assets, made two and three years prior to estimation period, contribute to decrease of bankruptcy probability, while the result of investments in short term is not yet apparent.

- Positive effect of GDP and industrial production growth is observable only with the lag. Thus, GDP growth rate is negatively related to bankruptcy risk two years before estimation, while for industrial production this period is three years. In short-term both indicators are positively related to bankruptcy risk.

- Consumer prices index and GDP deflator show negative association with bankruptcy risk two years prior to estimation period.

- Unemployment rate shows its positive relation to bankruptcy risk during the descending phase earlier (one year before estimation), than in the upward phase of the business cycle (two years before bankruptcy).

- All interest rate indicators demonstrate negative relation to bankruptcy risk in short-term.

- Effective exchange rate is positively correlated with the default probability one year prior to bankruptcy. The explanation of this relationship may be found in the fact that depreciating exchange rate is associated with more expensive import of raw materials and equipment for domestic production.

Thus, negative association of main business cycle indicators with corporate bankruptcy risk means that in the upward phase macroeconomic environment indicators contribute to risk mitigation.

During the descending phase a few business cycle indicators show relation to bankruptcy risk. Among them are industrial production index, GDP growth rate, producer and consumer price indexes, and investments in fixed assets, which are positively related to the bankruptcy risk two years prior to the period of estimation. In general, during the downward phase of the business cycle influence of macroeconomic factors create potential conditions for the rise of bankruptcy risk level.

CONCLUSION

Basing on the goal and objectives of the research and conducted analysis, we came to the following concluding remarks.

Firstly, macroeconomic environment contributes to development of crisis processes in a company. As showed our analysis, corporate bankruptcy risk is affected by business cycle indicators. The specific characteristic of macroeconomic indicators is that most of them (Investments in fixed assets, Industrial production and other) reveal their influence on bankruptcy risk with the lag of two-three years.

Secondly, macroeconomic indicators demonstrate stronger relation to bankruptcy risk over the upward phase of the business cycle than over the downward period. During the ascending phase of the business cycle macroeconomic variables contribute to accuracy of bankruptcy risk estimation, while in the descending phase these indicators don't contain information missing in financial indicators of an enterprise.

Thirdly, depending on the business cycle phase different macroeconomic indicators express their relation to corporate bankruptcy risk.

- In the downward phase industrial production index, GDP growth rate, inflation (measured by producer price index and consumer price index), and investments in fixed assets demonstrate positive association with default risk two years prior to bankruptcy.

- In the upward phase effects of business cycle indicators on corporate bankruptcy risk can be divided into three groups: long-term, medium-term and short-term effects.

  - In the long-run (3 years prior to bankruptcy) the following indicators relate to corporate bankruptcy risk: investments in fixed assets, industrial production, and oil prices. All of the indicators demonstrate negative association with default probability.

  - Medium-term impact (2 years before bankruptcy) on default probability demonstrate such macroeconomic factors as refinancing rate, repo rate, inflation (measured by consumer price index and GDP deflator), investments in fixed assets, and GDP growth rate. The relation of these indicators to bankruptcy risk is negative.

  - Short-term (1 year before bankruptcy) effects are connected with effective exchange rate, short-term and long-term interest rates on federal loan bonds. Effective exchange rate reveals positive relation to bankruptcy risk, while interest rates are negatively correlated with default probability.

Finally, influence of company's financial indicators on bankruptcy risk also varies depending on time remaining before failure and the business cycle phase. Among all financial ratios under consideration, profitability and financial structure indicators reveal the strongest

association with bankruptcy risk. Financial structure indicators express closer relation to bankruptcy risk during the downward period than in the upward phase. In the descending phase of the cycle first signs of insolvency appear in financial structure indicators already three years prior to bankruptcy. During the course of time, profitability ratios start worsening and become dominant explanatory factors one year before failure.

Managerial implications

Research findings are potentially useful for internal managers of enterprises. As cyclical development is essential for the market economy, and influence of macroeconomic factors cannot be controlled, managers should adapt company's policy to external changes.

During the ascending phase of the business cycle negative relation of the main macroeconomic indicators to bankruptcy risk describes favorable macroeconomic environment for expansion of business. Moreover, weaker impact of financial structure indicators on bankruptcy risk means good time for raising debt funds for business development purposes.

In the downward phase business cycle indicators demonstrate positive relation to bankruptcy risk, which characterizes unfavorable external conditions and increased pressure on bankruptcy risk. In this business cycle phase managers should take additional measures to keep business profitable. During this period bankruptcy risk is vulnerable to changes in financial structure indicators, that is why reliance on equity and restriction of outside borrowings contribute to stronger financial position.

In addition, expected values of business cycle indicators can be useful for estimation of macroeconomic influence on bankruptcy risk in the next period. Expected trends of business cycle indicators help to adjust business development strategy, decide whether it will be appropriate time for business expansion or not.

Limitations and directions for further research

Firstly, current research is based on data of medium and large Russian companies. Small firms may be affected by other bankruptcy factors, and this also requires separate research.

Secondly, only companies from manufacturing industry were considered. It is very likely that industrial differences also take place.

Thirdly, only mature companies were included in research sample, consequently, conclusions of the current study cannot be applied to young companies. Factors affecting bankruptcy risk in newly established companies may be a subject for subsequent research.

Finally, annual financial and macroeconomic data was used in the study. Quarterly or even monthly data may improve results accuracy.

Taking into account these limitations, further research may be conducted basing on data with higher frequency, data on companies from other industries and newly established firms.

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APPENDICES

Appendix 1. Number of bankrupt and operating companies in the research sample by manufacturing industry subsectors

	Number of bankrupt companies	Number of operating companies	Total
Food products including beverages	42	121	163
Production of other non-metallic mineral products	31	89	120
Wood processing, products from wood and cork	22	72	94
Electrical machinery and equipment	19	61	80
Metallurgical production	18	52	70
Machinery manufacturing	15	49	64
Textile industry	16	56	72
Automobiles, trailers and semi-trailers production	11	31	42
Production of finished metal products	12	28	40
Electrical machinery and equipment	7	22	29
Production of crafts, aircrafts, spacecrafts and other vehicles	5	13	18
Office facilities and computer machines	6	12	18
Rubber and plastic articles	6	17	23
Chemical industry	5	11	16
Leather, leather products and footwear	4	14	18
Manufacture of electronic components, radio, television and communication equipment	4	12	16
Production of furniture	4	16	20
Publishing and printing	4	12	16
Production of finished metal products	3	10	13
Production of pulp and paper	3	11	14
Recycling of secondary raw materials.	2	5	7
Other	11	36	47
Total	*250*	*750*	*1000*

Source: The present study.

Appendix 2. Correlation matrix of macroeconomic variables

	IPI_gr_1	GDP_gr_1	IFA_w_1	IPP_1	CPI_r_1	GPD_de~1	Ref_1	Repo_1
IPI_gr_1	1.0000							
GDP_gr_1	0.9337	1.0000						
IFA_w_1	0.8972	0.9748	1.0000					
IPP_1	0.5600	0.3371	0.3835	1.0000				
CPI_r_1	0.0772	0.3749	0.3847	-0.1332	1.0000			
GPD_defl_1	0.7974	0.9083	0.8549	0.1810	0.5122	1.0000		
Ref_1	-0.0020	0.3461	0.3376	-0.4959	0.9017	0.5213	1.0000	
Repo_1	-0.0643	0.2832	0.2637	-0.5595	0.8759	0.4809	0.9957	1.0000
ST_ir_1	-0.9544	-0.8761	-0.7933	-0.4125	0.0135	-0.8155	0.0116	0.0524
LT_ir_1	-0.9243	-0.9765	-0.9453	-0.3127	-0.2903	-0.8278	-0.2780	-0.2152
spread_1	0.6066	0.3864	0.2685	0.3777	-0.4125	0.4677	-0.3924	-0.3874
Ef_exr_1	0.9383	0.9061	0.8106	0.4461	0.2298	0.8816	0.1533	0.1096
Unemp_1	-0.7061	-0.8452	-0.8309	0.0851	-0.2681	-0.6807	-0.4194	-0.3733
Oil_1	0.5787	0.6509	0.5750	-0.3107	-0.0410	0.6295	0.2647	0.2608
MPR__6m_1	-0.9804	-0.8592	-0.8142	-0.5757	0.1073	-0.6987	0.1675	0.2237
M2_wide_1	0.5145	0.4181	0.5477	0.8628	0.0738	0.1984	-0.2428	-0.3284

	ST_ir_1	LT_ir_1	spread_1	Ef_exr_1	Unemp_1	Oil_1	MPR__6~1	M2_wid~1
ST_ir_1	1.0000							
LT_ir_1	0.8736	1.0000						
spread_1	-0.7618	-0.3504	1.0000					
Ef_exr_1	-0.9523	-0.8750	0.6682	1.0000				
Unemp_1	0.6697	0.8892	-0.1053	-0.6255	1.0000			
Oil_1	-0.6987	-0.6779	0.4424	0.5681	-0.8279	1.0000		
MPR__6m_1	0.9614	0.8760	-0.6844	-0.8991	0.6557	-0.5875	1.0000	
M2_wide_1	-0.2926	-0.4150	0.0108	0.3096	-0.1394	-0.2567	-0.4909	1.0000

Source: The present study.

Appendix 3. Descriptive statistics of bankrupt companies over the upward and downward phases of the business cycle

Bankrupts in the downward phase

Variable	Obs.	Mean	Std. Dev.	Min	Max
Financial structure indicators					
Total debt / Total assets	102	0.5719	1.1075	0	9.9569
Equity / Total liabilities	101	-0.1928	0.4003	-0.9870	2.0598
Total liabilities / Total assets	102	1.6559	1.2810	0.2100	7.6157
Current liabilities / Total assets	102	1.4578	1.2007	0	7.1142
Solvency and liquidity indicators					
Current assets / Current liabilities	101	0.8160	0.8848	0.0111	7.8183
Current assets / Total liabilities	101	0.5861	0.3331	0.0111	1.6362
Working capital / Total assets	102	-0.7301	1.2090	-6.1529	1
EBIT / Current liabilities	101	-0.1732	0.2418	-1.3468	0.4118
Profitability ratios					
Net income / Revenue	100	-1.6354	6.2261	-55.1672	0.0836
Retained earnings / Total assets	102	-0.8742	1.3972	-7.8149	0.1840
EBIT / Total assets	102	-0.3401	0.6666	-3.9297	0.2067
Net income / Total assets	102	-0.3817	0.7575	-4.9276	0.0689

Bankrupts in the upward phase

Variable	Obs.	Mean	Std. Dev.	Min	Max
Financial structure indicators					
Total debt / Total assets	148	0.5099	0.8825	0	7.6958
Equity / Total liabilities	147	-0.1747	0.4013	-0.9720	2.0094
Total liabilities / Total assets	147	1.6656	1.3132	0.1996	8.4153
Current liabilities / Total assets	148	1.4721	1.2053	0.1031	8.4153
Solvency and liquidity indicators					
Current assets / Current liabilities	148	0.7839	1.0011	0.0234	7.8108
Current assets / Total liabilities	147	0.5532	0.3163	0.0139	1.7995
Working capital / Total assets	148	-0.8365	1.3613	-7.8518	0.7759
EBIT / Current liabilities	148	-0.2742	0.4674	-4.3163	1.4222
Profitability ratios					
Net income / Revenue	145	-2.7442	8.9113	-58.0692	0.0756
Retained earnings / Total assets	148	-0.8607	1.3966	-7.6193	0.3447
EBIT / Total assets	148	-0.4447	0.6756	-3.5436	0.3906
Net income / Total assets	147	-0.4878	0.7274	-4.5436	0.1024

Source: The present study.

Appendix 4. Descriptive statistics of operating companies over the upward and downward phases of the business cycle

Operating companies in the downward phase

Variable	Obs.	Mean	Std. Dev.	Min	Max
Financial structure indicators					
Total debt / Total assets	307	0.1603	0.2107	0	1.0191
Equity / Total liabilities	307	2.9472	4.1649	-0.2293	27.5419
Total liabilities / Total assets	307	0.4611	0.2842	0.0350	1.1927
Current liabilities / Total assets	307	0.3647	0.2501	0.0315	1.1541
Solvency and liquidity indicators					
Current assets / Current liabilities	307	3.0407	3.4869	0.0607	26.4138
Current assets / Total liabilities	307	2.4310	2.9972	0.0587	25.7665
Working capital / Total assets	307	0.2646	.2633	-0.5995	1.1079
EBIT / Current liabilities	307	1.1324	1.6295	-0.7968	8.5586
Profitability ratios					
Net income / Revenue	307	0.0719	0.0851	-0.1657	0.4464
Retained earnings / Total assets	307	0.3963	0.2871	-0.2576	1.0624
EBIT / Total assets	307	0.1815	0.1653	-0.1215	1.2454
Net income / Total assets	307	0.1193	0.1247	-0.1494	0.6919

Operating companies in the upward phase

Variable	Obs.	Mean	Std. Dev.	Min	Max
Financial structure indicators					
Total debt / Total assets	443	0.2225	0.2425	0	1.0433
Equity / Total liabilities	443	2.3164	3.9049	-0.2141	27.5471
Total liabilities / Total assets	443	0.5252	0.2804	0.0221	1.2725
Current liabilities / Total assets	443	0.4063	0.2472	0.0221	1.0502
Solvency and liquidity indicators					
Current assets/ Current liabilities	443	2.7172	3.4736	0.2163	34.3120
Current assets / Total liabilities	443	2.1219	3.0207	0.1632	34.3120
Working capital / Total assets	443	0.2297	0.2608	-0.6887	0.9163
EBIT / Current liabilities	441	0.6420	1.1276	-0.8673	9.8746
Profitability ratios					
Net income / Revenue	443	0.0431	0.0832	-0.7902	0.3893
Retained earnings / Total assets	443	0.3415	0.2905	-0.3839	0.9640
EBIT / Total assets	441	0.1224	0.1148	-0.2682	0.6818
Net income / Total assets	443	0.0742	0.0965	-0.1584	0.5444

Source: The present study.

Appendix 5. Examples of models with business cycle variables for upward and downward phases of the business cycle

Model for the upward phase

```
Logistic regression                          Number of obs   =        590
                                             LR chi2(5)      =     513.13
                                             Prob > chi2     =     0.0000
Log likelihood = -74.664585                  Pseudo R2       =     0.7746
```

BN	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Size_1	-1.369937	.257908	-5.31	0.000	-1.875428	-.864447
NITA_1	-24.06177	3.87319	-6.21	0.000	-31.65308	-16.47045
RevTA_1	-.6202429	.2087679	-2.97	0.003	-1.02942	-.2110654
TLTA_2	4.992677	1.106372	4.51	0.000	2.824228	7.161126
IPI_1	.0488143	.0181321	2.69	0.007	.013276	.0843526
_cons	17.39372	5.056612	3.44	0.001	7.482945	27.3045

Note: NITA_1 – Net income to total assets one year before estimation; RevTA_1 – Revenue to total assets one year before estimation; TLTA_2 – Total liabilities to total assets two years before estimation; IPI_1 – Industrial production index one year before estimation.

Model for the downward phase

```
Logistic regression                          Number of obs   =        409
                                             LR chi2(3)      =     345.46
                                             Prob > chi2     =     0.0000
Log likelihood = -56.988266                  Pseudo R2       =     0.7519
```

BN	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
TLTA_2	7.074195	1.321749	5.35	0.000	4.483615	9.664775
EBTTA_1	-19.77442	3.260697	-6.06	0.000	-26.16527	-13.38357
IPI_2	.2742164	.1163035	2.36	0.018	.0462656	.5021671
_cons	-36.78433	12.91014	-2.85	0.004	-62.08774	-11.48093

Note: TLTA_2 – Total liabilities to total assets two years before estimation; EBTTA_1 – Earnings before taxes to total assets one year before estimation; IPI_2 – Industrial production index two years before estimation.

Source: The present study.