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COVENANTS OF A CREDIT AGREEMENT AS A REAL OPTION

Master's thesis by the 2nd year student
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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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АННОТАЦИЯ

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Описание цели, задач и основных результатов	В работе применяется метод реальных опционов для анализа кредитных договоров с ковенантами с целью определить потенциал снижения процентной ставки для подобного долга. В работе были рассмотрены основные теории использования ковенант в контрактах, была построена теоретическая модель заемщика с использованием инструментария имитационного моделирования и количественно оценены стоимости реальных опционов и потенциал снижения процентной ставки. Результаты исследования показывают, что для стандартного заемщика процентная ставка по кредиту может быть снижена приблизительно на 0,2% при включении ковенанты коэффициента обслуживания долга в условия договора.
Ключевые слова	Кредитный договор, ковенанты, реальные опционы, стоимость займа, коэффициент обслуживания долга

ABSTRACT

Master Student's Name	Valeriy D. Kurepanov
Master Thesis Title	Covenants of a Credit Agreement as a Real Option
Faculty	Graduate School of Management
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Academic Advisor's Name	Vitaly L. Okulov
Description of the goal, tasks and main results	We apply methods of real option analysis to the loan contract with covenants in order to determine the interest rate reduction potential that borrower can refer to in order to negotiate lower cost of debt. In the Thesis, we discuss different lines of research on debt covenants, build a theoretical model of a borrower, and apply simulation procedure in order to obtain future states of the firm and calculate the value of real options. The findings of the work indicate that for a normally operating borrower the interest rate of a loan with DSCR covenant can be reduced by approximately 0,2%
Keywords	Loan contracts, covenants, real options, costs of debt, debt service coverage ratio

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Introduction

When the credit agreement between lender and borrower is signed, it is common to find a set of covenants included in the terms. We define loan covenants as specific clauses written in the loan contract that impose certain actions on the borrower or restrict them. The diversity of these conditions is limited only to the creativity of the contract parties – from specifying maximum amount of dividends to obliging the borrower to keep a particular management team. When the borrower violates a particular covenant, the lender has a right to impose certain sanctions.

In recent years, the topic of covenants has gained importance in the financial literature as academics recognize the impact of these provisions on firm value, capital structure, managerial behavior, etc. as well as their prominent role in addressing specific problems like contract effectiveness or agency conflicts. Covenant theories began to emerge in the late 1970-s as a part of the agency approach to business. Later covenants were introduced to a large body of financial literature, from various accounting theories to studies of contracts. Numerous research on the subject explored the ways covenants may provide certain benefits or help tackle particular problems. The scientific importance of the subject is undoubted; yet, academics are far from having a full picture. While empirical research finds positive relations between the presence of covenants and other factors, like costs of debt or firm value, it is yet impossible to find a common theory to explain all these relations.

Covenants are frequently mentioned in the business news reports. When borrower violates loan contract clauses, a clear negative signal is sent to the markets. The consequences may be bad, from possible credit rating revision to share price drop. When Standard & Poor's agency downgraded Russian credit rating to non-investment levels, it created a risk of early repayment of corporate debt, as there were some covenants tied to the credit rating. (Metelitsa, Sharoyan, and Nemtsova 2015). Early repayment of outstanding debt may be difficult for some borrowers, or even impossible, as necessary liquidity levels were not maintained. In May 2015 the AvtoVAZ company violated covenants on loans totaling 36,6 bln. rubles, so one of the creditors, Sberbank, demanded to have a meeting with the management after the accounting statements are issued (Togliatti news May 22, 2016). In the same month, another borrower, KOKS Group, violated covenants on Gazprombank loan totaling 4,5 bln rubles due to revaluation of USD debt (Petlevoy 2016). Analysts wonder whether the firm would be able to withstand other covenants or the default is inevitable. While the economic situation is Russia is becoming less attractive, such news reports are becoming more common.

The diversity of covenant studies in literature and frequency with which covenants are mentioned in news reports indicate the relevance of the topic and its high practical importance for modern business. Unfortunately, the amounts of studies of covenants in Russian are far from being substantial. While Russian borrowers are suffering from high costs of debt and are facing possible covenant violations, the academic research with positive managerial implications becomes extremely relevant.

In this Thesis, we decided to focus on the connection between the presence of covenants in a loan contract and potential costs of debt. Among multiple theories on the subject, the majority is quite clear that both lender and borrower enjoy specific benefits that covenants provide and these benefits come at a price for both parties. The most obvious price the bank can pay is decreased interest on debt, and we find support for this claim in the academic literature (Bradley and Roberts 2004; Bazzana and Broccardo 2009; etc.). The empirical research on the subject also confirms that (e.g. Deng et al. 2015). Given the fact that almost all commercial loans contain covenants in some form – Roberts and Sufi estimate this share being 96% (Roberts and Sufi 2009) – calculating the potential discount on interest rate when certain clauses are included in the contract should be the top priority for the borrowers. If a company can actually negotiate lower interest, rather than simply accept the covenants that bank offers, then research on the subject is quite important not only for the management, but for financial theory overall.

In the Thesis, we used an unusual approach to estimate whether the preceding statement holds for Russian borrowers. Some of the researchers (e.g. Gorton and Kahn 1993) viewed covenants as *options* for the lender. We decided to employ the real options approach in our analysis of covenants to estimate whether they have a certain option value and whether borrowers can refer to this value and negotiate lower interest.

The aim of this research is to *calculate the potential of an interest rate decrease that is available for loan with a specific covenant.* We define "potential for an interest rate decrease" as the ability of borrower to obtain lower interest rate on loan through negotiation by referring to the extra option value that covenant provides the bank. Particular research objectives include:

- Define the term "loan covenant", classify existing covenants and determine their roles in loan process and debt contracts;
- Identify theoretical approaches to covenants and related borrower and lender activity;
- Evaluate the effects of covenants on both lender and borrower;
- Create a model of a firm that has a loan with a covenant in its debt structure, and estimate the value of real options this covenant provides;
- Calculate how much the interest rate on loan with covenant can be reduced compared to the covenant-free loan

To achieve the research goal we used modelling, simulation and real options analysis in the Thesis. Our work is different from existing theoretical and empirical research on the subject. On the one hand, while theoretical research explains existing phenomena, we employ the current theory of covenants to justify our claims. On the other hand, while modern empirical studies estimate significant relations between covenants and other factors with a sample of existing loans, we create a model of a company using the real-life industry data, incorporate a loan with covenants in it and simulate the firm's future state. With this methodological framework, we achieve greater variability and are able to answer the main research question from the viewpoint of how it *should be*, not how borrowers *generally do* that.

The Thesis is divided into three parts. In the first part, we discuss the main existing theories of covenants. The second part is dedicated to methodological framework of our research. The third part contains results of the analysis and managerial implications of the main findings.

1. Background and Literature Review

1.1 Debt covenants: definition, classification, and participation in bank monitoring process

The financial literature has recently experienced a boom of interest to debt covenants. The issues of academic journals dated 2010-2015 are filled with research particularly dedicated to covenants, even though theoretical fundamentals were created a while ago. The rising interest to the topic is no surprise – for years, quantitative research on firm value and capital structure ignored the specifics of debt contracts. At the same time, analysis of 3,603 private credit agreements done by of Robert and Sufi (2009) indicates that almost 97% of loans contain at least one financial covenant. Covenants can be categorized broadly by the accounting measures on which they are based – debt to cash flow (58%), debt to other balance sheet items (29%), coverage ratios (74%), net worth (45%), liquidity (15%), and cash flow (13%) (Robert and Sufi 2009, p. 1662-1663). Thus, a covenant should not be considered as an insignificant anomaly in the contract, but as an important and valuable part of the financial theory.

The literature generally agrees upon the definition of covenants. For instance, one of the most common: "loan covenants are specific clauses designed to protect the bank and prohibit the borrower from taking actions that could adversely affect the likelihood of repayment" (Greenbaum and Thakor 2007, p. 212). Quite similarly, Smith and Warner (1979) state that "A bond covenant is a provision, such as a limitation on the payments of dividends, which restricts the firm from engaging in specified actions after the bond are sold". Another, slightly different approach to covenants suggests they "specify minimum standards for a borrower's future conduct and performance" (Paglia and Mullineaux 2006). The violation of covenants is a default event and it allows the debtholders to intervene through either forced bankruptcy, renegotiation of debt terms or additional forced constraints on firm's behavior. In this context, covenants serve the role of controlling mechanisms for debtholders as they restrict the ability of shareholders to engage in strategies that are harmful for the wealth of debtholders.

One can encounter many different types of covenants in lending agreements across the globe. The main difficulty of gathering the data and exploring the relations between covenants and other factors is the secrecy of the loan agreement terms. Banks usually do not disclose what covenants they set for the borrower for the sake of privacy or competition. Analysts would need to guess, what is going on between a company and a bank during the negotiation process. However, specific critical values of some accounting-based covenants are considered "standard" in the financial world. The research by Demerjian (2007) showed that in a sample of 16,364 loans 78% of the deals included at least one financial ratio covenant. This proves again that covenants are important part of loan agreement terms, financial ratio covenants are the foundation of covenant structure of the deal and they can be more or less standard. Author explores the types of ratios used and determines five being most common – minimum coverage ratio (earnings/periodic debt-related expense), maximum debt to cash flow (total debt/earnings), minimum net worth (assets –liabilities equals to shareholders' equity), maximum leverage (total debt/total assets) and minimum current ratio (current assets/current liabilities). Author claims that all these are linked to a credit risk of the borrower (Demerjian 2007). Achleitner, Bock, and Tappeiner in their 2012 work "Financial Covenants and Their Restrictiveness in European LBOs – An assessment in the Aftermath of the Financial Crisis" find other common covenants – leverage, interest cover, cash flow cover, and capex on the basis of the survey conducted among 25 managers.

Credit risk is the probability that borrower will fail to make required principal and interest payments over the time of a loan (Demerjian, 2007). The credit risk of the borrower is evaluated at the inception of the loan. The higher it is, the stricter the loan terms will be. Unexpected rise of the credit risk is toxic for the borrower-lender relations. Altman in 1968 article "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy" discussed the issues of company default and built the first multivariate scoring model (z-score) to determine the default probability. Almost all modern default models are variations of this. Covenants were also explored in the paper: Altman concluded that by setting up covenants, creditors reduce the credit risk by demanding the borrower to stick to certain thresholds. (Altman 1968)

The main problem with credit risk is that it is unobservable: you cannot measure it directly or create the "ultimate ledger", so lenders need to use covenants as a proxy. Demerjian (2007) claims that previously listed covenants are indeed good proxies for the credit risk. Minimum coverage ratio, maximum debt to cash flow and minimum net worth use the operating performance measure. Operating performance is a good indicator of the credit risk – debt payments are made out of cash flows and earnings can be used as a stable predictor of these cash flows (Dechow et al. 1998; Barth et al. 2001). All things equal, companies with good earnings performance have lower credit risk and are less likely to default; coverage ratios, debt to cash flow and net worth covenants capture this rule. Current ratio captures the short-term-liquidity. Lack of short-term liquid assets may be the cause of technical default on payment. Leverage is an indicator of credit risk as well – the higher the proportion of debt is, the higher are the possible distress costs are.

Gorton and Winton (2003) stress that covenants facilitate the dynamic relations between lender and borrower. These relations are based on a fact that future is uncertain and many factors that may affect the position of the borrower positively or negatively are hard to predict. Both parties may include the specific provisions in the contracts in order to compensate their inability to know the future for sure. Violations of these provisions will be recorded in future on the basis of the available information. In case of the violation, lender may act to lower the credit risk level.

In order to proceed with various theoretical and empirical studies of covenants it is necessary to provide some degree of covenants classification. R. Belyaev from Graduate School of Management in 2015 “Covenants as Risk Management tool in Credit Relation” was one of the few to provide a comprehensive classification of debt covenants and I am going to cite results of his research here. One way to classify is to divide them in four groups: affirmative covenants – require certain actions to take, like sending the bank audited financial statements on quarterly basis; restrictive clauses – restrict certain borrower’s actions, like limiting the share of dividends in profits; negative covenants – forbid the borrower from taking certain actions before bank approves them, like prohibition to engage in M&A activity until the lender approves the deal; default provisions – when lender has a right to declare a technical default. (Greenbaum and Thakor 2007) Another classification suggests that covenants can be divided in financial; management, control and ownership; reporting and disclosure covenants. (Lancett 2014). H. Christensen and V. Nikolaev in 2011 article “Capital Versus Performance Covenants in Debt Contracts” in line with the Agency Theory of Covenants (will be discussed later) divide covenants in capital-based and performance-based. They argue that capital-based covenants control the agency problems by aligning debt-shareholder interests, while performance-based “serve as trip wires that limit the agency problems via transfer of control to lenders.” Companies trade-off these mechanisms. While capital covenants impose costly restrictions on capital structure, performance covenants require the accounting information to be available. Capital covenants are defined as covenants formulated in terms of information about sources and uses of capital, that is, balance sheet information only. Performance-based covenants, on the other hand, are formulated in terms of current-period performance or efficiency ratios. They include interest coverage, fixed charge coverage, debt-to-earnings, and debt-to-cash flow ratios as well as earnings (cash flow) itself. Authors also find evidence that use of performance-based covenants is more likely for firms that experience financial constraints of the borrower, high credit risk portrayed by accounting information, are likely to renegotiate the contract and have restrictions on specific managerial actions. (Christensen and Nikolaev 2011) Other classifications of covenants can be also found in literature (Achleitner, Bock, Tappeiner, 2012; Saavedra, 2014; Karapetov, 2011; etc.)

The topic of covenant tightness should also be discussed separately. Terms like “covenant stringency,” “covenant tightness” or “strictness” are used in a large body of scientific literature and usually without any adequate explanation. As no widely appreciated research distinguishes these terms, we are going to treat them as synonyms. Belyaev (2015) provides a clear explanation of the strictness of covenants. Covenants impose restrictions on borrower's actions thus giving the borrower less freedom in decision-making. Restrictions can vary: covenants may require disclosing more or less information, demanding more or fewer managerial actions; set the threshold value of financial ratios close to current values or not, etc. The more the covenants restrict the borrower and require specific actions, the more they are tight or strict. (Belyaev 2015) Strictness can be also defined through covenant slack which is the difference between threshold and initial value of covenant ratio. The bigger the slack value is, the less strict is the covenant. For example, a covenant may require a borrower to maintain earnings/interest ratio at level of at least three. If the actual ratio is 3.1, further decline may be dangerous for the borrower. If the ratio is around six, then value of the ratio can decline by three before the default, if it is nine – even more. That is more slack before default. (Demerjian and Owens 2014)

James and Demiroglu (2010) in "The Information Content of Bank Loan Covenants" study the determinants of thresholds for financial covenants in bank loan agreements and specifically focus on covenant tightness. They discover that firms with fewer investment opportunities or that are generally riskier usually prefer tighter covenants. Moreover, selection of tight covenants in the sample was associated with improvements in the covenant variables. Overall, the findings suggest that "… selection of tight covenants conveys information concerning future changes in covenant variables, investment and financial policies, and the outcome of covenant violations." (James and Demiroglu 2010)

Murfin (2012) also studied debt covenants through the focus of their strictness. He is not giving the definition of strictness, but providing the empirical loan-specific measure that aims to capture the ex ante probability of a forced renegotiation. As a result, stricter contracts making trip wires more sensitive thereby providing the lender contingent control in more states of the world. (Murfin 2012). Author finds that particular banks tend to write tighter covenants than other lenders after payment default occurs in their loan portfolios, even if the defaulted entity is industrially or geographically distant from current borrower. The findings may suggest that recent defaults alter the bank's perception of its screening expertise, thereby changing the contracting behavior.

We discussed the nature of covenants, explored the existing approaches to their classification, and highlighted the "tightness" as an important feature. As we mentioned, when covenants are breached lender needs to engage and take action in order to lower the risk level. However, this is not a single-time action – lender should constantly track the performance of the client and covenant financial ratio in order to be not caught off guard when violation happens.

Rajan and Winton (1995) suggest that loan contracts should be structured in a way to provide incentives for lender to monitor the borrower, thus linking covenants and bank monitoring.

A bank as an intermediary serves to channel funds from individual investors to firms with productive investment opportunities (Hoshi et. al. 1990). Banks exist for certain reasons. Theory suggests that banks exist, in part, because they can exploit technologies to monitor the borrowers more effectively in comparison to direct investors (Diamond 1984). The purpose of this monitoring activity is to guide borrowers to make more value-generating investment decisions, as banks usually do not want the client to default, and protect the bank's rights on cash flows if the firm actually defaults.

D. Diamond (1991) in "Monitoring and Reputation: the Choice Between Bank Loans and Directly Placed Debt" examines the need for bank's ex post monitoring and finds out that its usefulness depends on credit reputation. In fact, banks monitor middle-tier risk companies more intensively than low-tier or high-tier. Borrowers with low risk possess long track record of no-default operations, they have an established reputation and their future profits are too high for them to engage in doubtful investment projects. Low-risk clients, on the other hand, do not have sufficient positive reputation to loose and without it they take the chance that monitoring may reveal their risky investments. In response, banks will simply charge higher interest rates, undertake less monitoring activities, and limit their exposure to debt. Therefore, "…the clientele of borrowers, who rely on monitored bank loans, are the middle-rated borrowers, whose rating is too low for reputational effects to eliminate moral hazard but is high enough for monitoring to eliminate moral hazard" (Diamond 1991, p. 716)

The simplest way for a bank to monitor firm activities is through financial statements. Financial statements enable banks to learn about the borrower's investment decisions and performance over time (Jensen and Meckling 1976). By assessing the quality of financial statements bank can evaluate the borrower's financial health and its actual risk level. Minnis and Sutherland (2016) study the theory of use of financial statements as monitoring device in debt contracting. They find that for half of the loans, financial statements are requested and variation is related to credit risk of the borrower, length of the lender-borrower relationship, collateral, and the provision of business tax returns. (Minnis and Sutherland 2016) Collectively, results of the research provide evidence that fundamental demand for information from banks exists and financial statements are indeed crucial channel for this information.

However, if the company is not required to produce financial statements, banks find different ways to monitor the loans. Sometimes, lenders may not need financial statements – they rely on faith and collateral. Collateral serves two roles after the originating of the contract: it provides incentives for borrower to stay away from risky activities (to keep the value of the asset) and bring compensation for bank in case of default. Moreover, financial statements (if shared frequently) may be particularly useful when collateral is present in the agreement. Collateral provides banks incentives to monitor financial statements to ensure that asset is intact and has not been transferred to related parties. (Minnis and Sutherland 2016)

Banks may also use other information to monitor their loans: firm's tax returns, information on repeated activities, by approving major deals, etc. Tax returns can be a good alternative to financial statements, as firms are required to report sales, expenses and other figures in them.

Finally, covenants are included in the monitoring process of the bank as both means to establish this process and as instruments to control the financial position and risk level of the borrower. For instance, some affirmative covenants may require sending the financial figures to lenders every month, which is way to establish the monitoring. Some restrictive covenants that, for instance, prevent the borrower from investing a sum more than specified in a single project is a way to establish control over the operations of the company and compensate the need for monitoring. Finally, a covenant that requires the borrower to maintain a specific accounting ratio is a way to monitor the financial position of the company. In case of covenant violation, lender can reassess the borrower, its risk level, and financial health.

1.2 Theoretical concepts of covenants: Agency Theory of Covenants.

The ability of covenants to resolve the agency conflict between shareholders and debtholders is the main implication of, how some authors call it, Agency Theory of Covenants, which is primary built on the works of Jensen and Meckling (1976), Myers (1977) and Smith and Warner (1979).

In their 1976 article, "Agency costs and the theory of the firm," Jensen and Meckling develop an ownership structure theory of the firm. They start by summarizing the progress to date on the theory of property rights, agency and finance. By combining the elements of these areas they develop a theory of firm's ownership structure, that help to answer the questions like: "Why an entrepreneur in a firm which has a mixed financial structure would choose a set of activities … such that total value of the firm is less than it would be if he was a sole owner?" or "Why lenders often place restrictions on the activities of the firms to whom they lend?", etc. Authors also defined the concept of agency costs, investigated their nature that is generated by the existence of debt and outside equity, and showed their relationship to "separation and control issue" (Jensen and Meckling 1976). The main focus of the paper is the nature of agency costs, the owner of the costs and the way they are created. The inception of covenants by debtholders is justified with their ability to limit the managerial behavior that results in reduction of bonds' value.

In his 1977 work, "Determinates of Corporate Borrowing," Steward Myers stated that future growth opportunities of the firm should be viewed as real options and thus capital structure (or the amount of corporate borrowing) is affected by the market value of these growth options. In his analysis author did not rely on perfect or incomplete financial markets. The main contribution of the paper is to partial theory of corporate borrowing, with Myers proving that the amount of debt issued by the firm should be set equal to that amount that maximizes the market value of the firm. He also suggested that firms should try to match loan maturity and asset life as an attempt to "…schedule debt repayments to correspond to the decline of future value of assets currently in place." (Myers 1977) The main contribution to future covenant theories is the finding that managers of the firms with real options can engage in suboptimal investment strategies and costs of these strategies are borne by firm's creditors. The main reason why borrowers actually accept the loan terms with embedded monitoring and renegotiation is that the costs are offset by the increase in firm value due to reduction of poor investment decisions and other agency costs. Myers also claims that managers usually complain about the restrictive covenants as if they were evil, but in fact, they are rational from the viewpoint of both creditors and debtors. Managers and shareholders "…freely choose to accept constraints today which rule out the behavior that seems rational tomorrow". (Myers 1977)

Finally, Smith and Warner in their 1979 article "On Financial Contracting: An Analysis of Bond Covenants" fully cover the practical application of covenants in credit agreements. On the basis of previously mentioned works by Myers and Jensen & Meckling they recognize the conflict of interest between debtholders and shareholders and test the "irrelevance hypothesis" (that is: firm's total value is not affected by the conflict) and "Costly Contracting hypothesis" (being: control of the bondholder/shareholder conflict through financial contracts can increase the firm's value). (Smith and Warner 1979). They find evidence for the second hypothesis and suggest that use of covenants is the necessary controlling mechanism, even though it involves costs. Value of the firm can be reduced via either conflict of interest between shareholders and debtholders or managerial behavior that aims to protect the shareholders' interests. Thus, restrictive covenants are necessary to facilitate the firm's value-maximizing strategies.

Analysis of Smith and Warner also shed light on relative costs of restrictions, which can be written into the debt contract. For instance, authors conclude that production/investment policy is too difficult to monitor. On the contrary, dividend policy and financing policy have much lower monitoring costs. Finally, authors argue that it is in the interest of shareholders themselves to include debt covenants in the agreement: with the increasing value of debt, the associated agency costs will be reduced.

M. Bradley and M. Roberts in their 2004 article "The Structure and Pricing of Corporate Debt Covenants" are one of the first to provide the thorough description of Agency Theory of Covenants (ATC). It is worth mentioning, that this theoretical construct is not common in literature. However, we decided that it is worth using in the Thesis as it sufficiently incorporates major points and fundamentals of agency approach to covenants, which is represented in a huge portion of financial literature (Billett, King and Mauer 2007; Chava and Roberts 2008; Achleitner, Bock, Tappeiner, 2012, etc.) Bradley and Roberts root the ATC in the works of Smith and Warner (1979), Myers (1977), and Jensen & Meckling (1976). The foundation of the theory is the conflict of interest between shareholders and debtholders. It was briefly mentioned before, but now we are going to provide a more a detailed description.

The management of the company is hired, because stockholders believe that it can increase the value of the firm with the help of the skills and experience. Thus, management should protect the wealth of shareholders and act in favor of their interests – which may not always be the case in reality, by the way (Besanko et al. 2000). Debtholders and shareholders are the two parties that have different relations to the company and different returns. Their opinions concerning dividend policies, investment, and financing are conflicting due to the nature of different relationships. For instance, shareholders have the higher overall required rate of return and they are positive about the company taking more risky projects, while debtholders may see it as a threat to the stability of their interest payments. Thus, managers are likely to engage in strategies that are opportunistic to debtholders (and as ATC suggests, rational creditors should expect that). According to Bradley & Roberts (2004), detrimental actions include, but are not limited to:

- *Unauthorized distributions*. Managers can liquidate the firm's assets and distribute the proceeds as a dividend or repurchasing shares at a premium. Black (1976) illustrates it as "there is no easier way for a company to escape the burden of a debt than to pay out all of its assets in the form of a dividend, and leave the creditors holding an empty shell". Although it is an extreme case, it shows that all growth in payments to shareholders that is not supported by the increase in external financing is detrimental to debtholders' wealth. Stockholders, however, prefer to have part of the firm's profit to be distributed as dividends, as while they are invested in projects, resulting cash flows may only end up in hands of creditors. (Black 1976)

- *Claim dilution*. If there is a certain debt structure within the firm with senior debt being prioritized higher than subordinated debt, current debtholders face the risk of subsequent debt given the higher claim. This risk affects the price of corporate bonds (Smith and Warner 1979). When managers are issuing debt of higher priority than existing debt, value of existing claims diminishes. (Nash et. al., 2003)
- *Asset substitution.* Managers can accept higher-risk projects than had been anticipated by bondholders when they purchased their bonds. (Bradley and Roberts 2004) Debtholders do not gain anything from projects with increased risk level, but bear the increased costs of potential default, while shareholders' risk is limited to equity and they can win excess returns.
- *Over-Investment.* Cash flows can be retained to fund negative net present value projects. The overinvestment is generally associated with lower firm value (Berger and Ofek 1995) and more related to conflict between ownership and control. For example, managers can prefer to invest in negative-NPV projects to increase their own human capital and make the firm success associated with their personal skills. (Shleifer & Vishny, 1989). Still, this strategy can be employed by managers to decrease the value of debtholders' wealth due to information asymmetries, as part of asset substitution, etc.
- *Under-Investment*. Underinvestment happens when projects with positive net present value are foregone. There are negative effects for the firm's value and for the debtholders if management redistributes wealth to stockholders by rejecting to invest in certain positive-NPV projects, as they only benefit the firm's bondholders. (Begley and Felham 1999). Underinvestment is more likely to occur when firm is in financial distress as stockholders would like to maintain dividend payments thus reducing the amount of assets ready for investment. (Malitz 1986)

Here is some example of the real-life detrimental action towards the debtholders from the article "Bond Covenants and Creditor Protection" by W. Bratton, 2006:

"Assume that Firm A is worth 100 and has borrowed 50 from Lender 1 pursuant to an unsecured loan. The loan was priced on the assumption of no further borrowing by Firm A but contains no explicit restrictions. Firm A then borrows 35 from Lender 2 and invests the proceeds in a project that turns out to be worthless. Firm A emerges 85 percent levered. The interest rate on the second borrowing will reflect that possibility, compensating Lender 2, while the interest rate on the first borrowing does not compensate Lender 1. Lender 1's investment declines in value, with the benefits of the decrease accruing to Firm A and Lender 2. Lender 1 is even worse off if Lender 2 makes a loan secured by assets worth 35. So long as the obligation to Lender 2

remains outstanding, the encumbered assets will not be available to satisfy Lender 1. Accordingly, Lender 1 must look for repayment to an asset base of 65 rather than the base of 100 envisaged at the time of the loan." (Bratton 2006, p. 43)

The above example of claim dilution proves that such managerial strategies are not hard to perform. There is also a body of research suggesting that there is a positive association between shareholder power and some of the aforementioned actions. For example, Cremers and Nair (2005) show that a portfolio of firms with long positions on companies that are mostly owned by active shareholders (like public pension funds) and low takeover protection, and short position on companies with similar ownership, but low takeover vulnerability, earns positive abnormal returns. A portfolio buying firms with low ownership participation that is vulnerable to takeovers and shorting companies with same ownership and great takeover protection earns no abnormal returns. This evidence is supporting the idea that active shareholders can encourage the activity on the takeover market (John and Kedia 2006). The debtholders act rationally and they can predict detrimental actions and price the corporate debt accordingly. Thus, stockholders will pay ex ante for the potential opportunistic behavior ex post. As stockholders bear the agency costs of debt, they will try to minimize them by including debt covenants in the loan agreement. Thus, covenants will control the management from taking actions that are detrimental to debtholders. Debtholders will be willing to pay more for the debt contract with covenants. (Bradley and Roberts 2004)

It is clear that actions listed above will have certain effects on overall firm's behavior and performance. Bradley and Roberts (2004) further test the implications of the ATC, which include:

- Potential benefit for shareholders from actions of management is greater when the firm is in financial distress.
- Since the agency costs of debt are inversely related to a firm's financial condition, the poorer the firm's financial condition, the more likely is it that the firm would include a covenant in its debt contracts.
- Since it is virtually impossible to renegotiate covenants with public bondholders, firms that include covenants in their debt contracts would issue primarily private as opposed to public debt.
- Firms with significant growth opportunities will include covenants in their indenture agreements.

These implications were tested on 2002 sample of private corporate debt agreements from Dealscan. The findings are generally in line with theory presented above and support the findigs obtained by Malitz (1986), Begley (1994), Nash et. al. (2003), etc. Ileen Malitz in the 1986 article "On Financial Contracting: The Determinants of Bond Covenants" tested the sample of 252 public debt issues and found out that presence of covenants is negatively related to the size of the company and positively related to the leverage ratio. At the same time, Begley (1994) studied the sample of 130 public issues and discovered that restrictive covenants are more likely to be found in debt contracts of firms close to bankruptcy, with low asset value and low projected cash flows. While Bradley and Roberts successfully tested the past evidence of the ATC, they also discovered that the decision to include covenants and promised yield of the debt security is determined simultaneously. Moreover, bonds with covenants would have a yield lower than debt securities without any provisions. (Bradley & Roberts, 2004)

F. Bazzana and E. Broccardo in their 2009 "The Role of Covenants in Public and Private Debt" employ the ATC to investigate the efficiency of covenants in bond contracts. At first, they summarize the previous research to outline the *costs and revenues* of introducing covenants in the contract to decrease agency conflict. The borrower would enjoy lower spread on debt securities that have covenants compared to covenant-free instruments for an exchange of constraints of company's activities. The lender would offer less interest on debt for an exchange of an option to interfere in company's activities and to have a more effective monitoring system. The authors also found out that while covenants can be effective in reducing agency costs, lack of coordination between debtholders might reduce this efficiency due to high amount of renegotiation costs followed by covenant violations. (Bazzana & Broccardo, 2009)

Therefore, judging by all of the aforementioned, there is a significant volume of scientific literature that explains the fundamental reasons of presence of covenants and their impact on the firm behavior and performance from the agency perspective. The inclusion of covenants is justified by the reasons of mitigating shareholder/debtholder agency conflict and providing associated benefits. Their possible impact on quantitative parameters like debt yield, capital structure, leverage, etc. is not random. Covenants can reduce the agency costs between borrowers and lenders, but each party has to pay the price for it.

1.3 Theoretical concepts of covenants: Accounting perspective

The theoretical research on the subject of covenants may deviate from the mainstream agency approach and utilize a different view on the issue. For example, Dichev and Skinner (2002) in their article "Large-Sample Evidence on the Debt Covenant Hypothesis" run large-sample tests of so-called debt covenant hypothesis. They approach the issue of covenants from an accounting perspective.

In the accounting research, "debt covenant hypothesis" stand for the idea that managers tend to make accounting choices to reduce the likelihood of their firms will violate loan covenants. Hypothesis was proposed by Watts and Zimmerman (1986) – they predicted that firms which are close to thresholds (have low covenant slack) will make income-increasing accounting choices. The strength of managers' incentives to prevent covenant breaches from happening depend on the costs of these breaches – these are costs of technical default (Smith and Warner 1979; Holthausen and Leftwich 1983). Thus, accounting literature on covenants mainly seeks ways to estimate these costs and find out, whether accounting choices of managers are specified to avoid covenant violation.

Dichev and Skinner (2002) provided solid evidence that debt covenant hypothesis is true and decisions of managers indeed depend on debt covenants. Their findings are consistent with some prior research by Sweeney (1994), DeFond and Jiambalvo (1994), but contradict the results of DeAngelo et. al. (1994) research. It is worth mentioning, that this work is superior to its predecessors as it uses larger and more representative sample. Previous literature usually focused on the accounting choices of firms, ending up in technical default, so their support for debt covenant hypothesis was questionable: if the firms from the sample mainly defaulted, they can represent only unsuccessful attempts of avoiding covenant violation. The article by Dichev and Skinner (2002) does not have this drawback. Furthermore, the work provides evidence that in private lending agreements covenants are set relatively tightly, covenant violations in the sample are quite common (almost 30% of loans) and mostly these violations are not a result of financial distress (Dichev and Skinner 2002). Authors suggest that private debt agreements lenders frequently use covenants as a screening device – that complements the aforementioned Christensen and Nikolaev (2011) research.

Several studies have examined the covenant breaches and associated costs of debt covenant violation. For instance, Chen and Wei in 1993 article "Creditors' Decisions to Waive Violations of Accounting-Based Debt Covenants" explore the violation of covenants from creditor point of view and explain the creditors' decision-making process after covenants are violated. They find out that after the covenant breach creditors can either waive the violation or impose sanctions like early repayment, interest rate negotiation, etc. They also build the creditor decision model either to waive or call the debt with option pricing techniques. Beneish and Press (1993) in "Costs of Technical Violation of Accounting-Based Debt Covenants" investigate the technical violations of accounting-based covenants for the sample of 91 firms. Their findings suggest that in case of obtained waiver costs range from 1.2 to 2 percent of market value of equity, depending on the assumptions made. However, if the creditor wants to impose the additional restrictions after the covenant breach, then losses can fall between 4.4 to 7.3 percent. These two studies have a drawback, that is recognized by the authors: the samples are likely to include only "the worst" covenant violations as according to SEC Regulation S-X, Rule 4-08, firms are not required to report the violations that have been cured by the report date.

Sweeney (1992) examines how managers respond to tightening constraints and explores the accounting decisions of managers before and after they violate debt covenants. Generally, her findings are in line with previously mentioned Dichev & Skinner (2002) work. The article provides evidence that managers are more likely to make "income-increasing discretionally accounting changes" when approaching such constraints, than managers from control firms. (Sweeney 1992) Managers of default firms are inflating the accounting earnings figures even more often and earlier adopt the income-increasing changes to accounting policies. Sweeney also mentions that accounting changes helped to delay the technical default for 5 out of 22 default firms. However, she states that in some cases, even substantial default costs will not motivate managers to make accounting changes, for example, when degree of managerial flexibility is low. Thus, the relevance of default costs for managers can be argued in some cases.

Further research on debt covenant violations was conducted with some implications to other areas of management. Clifford W. Smith in 1993 "A Perspective on Accounting-Based Debt Covenant Violations" summarized the theoretical and empirical findings on the topic. Anand Jha in 2013 work "Earnings Management Around Debt-Covenant Violations" uses a large sample of quarterly data to investigate how earnings are managed around the debt covenant violations. This can be seen as a modern follow-up to Sweeney's research, with an exception that more narrow time interval is examined. The main finding on the paper is that "managers manage earnings upward in the quarters preceding a debt-covenant violation, but downward in the quarter a violation occurs. And they continue to manage earnings downward while the firm remains in violation" (Jha 2013) Author argues that earnings management is also done to improve the bargaining power of the management in the follow-up renegotiation. Furthermore, Jha finds no evidence of excessive earnings management done by high-levered firms done in order to prevent the covenant breach.

Fargher et. al. (2001) use the preceding research on firm's behavior around the covenant violation (Beneish and Press 1995; Wilkins 1997) to make the proposition that technical violations of covenants involve significant breaches in financing agreements of firms; thus "these breaches are likely to be associated with significant increases in violating firms' risk". (Fargher et. al. 2001). Authors test this proposition by evaluating the changes in systematic and unsystematic risks associated with initial technical violations. They conclude that there is solid supporting evidence that both systematic and unsystematic risks increase close to covenant breach. These findings are open to interpretations. The investors can be using the financial disclosures on technical default for pricing and risk assessment. It may also be the case that risk measures and the violation announcements both reflect the same underlying weakening in the firm's financial condition.

E. Borgonovo and S. Gatti of Bocconi University (Italy) extend the traditional risk analysis of investment projects in their 2013 "Risk Analysis with Contractual Default. Does Covenant Breach Matter?" by implementing the consequences of covenant breach in the Monte Carlo simulation that is used to obtain the NPV distribution. Authors present the framework of modelling material breaches (result in possible firm default) and technical breaches (accidental violation of accounting variables) and apply their models to a real case study of project financing of 64-million Euro biomass plant. Findings suggest that both technical and material breaches matter, with their impact on NPV distribution being more relevant with rising leverage and costs of debt. Although their approach does not involve accounting theory directly, results of the research are extremely relevant when we discuss the covenant violations later in the methodology session. (Borgonovo and Gatti 2013)

To sum up, various accounting theories treat covenants as important factors of accounting decisions of the firm. This body of literature focuses on different situations that involve covenants and that would likely influence the firm's reporting – mostly, covenant violations. As covenant violation is the main factor that affects the accounting both ex ante and ex post, no surprise it is the main issue of the accounting research on covenants. Different works prove that managers tend to make revenue-generating accounting choices in order to prevent covenant violations and that credit risk indeed depends on breaches – it increases significantly right before the violation. The accounting theory also explains tight thresholds. They are used by lenders to monitor closely the activity of the borrower (as "trip wires") and violations of tight thresholds are often waived.

1.4 Theoretical concepts of covenants: Incomplete Contracts approach

A set of academic literature provides research on covenants via the so-called incomplete contracts approach. The contract between the bank and the borrower can be complete and incomplete. The economic theory suggests that writing complete contracts (contingent on all future states of nature) is a certain way to improve overall efficiency of a transaction as it facilitates the full risk sharing in these future states of nature. Still, complete contracts are not available in practice. Renegotiations, that sometimes happen after the contract is signed, are even more at odds with this theory. (Freixas and Rochet 2006) When the lending agreement is signed, it is impossible to predict all the outcomes and events that may happen to the company. If the firm goes bankrupt, lenders will have to initiate the bargaining process in order to save at least some of the assets they have a claim on. That is clearly a negative outcome for the lenders, but for them it was too difficult to predict the exact chain of events that triggered the bankruptcy.

Incomplete contracts theory considers this fact and allows one to work with information asymmetries in contracts. Bolton & Scharfstein (1990) and Hart & Moore (1988) recognize the situation when different states of nature are observable only by two parties to the contract, but these states are not verifiable (outsiders cannot observe it). An incomplete contract will typically require delegating the decision-making power (limited to a predetermined set of actions) to one of the parties. This power should be dependent on the verifiable signal, thus, for instance, a contract may specify that creditors take over the firm in the event of default. (Freixas and Rochet 2006) Belyaev (2015) illustrates this concept with a following example:

"…Suppose that lending contract has a covenant that limits the borrowing by two times of the amount of net capital of the firm. If the borrower tries to raise more money or his net capital value depreciates, then the covenant violation will occur. Bank can demand early repayment of the debt or change of loan conditions in order to lower the risk and increase income… As we can observe from this situation, the lending agreement does not include all possible scenarios that result in increased lender's risk level – like borrower investing in more risky project or unexpected losses of the company. Instead, bank and borrower fix the financial ration in the loan agreement that serves as an indicator of borrower's financial health and risk level"

Nobel Prize winner of 2014 J. Tirole discusses information asymmetries, contracts and covenants in his 2009 "Cognition and Incomplete Contracts." He states that "incomplete contract is a contract specifying the available design, which is renegotiated whenever this design turns out not to be appropriate". Tirole claims that analyzing the outcomes, choosing the full terms of the agreement and assessing the results is costly for the bank. Parties to a contract consciously use heuristics and leave it incomplete. Covenants protect the lender from unpredictable situations that might happen (Tirole 2009)

Theory suggests that renegotiations between parties play a key role in incomplete contracts. Two parties know that ex post the contract is not optimal. Therefore, "since they are better off renegotiating the terms of the contract, they can't credibly commit not to renegotiate." (Freixas & Rochet 2006, p. 114) Renegotiation is a way to improve efficiency of the contract.

Gorton and Kahn in their 1993 "The Design of Bank Loan Contracts, Collateral, and Renegotiation" explore this idea in order to find the fundamental difference between public debt (bonds) and private loans. One of the easily observable differences between debt types is the presence of covenants: loans usually have much heavier covenant structure than public debt. According to Gorton and Kahn, private loans have the embedded options to call the loan back. This is a trigger for renegotiation and renegotiation will automatically increase the effectiveness of the contract. Covenants are valuable as they allow efficient loan renegotiation. Authors also claim that they have introduced new and only justification of bank existence via renegotiation – while ex ante screening of borrowers and ex post monitoring of the borrowers is important, it does not explain the seniority of bank claims, why banks are not equal to junior claimants or even equity investors. (Gorton & Kahn, 1993)

The connection between covenants and debt renegotiation is a significant topic in academic literature. Empirical studies show that it is actually a common practice to renegotiate loans, for instance Zinbarg (1975) claim that loans in the portfolio of Prudential Insurance Company of America are renegotiated at least once a year. Aghion and Bolton (1992) also utilize the incomplete contracts approach to covenants. They view covenants as tools to allocate control rights between managers and creditors optimally. Research shows that if the borrower faces the liquidity constraints, then renegotiation will not help to achieve the first best optimum (Aghion and Bolton 1992). That is contradicting the Kahn and Huberman (1989) findings: renegotiation can achieve an efficient outcome, while no other simple contract can. Aghion and Bolton place the trade-off in controlling agency problems versus giving the borrower leeway to act efficiently as their main priority, which is similar to focus of Berlin and Mester in their 1992 work "Debt Covenants and Renegotiation." In the article, they explored the connections between stringency of covenants' restrictions and ease of renegotiation of debt contracts. The results of the research concern the "impact of the firm's creditworthiness on the value of the renegotiation option" (Berlin and Mester 1992). When firm's creditworthiness is low, its increase will positively affect the value of the renegotiation option. However, beyond some minimum level further creditworthiness increase will only reduce the option value. Their model also suggests that bank loans include covenants because they allow the bank to restrict the set of actions borrower can take, not because of their loan call back option as Gorton & Kahn argue. The following finding is quite intuitive: the possibility of renegotiation should make covenants stricter. The overall results are consistent with empirical and anecdotal evidence. Although authors believe, that their findings are quite intriguing, they do not answer any questions about the optimal contract design with different types of debt (public and private), thereby setting a path for further research. Unfortunately, this "fruitful avenue of future research" was left undeveloped. Some authors like Bulow and Shoven (1978); Gertner and Scharfstein (1991) discuss the issue, but fail to provide the optimal contract design in the face of debtholder conflicts.

Garleanu and Zwiebel in their 2006 "Design and Renegotiation of Debt Covenants" also consider the effect of design and renegotiation of covenants in debt contracts as a "specific example of the contractual assignment of property rights under asymmetric information" (Garleanu and Zwiebel 2006). In particular, they explore the situation where managers have more information than the bank on future investment transfers from debt to equity. The findings of their research indicate that this adverse selection problem results in allocation of greater ex-ante decision rights to the less informed party – which is the creditor – that would be under symmetric information condition. The practical implication would be tighter covenants upon interception and their further waive after the negotiation (creditor is giving away the excessive rights). The results of Garleanu and Zwiebel research contradict the previous incomplete contracting models – they were assuming that management is the one gaining excessive rights ex ante. The authors rely on 2005 work by Dessein (2005) "Information and Control in Ventures and Alliances" when they consider control rights allocation under asymmetric information. Dessein, however, did not explore renegotiations and was more focused on private entrepreneur-investor relations. His findings indicate that the entrepreneur (informed party) ceases control rights to the venture capitalist (the uninformed party) in order to signal congruent preferences. (Dessein 2005)

To sum up, incomplete contracts approach mainly focuses on information asymmetries between lenders and borrowers in debt contracts and suggests covenants are a way to reduce them – while debt renegotiation makes the contract more effective, covenants are actually embedded options to renegotiate.

We observe that main three approaches to covenants include agency theory, incomplete contracts approach and various accounting theories on the subject. The agency approach treats covenants as means to resolve the agency conflict between the debtholders and shareholders and to reduce agency costs of debt. Accounting theories focus on their impact on accounting decisions and figures, mostly via the covenant breaches. Research on incomplete contracts treat covenants as means to reduce information asymmetries.

The three approaches to covenants more or less exhaustively construct the theoretical background of the covenant research. Belyaev (2015) also emphasizes on results of resource-based theory of strategic management as being important for covenant studies. As this perspective is not specifically relevant for the research, it is still worth mentioning to provide the full picture on the subject.

Belyaev claims, that resource-based theory stems the success of the company in its possession of the specific assets that give the company competitive advantages. For instance, Williamson distinguishes organizational routines and core competences that are possible due to allocation of specific resources into clusters (Williamson 1999). Belyaev suggests, that credit risk is directly related to unique company resources. When company loses its own core competences, its ability to conduct business smoothly is jeopardized. That might be followed by future problems with the ability to make interest payments, thus the credit risk is increased. The ideas of strategic management resource-based theory suggest that creditors should be interested in borrowers retaining their core competences and unique resources. Belyaev argues that lenders can use specific positive covenants for that reason. For example, if the unique management competence is the competitive advantage of the organization, then loan covenant can demand from the borrower to retain the key managers, keep the managerial structure or distribution of responsibilities. (Belyaev, 2015)

Belyaev refers to work of Bishara and Orozco while discussing the implications of the resource-based theory. In their 2012 article, “Using Resource-Based Theory to Determine Covenant Not to Compete Legitimacy” authors explored the nature of modern knowledge-based economy and concluded that today main assets of the company are not comprised of production facilities, inventory and other tangibles. Instead, leaders of the industry like Apple, Google or Facebook constantly generate new ideas that develop into innovations. (Bishara & Orozco, 2012) Aside from new ideas and commercialized innovations, Belyaev selects managerial practices, policies regarding the health, safety, and environment (HSE) as new kind of company assets that are becoming a crucial factor of the credit risk of the borrower. The idea is to incorporate the new reality into the covenants that are stuck in world of financial ratios and company reporting. Banks can start to include covenants that protect strategic intangible assets of the firm in the loan agreements to maintain the credit risk of the borrower. Moreover, covenants can be a mechanism that controls the borrower’s compliance of ecological and social norms and rules. (Belyaev 2015)

1.5 The effect of covenant loan structure on borrowing terms

We have discussed the main theoretical approaches to covenants and specifically focused on the ways they can resolve certain problems. It turned out, that various theories isolate different benefits that covenants provide while included in the debt contracts: from resolving the agency conflict and minimizing the agency costs to making debt contracts more effective via renegotiation and establishing the oversight mechanisms. We must admit that all approaches have their practical point. K. Paglia and D. Mullineaux in their 2006 article “An Empirical Exploration of Financial Covenants in Large Bank Loans” studied the reasons for inclusion of covenants in the contracts and found out that their use is affected by potential agency problems, information asymmetries, incentives to monitor, and growth opportunities alike. (Paglia and Mullineaux, 2006) All theories, however, conclude that the effect is double-sided: both lender and borrower should be voting for the inclusion of covenants in the contract.

In order to proceed with the research we have to estimate the practical effects that covenants have on the loan agreement. Most of them are already mentioned as a part of theoretical background. We will continue with a short recap of the main practical consequences of inclusion of covenants on the loan agreements from previously discussed theoretical approaches and then list the findings from the empirical academic literature. These articles commonly test the relations between covenants and other variables inside the specific environment. They are mostly not related to aforementioned theoretical frameworks – the research is primarily focused on relations and covariance.

As we discussed earlier, according to research on Agency Theory of Covenants, both lender and borrower enjoy the decreased agency costs when special provisions are included in the debt contract. However, reducing agency costs comes at a price that both the borrower and lender have to pay. At first, covenants reduce the managerial flexibility that may be both a good and a bad thing at the same time. On the one hand, reducing the decision-making power of the management may protect the debtholders from detrimental company strategies. On the other hand, less flexibility may result in lower firm value as company would have to pass out on possible profitable transactions. Moreover, bank can establish a better monitoring system via covenants. In any case, cost that borrower pays is still a gain for the lender. The bank has to pay the price as well – by reducing the cost of debt for the lender.

The accounting perspective on covenant research mainly studies the covenant violations and managers' decisions when violations are close or already happened. It turned out that accounting choices of managers clearly depend on covenant thresholds. This is also a cost for the company – by including covenants in the contract, managers would make certain choices to maintain the appropriate accounting figures rather than thinking about company value instead. The bank, on the other hand, will probably divide the breaches into technical and material and will waive the violation if the breach is not related to financial distress.

Finally, the incomplete contracts approach sees covenants as a way to make debt contracts more effective – they are perceived as an option to renegotiate the terms. Renegotiation allows reducing the information asymmetries between parties and allocating control rights better. As a result, we get a more efficient contract where banks do not charge extra cost of debt for uncertainties and borrower's decision-making is more transparent.

While different perspectives on covenants may contradict each other on specifics – like would companies with significant growth opportunities rely on covenants – they agree on basics: covenants are beneficial for both lender and borrower (for various reasons), both parties pay the price for including them in the contract but also enjoy the benefits. The gains of the company are most material: theory suggests that contract with provisions would be cheaper for the borrower than agreement without them.

The idea, that presence of restrictive covenants reduces the yield on debt is generally obvious in theory, but needs empirical confirmation. We find support for this statement in an article by Russian researcher Anna Zadorozhnaya "The Influence of Covenant Protection on

Yield of Corporate Bonds" (2015). The article presents the results of empirical study of how covenant protection affects the cost of debt. Covenants mitigate problems of risk transfer in agency conflicts, and influence the corporate financial policy with cost of debt reduction. Research results demonstrate that a negative relation between bond spread and the presence of covenants exists, which is consistent with the costly contracting hypothesis (CCH), but registered only in Eurobond market. So, if the bond covenants on domestic market in Russia are not affecting cost of debt, then valuation of loan covenants with instruments of real option analysis is becoming more significant for all market participants. (Zadorozhnaya 2015)

Article by Deng et. al. "The Role of Debt Covenants in the Investment Grade Bond Market – The REIT Experiment" (2015) examines the investment grade bonds and covenant protection. Investment grade bonds usually do not have covenants in debt terms. The rationale is that investment grade firms are financially stable and covenants do not provide extra benefits. Authors, however, claim that in the case of Real Estate Investment Trusts (REITs), investment grade REITs tend to hve a covenant protection with leverage limits and requirements to maintain particular interest coverage ratios and fixed charges. This unique environment of REIT bonds gave a perfect opportunity for the researchers to examine the importance of debt covenants on debt markets. The findings of the article is somewhat surprising: debt covenants are indeed common among investment grade REITs in the REIT market and solid evidence exists of their higher use compared to non-investment grade REITs. Authors show that debt covenants are rarely a mandatory term in the market, as investment grade REITs choose covenant provisions based on accounting ratios for which they have enough slack. Finally, article provides evidence for lower cost of debt when these investment grade REIT bonds are issued with covenants. The last finding supports the idea of negative relation between yield and presence of covenants, suggested and tested by other researchers. (Deng et. al., 2015)

Jin Yu (2010) in the work "The Value of Debt Covenants: A Quantitative Framework" was the first to incorporate debt covenants into dynamic structural model with endogenous choice of real investment and capital structure in the presence of agency conflicts. This research framework is crucial for any research on covenants as it includes calibrated simulations – with current unavailability of data, simulated numbers become a good substitution. Findings by Yu indicate that coverage ratio covenants dominate book leverage ratio covenants. With optimal interest coverage (book leverage) ratio covenants, market leverage ratio increases from 26% to 39% (37%) and overall firm value increases by 3.0% (2.5%) and the market leverage ratio increases from 26% to 39% (37%). Yu concludes that covenants and their violations are important determinants of firm's investment and financing policies and provides model for optimal covenant tightness. (Yu 2010)

Finally, N. Reisel in her 2004 article "On the Value of Restrictive Covenants: An Empirical Investigation of Public Bond Issues" contributes to the covenant theory by investigating the costs of including covenants in the bond issues. The results of her research again prove that lender pays the borrower with decreased costs of debt for covenant protection. Reisel finds out that on average firms can reduce the costs of debt by astonishing 311 basis points by including restrictive financial covenants in the contract. She also tested the same relationship with asset sale, payout and investment covenants, but did not find the significant relationship. Reisel suggests that results of the research imply that high growth firms should find it too costly to include covenants that restrict investments, asset sale and payoff. (Reisel, 2004) This is contradictory to results of 2007 empirical work "Growth Opportunities and the Choice of Leverage, Debt Maturity, and Covenants" by M. Billet, T. King and D. Mauer, who find a positive relation between restrictive covenants and growth opportunities, debt maturity and leverage.

The recent empirical works on the subject again prove that covenants in the loan contracts have a certain value and lender pays its part by lowering the costs of debt for the borrower.

2. Methodology and Data

2.1 Propositions

As we mentioned in the introduction, the aim of this research is to *calculate the potential of an interest rate decrease that is available for loan with a specific covenant*. By "potential for an interest rate decrease" we understand the ability of borrower to obtain lower interest rate on loan through negotiation by referring to the extra option value that covenant provides the bank. As we have observed in the literature review section, various theoretical studies imply that debt covenants are beneficial for both parties (lender and borrower) and both parties have to pay for them. The lender pays via decreased costs of debt. If so, we are going to estimate the value of the specific covenant in the contract using the real options approach. If the value is more than zero, it means that all else equal, contract with the covenant is more beneficial for the bank than light covenant loan structure (covenant-free debt). However, we assume that bank should not offer loans of different cost to the same borrower at a specific point in time, thus covenant of a specific tightness can be used by a borrower to justify interest rate discount.

In order to achieve the research goal, several research objectives should be met:

- Define the term "loan covenant", classify existing covenants and determine their roles in loan process and debt contracts;
- Identify theoretical approaches to covenants and related borrower and lender activity;

- Evaluate the effects of covenants on both lender and borrower;
- Create a model of a firm that has a loan with a covenant in its debt structure, and estimate the value of real options this covenant provides;
- Calculate how much the interest rate on loan with covenant can be reduced compared to the covenant-free loan

Several obstacles stand in the path of the research. We need to overcome them to achieve the research goal successfully:

At first, *every company is unique and has a different set of characteristics*. The oil extraction company from the UK with low share of debt and high-levered Russian telecommunications industry player are different in terms of cash flows, revenues, margins, etc. Therefore, each company will receive individual set of covenants of different tightness. Even within the same country and industry, companies have different accounting ratios that need to be maintained. Thus, each possible effect of covenants on loan terms would be different. In order to overcome this obstacle we would focus on one specific industry, which is Russian oil industry. We are going to use the industry data on distribution of company characteristics to simulate the accounting variables of the generic company. This is going to be a dataset for the research.

Second, *there is a degree of uncertainty of how to incorporate management decisions*. Managers create a strategy for the company and decide, whether the firm should borrow cash, invest in projects, etc. Simulating some of the variables can be invalid, unless management decisions are incorporated into the model or specific assumptions are made. Moreover, as we have observed in the accounting approach to covenants, managers tend to make revenue-generating accounting choices in order to prevent the covenants from breach. In our model, we are not going to incorporate the preventive managerial activity before the breach, as it is a part of a separate research and a good area of future development. At this point in time, it is crucial to build a stable working model without overcomplicating the results. As for the variables not prone to simulation – we are going to make industry-specific and variable-specific assumptions concerning each of them, which will be presented later on.

Third, *many covenants exist in the contract at the same time and each probably has its own impact on the loan.* As a part of the research, we decided to focus on debt service coverage ratio (DSCR) and stick to the threshold of this covenant. In Corporate Finance DSCR is a measure of the cash flow available to pay current debt obligations. The current debt obligations include interest, principal and lease payments. The ratio is calculated as (Rehmann 2013):

$$DSCR = \frac{Net\ operating\ income}{Total\ Debt\ service} \quad (1)$$

The higher the ratio is, the easier is to obtain the loan. On practice, Earnings before Interest and Taxes (EBIT) are used as a proxy of the available cash flow. During the simulation procedure, at each iteration the actual values of DSCR will be compared to the threshold value at each period. In case of a breach, lender's actions will be incorporated in the model and value of a covenant will be calculated. Later, the distribution of values of a covenant will be then presented with a choice available for the company (managerial implications). We are going to assume that DSCR is the only covenant in the loan contract of the firm.

Fourth, *what are the consequences of covenant breach*? The violation of DSCR covenant means that the borrower failed to maintain the minimum DSCR ratio (threshold). If the bank sets the DSCR covenant ratio to 3, then the borrower would violate it if the actual ratio goes lower – like 2, or 1, or 0, or even -1 (in case EBIT is negative). From different theoretical approaches to covenants we have observed that lender can interact with the borrower in many different ways after the covenant violation. At first, bank can announce the technical default of the borrower and demand an early repayment of the loan. Second, bank can impose sanctions on the borrower and increase the interest rate of the debt, add more covenants, take control over some of the operations, and many more. Finally, lender can give a waiver and leave it "as is" with hope that situation is going to improve in the future.

We are going to incorporate the approach of Borgonovo & Gatti (2013) to covenant violations in our model. They divide the breaches into material (possible debt services default due to inability of the borrower tp pay debt-related payments) and technical (credit risk is not changing, no risk of future default – accidental covenant violation).

In case of the technical breach, we assume that bank utilizes the cash sweep strategy. The cash sweep is the mandatory use of excess free cash flow to pay down outstanding debt rather than distribute it to shareholders (Ventureline 2015). In other words, lender restricts the dividend payments to shareholders in the period when the breach occurred. This is not the only way to deal with the technical covenant violation – as we mentioned in the theory section banks may waive the violation and let the company continue its operations without any sanctions. (Chen and Wei 1993; Beneish and Press 1995) However, it is hard to determine the value of this option to engage as the decision to waive should be supported by careful evaluation of company's risk profile. What if the borrower is clearly off track and waive is guaranteed only if management do some revenue-generating decisions? Cash sweep is the solution as the outcome is clear, decision it is certainly in the interest of debtholders and it eliminates the detrimental strategy of unauthorized distribution of assets (agency conflict).

In case of the material breach, lenders will demand an early repayment of the outstanding debt at its present value. The cash is taken from asset sales and free cash flow. The material breach is not exactly a default – but a signal for a future one. If the company is unable to make debt service payments in full out of cash flow and current assets in this period, then it is in default. While material breach happens in Y_n the following default happens in period Y_{n+1}.

Simulation is essential part of our analysis as it allows us to model the behavior of the firm in the long run, see how specific covenant is breached and what consequences that will have. Researchers have used simulation before in their works devoted to covenants. For example, Gamba and Triantis (2013) in their article “How Effectively Can Debt Covenants Alleviate Financial Agency Problems?” examine how effective debt covenants can be in moving shareholders’ investment and financing policies closer towards first-best policies, and the extent to which agency costs can thus be mitigated. Methodology of their research includes modelling the investment and financing decisions in an infinite-horizon discrete-time dynamic and stochastic framework. The control variables are the book value of assets in place and the face value of outstanding debt. At first, authors model the finite set of heterogeneous firms in the economy, each driven by an independent company specific risk, but then describe the behavior of the individual firm.

Another methodological step is the application of the real option analysis to the simulated data. After we have understood how company’s accounting variables are going to act over time and what is the effect of covenant breach, it is necessary to estimate the additional value the specific covenant provides the bank. We are going to apply the real options methodology, which is quite similar to financial options framework. Some authors included covenants into the real options analysis frameworks; however, their research topics are not relevant for this Master Thesis.

In the next sections, we are going to describe the process of model creation, simulation of the outcomes and option value of DSCR covenant calculation.

2.2 Model description

There is a firm that belongs to shareholders and equityholders alike. A firm comes from oil industry in Russia. The firm starts at time zero (t=0) and its condition would be observed in the next ten periods ($t \in \{0,1,2\ldots10\}$)

There are several reasons why we decided to use the industry data of oil companies. At first, there is a sufficient number of similar firms in the business and they operate under the same market conditions. Second, the accounting data we used is prepared under the same IFRS standards and similar approach to asset valuation, revenue recognition and debt valuation is used. Third, this is one of the oldest industries in modern Russia, thus the accounting data for more than 10 years is available. Forth, Russian oil businesses have long relations with the banks; they are familiar with the debt financing and can borrow at comparable interest rates. Finally, oil industry is considered a stable one, even in the period of low oil prices, with equity beta being close to one for all companies in the list. (Investfunds.ru, 2016) A stable industry may expect stable cash flows in the next ten years.

The firm enters time zero with a certain amount of assets, total debt/total equity ratio, dividend payout rate, and amount of existing debt service payments. It borrows the amount of *N* US dollars at the interest rate *i* and has to repay the debt in equal installments during the next 10 periods. Principal payments are made during the whole duration of the loan. Bank sets the threshold for the Debt Service Coverage Ratio covenant at the amount of *T.* In case of the threshold violation in any given period, bank can call the technical default on debt and demand the early repayment of the outstanding debt at PV. However, as we mentioned earlier, the bank would divide the breaches into material and technical and utilize the "cash sweep" strategy if the breach is not related to possible default.

It is necessary to mention the meaning of "covenant threshold" here. For DSCR covenant, the threshold value is the minimum value the company should maintain throughout the duration of a loan. If the value of DSCR falls beyond the threshold, that means that company is either not maintaining the sufficient levels of operating income, or is paying excessive debt payments, or both. The value of the threshold is determined by bank in our case; however, in reality both lender and borrower have to agree on the threshold.

The future states of the company should be forecasted. You may find two main approaches to forecasting the value of the parameters in literature: *qualitative* and *quantitative.* Qualitative forecasting is used when no reliable historical or comparable data exists and it is based on expert opinion approach, management expectations, polling, surveys, etc. These methods are not applicable to our research. Quantitative forecasting requires reliable numerical historical or comparable data that can be divided into time-series, cross-sectional or panel. Here are some well-known methods of quantitative forecasting:

- ARIMA and auto-ARIMA (autoregressive integrated moving average) takes the historical time-series data to perform the back-fitting optimization routine to account for autocorrelation. The model's advantage as it corrects the nonstationary characteristics of the data for the sake of stability and learns over time by correcting the forecasting errors.
- Multivariate regression models the relationship structure of the dependent variable on the exogenous variables. The model itself can be linear and non-linear.
- Maximum likelihood estimation is used to forecast the probability of the event with the independent variables. The approach can be used on Logit, Probit and Tobit regression models and is effective when traditional regression models fail (for instance, predict the probability more than one)

- ARCH and GARCH (generalized autoregressive conditional heteroscedasticity) models are used to characterize and model time series. In the financial modelling they are particularly effective in estimating the historical volatility and predicting the future volatility of a marketable security. Many variations of the original techniques exist now.
- Stochastic process forecasting is used when variables can't be predicted using the traditional means of regression analysis. A stochastic process is a sequence of events of probabilistic nature. The main stochastic processes include Random Walk, Geometric Brownian motion, Jump-Diffusion, etc.
- Markov chains, non-linear extrapolation, etc.

In our research, we are going to us the Geometric Brownian Motion to forecast future values of some parameters of the company and Maximum Likelihood models with GARCH (1,1) to obtain the historical volatilities of these parameters.

The data for the oil industry was used from the 2016 work by Igor Sennikov "Implementation of Simultaneous Equations Model to Forecasting Residual Income of Russian Oil Companies" and verified with Thomson Reuters Eikon. We took the largest Russian companies in the industry and collected their balance sheet and income statement figures to estimate the amount of *sales revenue (SR)*, *operating expenses (OPEX)*, *total assets (TA)*, *Debt/Equity ratio (D/E)*, *share of debt service payments in total debt outstanding (P), portion of quick assets in total assets (Q), and dividend payout ratio (Div)* for the period from 2004 to 2014. The full list of the firms can be found the Appendix 1.

After the panel data on variables was obtained, we calculated the industry averages of the revenue, OPEX and total assets for each year to eliminate the discrepancies coming from poor management, size of the company and internal factors. It turned out that for ten years firms on average gained net operating profit and experienced asset growth.

The future revenues, costs and asset values were simulated for the next 10 periods using the geometric Brownian motion (GBM).

GBM is certainly not the best approach to use when forecasting the future amounts of company revenues or operating costs; however, it is intuitive, applicable to the simulation procedure and incorporates uncertainty of outcomes that is required for option analysis. The process itself takes the form of:

$$\frac{S}{S} = (t) + \sigma\xi\sqrt{dt} \quad ; \tag{2}$$

Where

S is the previous value of the variable,

S is the change in the variable's value in the next step,

σ is the annualized volatility,

is the annualized growth or drift rate

By using this model, we assume that each period the variables will "drift up" by a specific amount, but also will experience a shock which will be a standard deviation (σ) multiplied by a random number (ξ). (Brewer et al. 2012) We are not applying the GBM directly to the cost or revenue values, but instead we are using the log returns of the variables as a proxy. The log returns have a sound meaning when they are applied to asset prices – they represent a convenient mathematical proxy of the rate of return investor in the asset gets after the prices change. Log returns have a following formula:

$$R_t = \log\left(\frac{P_t}{P_{t-1}}\right) \quad ; \tag{3}$$

Where,

R_t is the log return of the asset

P_t is the price of asset in period t

P_{t-1} is the price of asset in period t-1

In our case, log returns help us to convert the non-stationary data of revenues, costs and asset values to stationary log differences thus allowing us to apply the Geometric Brownian Motion. The drift of the stochastic process was calculated as the average value of the log differences and the volatility of the returns (sigma) was obtained by building the GARCH (1;1) model.

Standard deviation (sigma) can be obtained by using several methods: historical variance; applied variance and maximum likelihood method. The historical variance method is the easiest one to calculate but the results it produces are the most unreliable. (Hull, 2012) In order to evaluate the applied sigma the underlying asset should be actively traded on the market which is not the case of our research. Therefore we used the maximum likelihood method in order to estimate the parameters of GARCH (1;1) and find the long-term volatility.

The equation for GARCH (1;1) sigma is the following:

$$\sigma_n^2 = \gamma V_L + a u_{n-1}^2 + \beta \sigma_{n-1}^2 \quad ; \tag{4}$$

where

$$\gamma + \beta + a = 1 \wedge \omega = \gamma V_L \quad ; \tag{5}$$

V_L is the long-term volatility, that was required for the GBM. The first step was to calculate the historical sample variance and assume that it is V_L, when we set some random ω, β and find a as 1- β – ω / V_L. The likelihood measure is:

$$-\ln(v_i) - u_i^2/2 \quad . ; \tag{6}$$

Its sum has to be maximized by choosing ω , β and a via the iterative search procedure, with the following restrictions:

$$\omega \geq 0 \quad , \quad \leq 1, a \geq 0, b \leq 1 \wedge b \geq 0. \quad ; \tag{7}$$

After finding the optimal values of the parameters, we can find the long-term variance as

$$V_L = \omega / (1 - \alpha - \beta) \quad ; \tag{8}$$

After the volatility of differences of industry revenues, operating expenses and total assets was estimated, we used the methods of VBA programming to simulate the future value of assets, revenues and operating expenses. The number of iterations was set as 50 and then the average outcome was taken for a reason to control for the managerial actions. We suggest that although the revenues and operating expenses of the firm may follow a random walk on the time period of ten years, managers still have the influence to use accounting to move the figures to average values. Moreover, by averaging out the random walk we lower the amount of future simulations we would have to take in order to estimate the distribution of covenant violations.

Several assumptions had to be made in order to proceed with the simulation. At first, we were interested in the amount of interest payments the firm makes for the debt that was issued before time zero. We have analyzed the industry time-series data of interest payments in the Thomson Reuters Eikon (Thomson Reuters 2016) and concluded that annual interest payments of the companies constitute a fixed share in the total debt outstanding. For instance, in the Russian oil industry interest payments are usually 6% of the Total Debt – which makes sense, that on average companies simply pay the annual cost of debt as interest and accounting discrepancies are ruled out. Therefore, for the sake of simplicity we make an *assumption 1:* annual interest payments, other than newly borrowed debt, represent the fixed share of value of liabilities.

Second, dividend payments vary from period to period. Again, for the sake of simplicity we make an *assumption 2*: each year the company has the same fixed dividend payout ratio (if the income attributable to shareholders is more than 0). The ratios were taken from Thomson Reuters Eikon industry averages section and then checked on the basis of the academic research papers. For instance, average dividend payout ratio in oil industry is 20% according to Thomson Reuters and D. Romanov independently proved that in his 2014 "Dividend Policy of Russian Oil&Gas Public Companies"

Third, we forecasted the future values of the D/E ratio. We considered the ratio as the amount of total company liabilities divided by total value of equity, so that D+E=Total assets. Therefore, the values of both company debt and equity were derived from the simulated value of assets. We further make an *assumption 3:* the values of D/E ratio are normally distributed among the companies with a mean equal to industry mean and variance equal to industry variance. We calculated the industry mean and variance of the D/E ratio on the basis of its historical ratio. Then we used the Monte-Carlo simulation method to generate random D/E ratios for the company in each time period under the standard normal distribution. We did not consider including the ratio values in the GBM process as the proportions of debt and equity do not follow a random walk of any kind, but are rather a product of the CFO activity. There is a certain body of literature that studies company leverage: some suggest that managers tend to stick to a target ratio (Korteweg 2010), other argue that leverage is a product of managers trying to benefit on the signals they send to market (Ross 1977) or that it represents how much managers rely on the equity as a last resort. (Myers and Majluf 1984) Although it is a topic of a separate research, we have observed the evidence that supports all of the findings within different firms. Therefore, we can suggest that on average, the strategies of managers will be ruled out and our firm would have a randomly distributed leverage ratio for the 10 year horizon, with the mean value being "target" leverage. The borrower strives to achieve the target capital structure and makes certain adjustments each period, but cannot hold the target leverage in the long term. As a result, certain discrepancies exist each period (that will be determined by the standard deviation in the Monte-Carlo simulation procedure)

Forth, in our model we have to control for the income taxes. As companies tend to defer tax payments or pay taxes in advance for the following periods, tax payments won't nessesary represent the net income multiplied by income tax rate. However, taxes play secondary role in our model and are primarily used to calculate the amount of income attributable to shareholders and excess cash flow to be paid out in a form of dividends. Thus, we make the *assumption 4* that each period the company would pay income taxes in the amount Tx equal to:

$$Tx = ¿ * TR; \tag{9}$$

Where NI is net income and TR is income tax rate that is equal to 20% in Russia.

It is worth mentioning, that Russian oil industry, which was used as the source of base data of the analysis, has a different tax structure, than other sectors. However, some works have proved that still on average the tax for the upstream operations is 20% (Sennikov, 2016)

Fifth, in our research we suggest that one of the possible outcomes of the simulation may be the default of the borrower (firm) at any given period. In our model, we call a default the inability to pay the interest and principal payments in full due to lack of cash flow and quick assets in place. In other words, if the amount of all interest payments and principal payments to the bank is higher than company's EBIT plus quick assets, then we can call it a default. By quick assets we assume assets that are equal to cash or can be quickly converted to cash without substantial loss of value (liquid inventories, marketable securities, etc.) (Encyclopedia of Finance). After careful analysis of the historical data, we concluded that it is possible to make *assumption 5* that share of the quick assets in total assets is a variable that is normally distributed among the companies with a mean equal to industry mean and variance equal to industry variance. Again, we used the Monte-Carlo method to generate random share of quick assets for our company in each period.

Finally, when all the exogenous parameters were simulated and necessary industry-specific assumptions were made we were able to calculate the EBIT (earnings before interest and taxes) value as difference between revenue and operating costs and Net Income as EBIT minus interest payments and tax payments. After that, we were able to calculate the value of DCSR covenant in each period and compare it with the threshold to identify the violations.

There were also other options for the model creation: we could use the specific company data for the simulation, set the main parameters randomly, or determine them at our own discretion. However, these choices would make the model either too specific or too indefinite for the research. If we chose the company data on revenues, costs and assets, we would have incorporated its specific strategy and management style into the model, thus making the results irrelevant in a broad sense. If the parameters were set randomly, then the practical implications of the outcome would be questionable. If the parameters of the simulation were picked by ourselves, then results cannot be truly reliable.

To sum up, we have created a model of a company in a certain industry with the main parameters being revenue, operating costs, EBIT, interest payments, tax payments, net income dividend payments, assets, equity and liabilities value. Revenues, costs and assets were forecasted with their log differences being taken as stochastic process and applied to Geometric Brownian Motion. The values of other parameters were obtained under specific assumptions. By creating this model, we can observe the possible covenant violations for the generic company on a ten period time horizon.

2.3. Covenant violations

The simulation procedure allow us to get possible infinite outcomes of future company performance. The borrower has a choice now: it can either give a loan without any covenants or include the DSCR provision in the terms. If the loan terms are covenant-free, then the borrower can still observe the probable "violations," but can do nothing about them. With the DSCR covenant included, however, the bank can engage when the breaches occur. We run the simulation procedure to obtain the distribution and probability of both technical and material covenant breaches for a specific threshold.

Consider a loan agreement with covenants. If the CB is the event "covenant is violated," let us consider (10) as the probability of this event:

$$p_{cb} = PR(CB) \quad ; \tag{10}$$

According to Borgonovo and Gatti (2013), the material breach is associated only with a subset of states in which a violation occurs. Then, we can assume that (11) and (12) denote the probabilities of technical breach and material breach respectively:

$$p_{TB} = PR(TB) \quad ; \tag{11}$$

$$p_{MB} = PR(MB) \quad ; \tag{12}$$

The two events are considered disjointed event though the state of the world with technical violation is equal or included to the state of the world with material violation.

According to some research, the default probability can be calculated as the relative frequency of events of default across scenarios. (Elsinger et al. 2006) We are able to observe the events of default in our model and with substantially large number of simulations can get the default probability for our firm. By running the simulation, we can also get the probabilities of technical and material breaches, which are equal to:

$$p_{TB} = \lim_{N \to \infty} \frac{n_{TB}(N)}{N} \quad , \quad p_{MB} = \lim_{N \to \infty} \frac{n_{MB}(N)}{N} \tag{13}$$

If we introduce a Boolean variable $U_{Tb}(n)$, that counts 1 when the breach is technical and 0 if its not, then:

$$n_{TB} = \sum U_{Tb}(n) \quad \text{and} \quad \widehat{p_{tb}} = \sum U_{Tb}(n) / N \quad ; \tag{14}$$

where N is the number of simulations and $\widehat{p_{tb}}$ is our estimate for the probability of technical violation. Same applies to material breach.

This is the approach to division of breaches into technical and material originally proposed by E. Borgonovo and S. Gatti (2013) and we are happy to partly employ it in the model.

Let us consider a scenario, when the event of default happens. In our case, the default of the borrower in period $_t$ is confirmed when:

$$Dp_t > CF_t + LA_t \quad ; \tag{15}$$

Where:

Dp_t is the debt payments in the period *t*,

CF_t is the Cash flow to firm in the period *t* and

LA_t is the amount of liquid assets in place that can be used immediately for debt payments

In other cases, the company is still able to pay its obligations in period t and default is not considered, even if borrower is unlikely to make debt payments in the next period t+1.

The event of default is accompanied by DSCR covenant violation, but we are not considering it as a material breach. At this scenario, the borrower will not be able to utilize any of the strategies, as company will not have sufficient funds for that.

Borgonovo and Gatti separate the technical and material violations on the basis of the numerical value of the threshold. In their words:

"…contract usually includes two sets of values for this financial covenant. The first indicates the minimum threshold below which lenders can require an accelerated repayment of the loan; the second, which is lower than the first, triggers the resolution of the credit agreement and represents the material breach of covenant. The joint consideration of the two sets of values generates a range of values for DSCR associated with a technical default that is frequently waived by means of a renegotiation of the loan repayment terms." (Borgonovo and Gatti 2013).

We used a different criterion for the separation. Imagine that in period *t*, the company fails to maintain minimum level of DSCR ratio, thus violating its covenant. If there is a default in the period *t+1*, we suggest that covenant breach was a predictor of a financial distress in a next period and thus the breach is material. However, if the company is still able to make its debt payments in t+1, then the breach is considered technical (the violation happened due to accounting reasons and does not represent the future default on payments). This does not mean, however, that technical and material breaches are not connected – the borrower may experience a streak of covenant violations, with *n* of them being technical, but final one before default being material. If the breach is technical, the bank uses the "cash sweep" strategy and restricts the dividend payments in the period. Dividends are considered an excess cash flow and used to repay some of the outstanding debt. The debt service payments are recalculated for the following periods. The cash sweep strategy is an adequate answer from borrower – if excess cash flow is used to repay the outstanding debt, then interest payments decrease in the following periods and the probability that a material breach happens in future decreases. In addition, academic research states that credit risk rises right before the violation (Fargher et. al. 2001), so bank tries to lower it back. If the breach is material bank sees it as a threat to future debt payments and demand the early repayment of the outstanding principal. We assume, that lender can positively identify both technical breaches and material breaches (for instance, by using the presented model). In other words, the uncertainty in bank's actions is ruled out. The lender will not miss any violations and will positively identify which breach is technical and which is material. In order to price the option well we need to use backward induction for the bank actions – the lender should have all the information regarding the future states and be able to make payoff-maximizing decisions.

Finally, the borrower may be unable to make debt payments in period *t* even if previously there were no violations of covenants. The lender is not protected from this sudden default with the DSCR covenant. We assume that in case of default in period *t* the bank will receive a payment that represent the portion of the loan value (50-100%) in period *t+1*.

For the research we have run 4000 simulations of future states of the company, obtained the distribution of covenant violations and probable states of default. Then we incorporated the bank actions given the covenant violations and obtained the loan value playoffs for the lender at each run. The detailed findings are presented in the third part of the Thesis.

2.4. Real options analysis

After we have modelled the company characteristics, observed the situations when the covenant is breached, we calculated possible value of the options that covenant provides to lender. What real options exist for the bank in this case?

In general, the covenant can be considered as an option "to exercise control" or simply "to engage" for the lender (incomplete contracts approach focuses on "option to renegotiate"). When the borrower violates the covenant, the bank can make payoff-maximizing or risk-decreasing decisions, which are unavailable if covenants are not present. In our case, the two strategies that are available for the bank are cash sweep and early repayment.

The general "option to engage" can be decomposed into more specific opportunities for the lender. At first, when the bank observes the material breach, it demands early repayment of the principal. The material breach is a predictor of a company default in the next period and thereby the bank is able to avoid the uncertainties associated with borrower default and losses related to time value of money – the default payment will represent only a portion of the outstanding principal and will happen after some time as borrower settles the amounts with other creditors and obtains the financing (by selling assets, issuing stock, etc.). Technical default payment is more valuable as it happens instantly after the material breach and covers all the remaining principal. Thus, in our model DSCR covenant provides the bank an *option to abandon (or terminate) the loan* when the PV of future debt payments falls below the required amount. This act is effectively exercising of a put option.

Second, when the bank observes the technical violation of the covenant, it uses cash sweep strategy to repay part of the outstanding principal. A technical breach signals the lender that borrower may currently be off track with its operations. Here DSCR covenant gives the bank a *flexibility option* on the debt payments – lender can vary them to help borrower avoid the default.

Third, there are several options that we are not discussing in this work due to complexity of the analysis involved. For example, by setting the tightness of covenants the borrower may *vary the tenure of the loan*. If the threshold is too high for the DSCR provision, then company is very likely to violate it even in the first years. Due to technical nature of these breaches (as covenant strictness is not affecting the probability of default), loan will have an effective tenure lower than 10 years (bank will constantly repay parts of the principal with cash sweeps). Another option is a *follow-up loan option*: when the bank is terminating the loan (by calling the technical default on the borrower), it can instantly lend the obtained money to another borrower with better financial health. This act essentially increases the flexibility of bank portfolio management.

If a covenant is a set of real options, then is should have a specific value, and according to options theory, lender should pay the premium to borrower. The value paid to the borrower is not simply monetary – it can be paid in form of lower costs of debt (in our case lower interest rate). Is covenant truly a real option? According to Mun (2012), real options analysis is applicable to situations when:

- *A financial model must exist*. Real options analysis requires the use of an existing DCF model, as real options build on the existing financial modeling techniques. If a model does not exist, it means that strategic decisions have already been made and no financial justifications are required, and hence, there is no need for financial modeling or real options analysis. We are going to use the financial model within our analysis and observe the future states of the company
- *Uncertainties must exist*. Without uncertainty, the option value is worthless. If everything is known in advance, then a DCF model is sufficient. Uncertainties are observable here, as future state of the accounting variables within the company is unknown and lender is risking the money if company cannot make debt service payments.
- *Uncertainties must affect decisions when the firm is actively managing the project and these uncertainties must affect the results of the financial model*. These uncertainties will become risks, and real options can be used to hedge the downside risk and benefit on the upside. The uncertainty within the borrower affects the decisions of the lender. Credit risks of the borrower for the bank is obvious.
- *Management must have strategic flexibility or options to make midcourse corrections when actively managing the projects.* Otherwise, do not apply real options analysis when there are no options or management flexibility to value. With covenants in place banks have a flexibility to engage in the operations of the borrower, or may let it go.
- *Management must be smart enough and credible enough to execute the options when it becomes optimal to do so.* Otherwise, real options are useless unless they

are correctly executed – both at the right time and under right conditions. We are going to assume that lenders are behaving rationally and decide to choose the best course of action when the covenants are violated. If the violation is not associated with default risk, then banks will not demand immediate repayment as it will not be beneficial for anybody. On the other hand, a clear default-type covenant violation is regarded as an early repayment event. (Mun 2012)

The first application of option analysis for debt valuation happened when Robert Merton in 1970s pioneered a different approach to credit assessment while interpreting the yield spread on bond as being the option premium to the debtholders for selling a put option on the assets of the company to equity holders. If the issuing company assets have a good performance, debtholders simply receive their principal and stay away from participation (unlike equityholders) If assets perform poorly, debtholders will receive a claim on those assets during liquidation for whatever recovery value they can get, rather than the full principal value. Debtholders lose an amount equal to the difference between what they lent to the company and the recovery value of those assets in such event (the option's "intrinsic value"), net of the "option premium" which is the bond's yield spread. (Merton 1974)

We could employ the Merton model to estimate the value of debt without and with covenants and find the value of the option as a difference between these two. However, there are specific drawbacks of the model that prevent us from doing so (assumed zero-coupon debt structure is not realistic, stock market prices should be derived to reflect the true intrinsic value of equity – and we can't simulate those prices, etc.)

Another way to value the real option is to use the instruments of financial options, like Black-Scholes option pricing model. S. Benninga characterized the use of Black-Scholes formula for real options as *"…no: Black-Scholes is not the appropriate tool. However, the Black-Scholes model is by far the most numerically tractable (i.e., easiest) model we have for valuing options of any kind. In valuing real options we often use the Black-Scholes model, realizing that at best it can give an approximation to the actual option value. Such is life."* (Benninga 2014, p. 496)

Again, certain complications make the B-S approach ineffective in our case. First, the option terms for the model are ambiguous – the intuition for the volatility of returns of the underlying, time to maturity, maturity itself, etc. is either not clear or don't make economic and financial sense. Second, the diversity of outcomes and uncertainties may produce faulty results. Other option pricing models – like binominal trees, Heath-Jarrow-Morton framework, finite difference models and others – may be very effective for financial options but produce complications or ambiguities in our case.

In order to estimate the value of our option, we will use the Monte Carlo method for option pricing (Boyle 1977; Broadie and Glasserman 1996). It requires producing the large number of possible paths for the underlying (which we have already done by now with our simulation procedures), then calculating the payoffs (discounted debt payments) and finally averaging them. We will calculate the payoffs for a loan with and without covenants, discount the payoffs to obtain debt value and derive the option value from formula:

$$DVC = DV0 + OV \tag{16}$$

Where DVC is the debt value with a covenant,

DV0 is the value of covenant-free debt and OV is the option value

The loan value will be calculated as follows:

$$DV_o = \frac{P_1 + I_1 + O_1}{(1+r)^1} + \frac{P_2 + I_2 + O_2}{(1+r)^2} + \ldots + \frac{P_n + I_n + O_n}{(1+r)^n} + \frac{¿_{n+1}}{(1+r)^{n+2}} \tag{17}$$

Where P_n is principal payment in period n,

I_n is interest payment in period n (I+P is equal in each period if no changes are made),

O_n is other payments (cash sweep or early redemption due to technical default),

Def_n is a payment the lender gets in case of borrower's default (default payment), which represents part of outstanding principal and paid in a year following the default

Finally, after the option price is estimated, we can compare the covenant-free debt contract and contract with covenants of the same agreement terms to find out whether the borrower can lower the interest rate to the lender to secure the same overall value of two agreements. Moreover, we will provide the distribution of covenant values for different thresholds, dividend payout ratios, industries, etc. In the end, practical implications of the results will be discussed.

3. Results

3.1 Industry

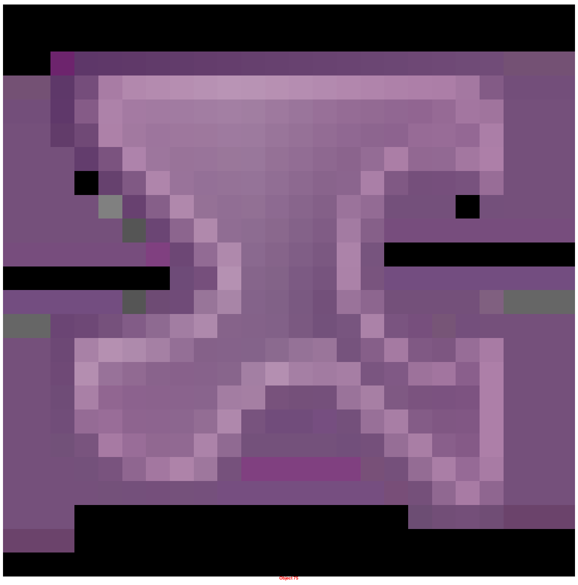
For the reasons previously mentioned, the simulation procedure of the model uses the data from the Russian oil industry. Therefore, the outcomes of the simulation are industry specific. Nevertheless, with certain adjustments the model can be used with parameters of a specific company, another industry averages, or even randomly generated parameters. The data of Russian oil companies was taken for its reliability and accessibility and in order to demonstrate the possible managerial implications under normal conditions. The results are presented as follows: we are going to provide the short industry description first together with results of simulation. Then we will present findings on the DCSR covenant violations and real option value. Finally, we will analyze abnormal scenarios (extreme volatility and leverage) to investigate whether results hold.

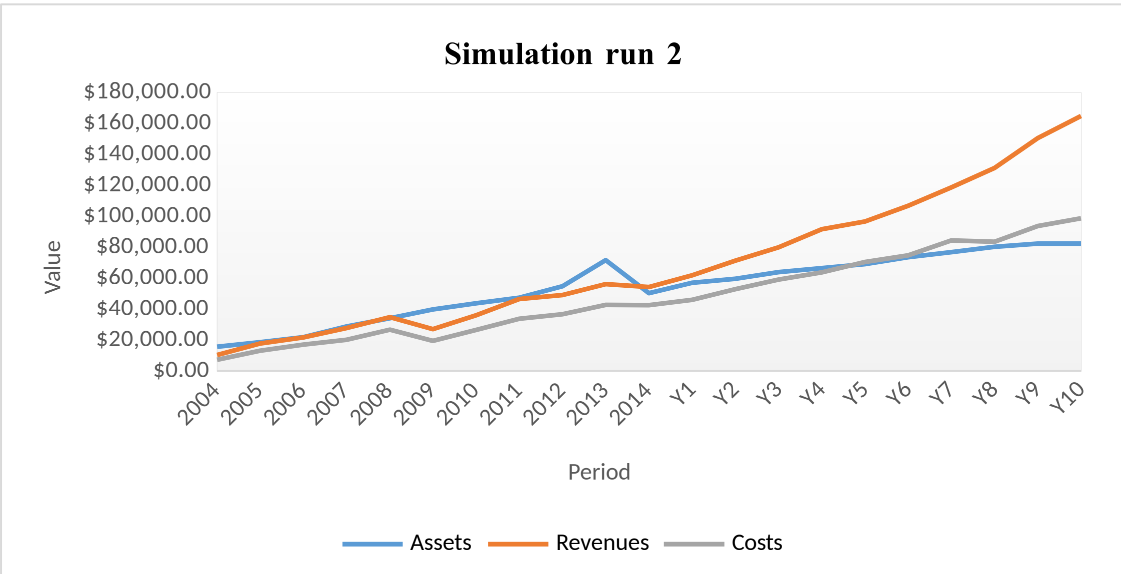
By Russian oil industry, we understand companies that have production and export of crude oil and oil products as their main business. The oil companies are typically large integrated players that benefit from economies of scale. The market value in 2015 was 71,1 billion USD and is believed to grow by a compound rate of 5% annually by 2020 (Marketline 2016). The market is quite competitive with seven giants (Rosneft, Lukoil, Bashneft, Surgutneftegaz, Slavneft, Tatneft and Gazpromneft) occupying a share of more than 80% (Sennikov, 2016). During 2004-2014 industry players experienced stable growth in revenues and assets due to high commodity prices cycle and continuous increase in production volumes. According to our estimates, the drift rates for assets values, revenues, and operating expenses were equal to 12%, 16% and 18% respectively and good financial health of the companies was only spoiled during the financial crisis. However, aggressive two-digit growth is not expected in the following periods due to various negative factors: from sharp decrease of oil prices in 2015 to revised investment plans and economic sanctions by EU and US. (Henderson 2015) Therefore, the further drift rates of the variables were adjusted in order to match the economic outlook more accurately to 5%, 9% and 11% respectively. The Russian company output estimates are currently seen as moderately optimistic. Four of the largest oil producers (Rosneft, Lukoil, Surgutneftegas, and Tatneft) have all claimed that production in 2015 will remain flat compared to 2014 in the worst-case scenario. We believe, that throughout the duration of the loan (10 years), the players would be able to exploit their capability to attract stable financing to restructure the business and invest in revenue-generating projects, as they all insist on in their investor presentations. The volatility of changes of asset values, revenues and operating expenses estimated via GARCH (1,1) remained low at 0,18, 0,21, and 0,22 respectively.

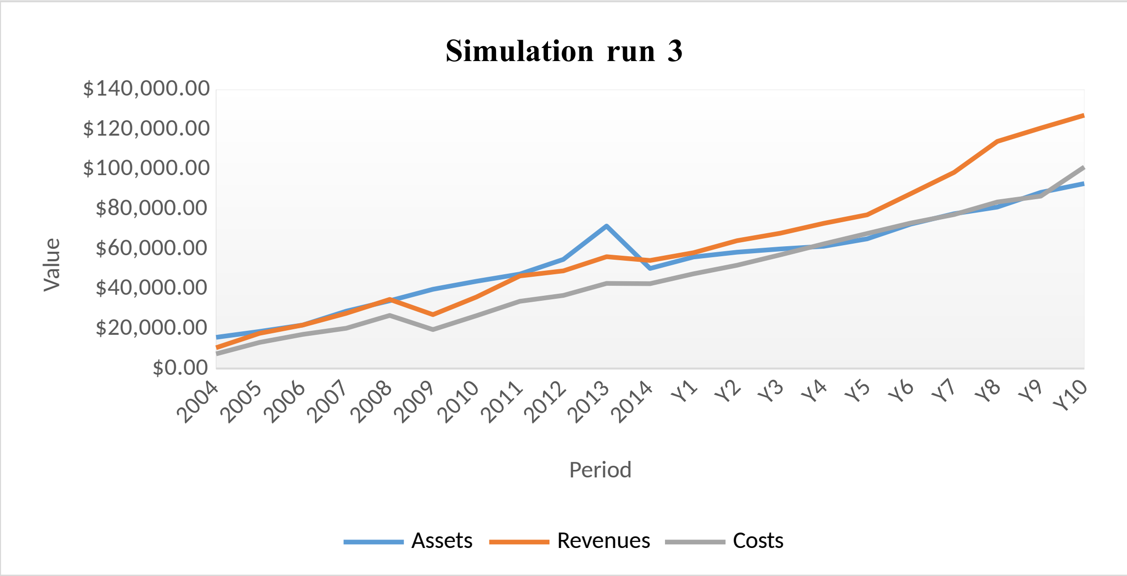
Russian oil companies use debt to finance investment projects and current operation, but not too aggressively – during the period of 2004-2014 the average Debt to Equity ratios rarely exceeded the value of 1. (Thomson Reuters 2016). We expect that future capital structure policies will not change radically and industry will maintain the mean ratio of 0,81 with a standard deviation of 0,21.

It is hard to tell how Russian oil companies use covenants in their bank loans, as this data is usually a confidentiality issue. Thus, we did not incorporate existing covenants in the analysis and simply introduced a new debt with DSCR condition to the model.

The full data upon which the simulation was built upon can be found in the Appendix 2. Figure 1 illustrates the several possible runs of the model and represents future states of revenues, operating costs and value of assets:




Simulation run 2
$180,000.00
$160,000.00
$140,000.00
$120,000.00
$100,000.00
$80,000.00
$60,000.00
$40,000.00
$20,000.00
$0.00
Value
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Y1
Y2
Y3
Y4
Y5
Y6
Y7
Y8
Y9
Y10
Period
Assets
Revenues
Costs



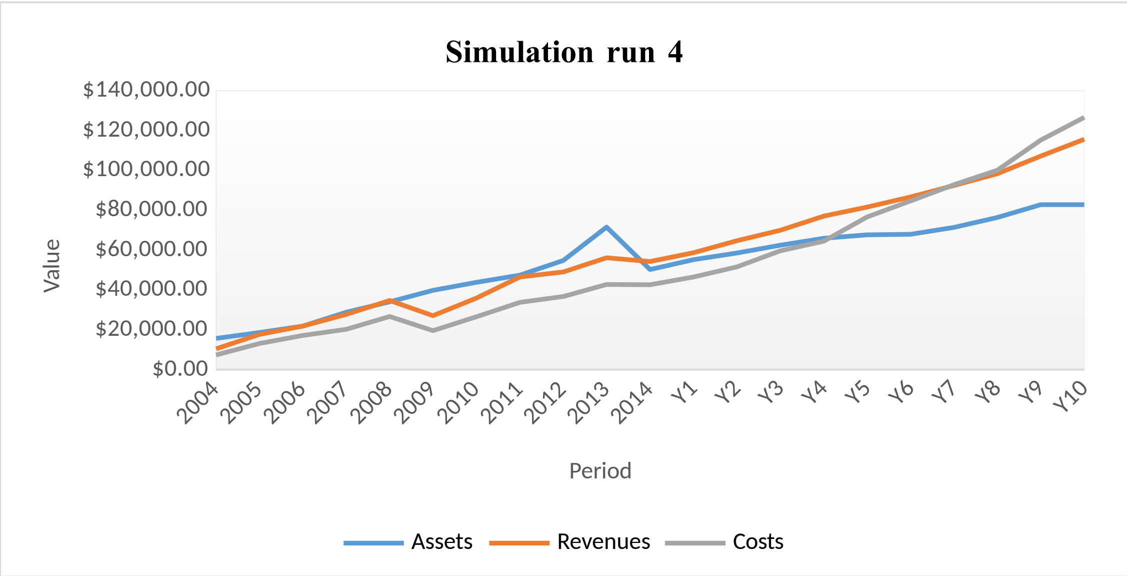


Figure 1. Possible future states of the modelled company.

Each run represents the possible (but not necessarily most possible) company performance in the next ten periods. We have conducted 4000 runs of a simulation and obtained a full range of future states of the abstract borrower. Each run produces different outcomes and each outcome can be explained from the economic viewpoint. For instance: in the first run, we can observe sharp rise in operating income and expenses with a more moderate growth of asset value. This might be a result of company increasing the extraction rates at existing drilling sites and hiring new workers in order to capture a bigger share of the market. That strategy pushed both revenues and costs up, but low profit and conservative financing strategy resulted in lower growth rates for assets. In the second run, we observe sharp increase in company revenues, but moderate or no growth in assets or costs. The reason might be a positive shift in commodity prices with devaluation of some company assets. Third run shows the situation, when both revenues, costs and asset value experienced stable growth which might be the result of some beneficial investments done by company management. Finally, in the fourth run of the simulation procedure we witnessed the operating expenses exceeding operating income and some gains in asset value. This can be a consequence of poor growth strategy, when management fueled the expansion with raising new financing (debt, equity or both) while being unable to maintain the profitability levels.

Table 1 represent the loan terms of the borrower that were used for the model:

*Table 1. Loan dataX*Loan data (mln USD)	
Principal amount	$3 000,00; $7000,00; $15000;
Loan term (years)	10
Annual interest rate	7,00%; 9,00%
Payments per year	1
Payment amount (Interest+Principal)	$427,13; $996,64; $2 135,66 for 7% loan $467,46; $1 090,74; $2 337,30 for 9% loan
Discount rate for bank	5,87%

Different principal amounts represent different cases – either the borrower is asking for a relatively small debt (6% of the total assets – 3000 mln. USD), medium one (15% of the total assets – 7000 mln. USD) or needs substantial amount of financing (30% of the total assets – 15000 USD). The discount rate the lender would use to estimate the PV of the loan is equal to risk-free rate of USD debt (4,87% – yield on 10Y sovereign Eurobonds of Russia) (Cbonds 2016) plus market risk premium of 1% (Thomson Reuters 2016). Two different interest rates represent the ability of the lender win higher or lower margins.

3.2 Covenant-free debt

First, we will consider the situation when the bank gives a loan without any covenants. The simulation allow us to observe the probabilities of the borrower to default at certain time periods under different loan conditions. Moreover, the analysis provides us with the expected loan value for each case. Figure 2 represent the individual and cumulative default probabilities for different loan agreements:

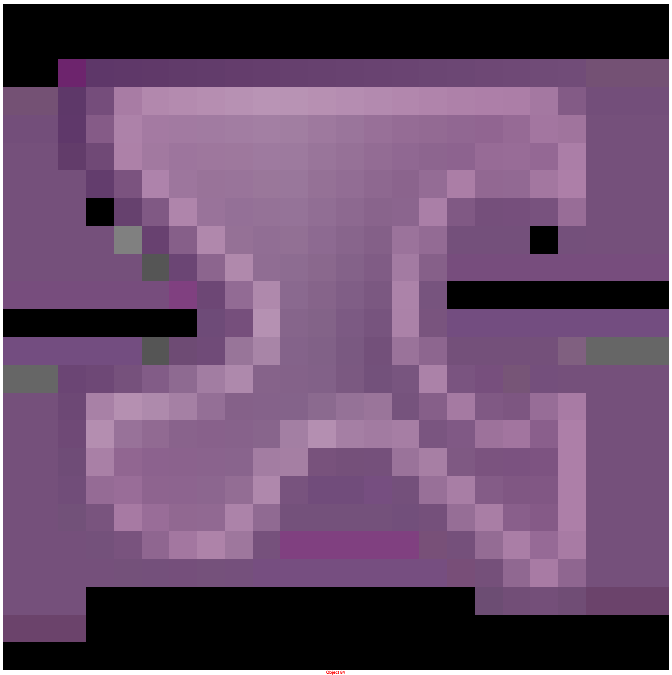
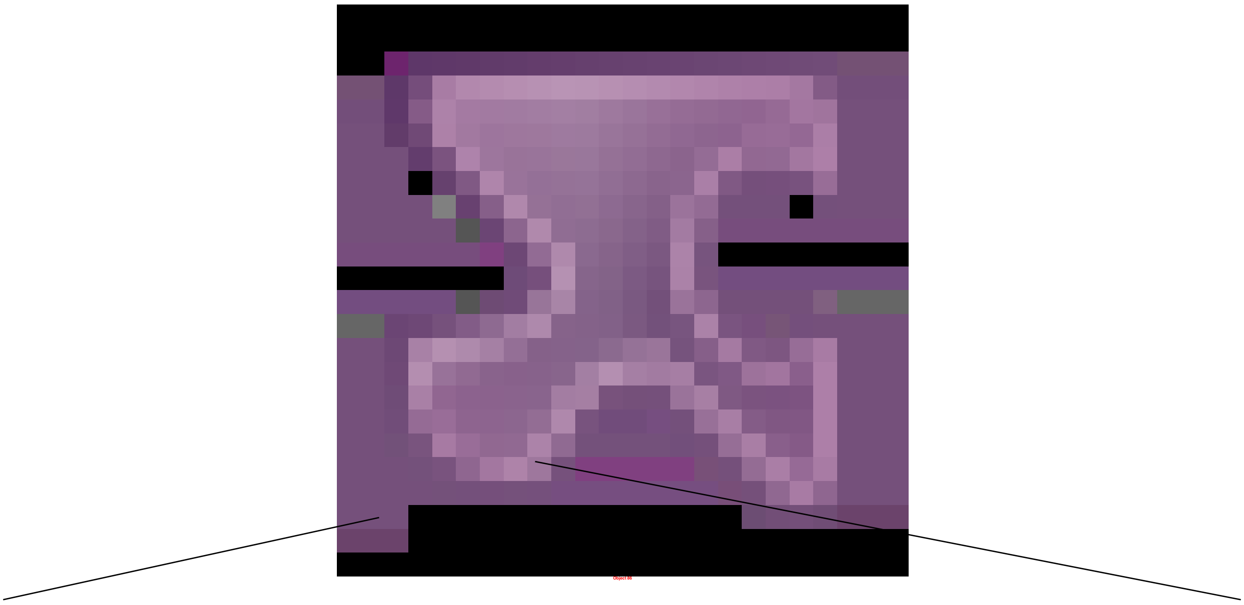


Figure 2. Default probabilities for the borrower under 7% loan with various principal values.

The histogram for the 9% loan can be found in the Appendix 3. The results indicate that the company is more likely to default in the later periods (Y8-Y10) and that individual default probabilities are not sensitive to the principal amount of the loan. This has a logical explanation – the more the time passes for the borrower, the higher the discrepancy can be between costs and revenues (result of random walk specification and features). In addition, according to the assumption 3, the firm sets its D/E ratio for each period and thus if the amount of new debt is excessive, then company would offset it with equity issue or early redemption of other debt obligations. The different interest rates do not have a major impact on the default rates of the borrower, probably because the increase in annual payment is relatively low (9,5%)

The cumulative probability for the whole duration of the loan barely exceeds 14% for various loan terms. That means that in the rest 85% of the cases the lender will receive all the debt payments in full.

In case of the covenant-free debt, the only issue that bothers the bank is the possible borrower default. The borrower can observe potential covenant breaches but can do nothing about them. After we run the simulation procedure for loan without covenants, we get the distribution of expected loan values, which are equal to a sum of payments discounted at bank's discount rate. The empirical distribution of loan values ($7000,00 principal; 7% rate) is presented in Figure 3:



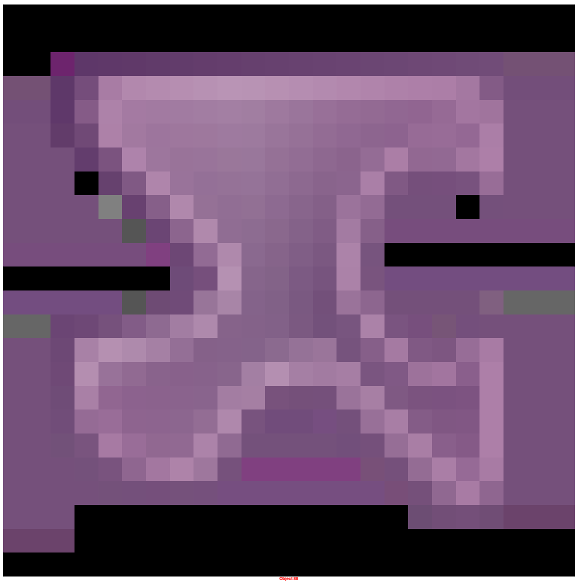


Figure 3. Distribution of loan values in case of the covenant-free debt.

The empirical distribution of loan values of covenant-free debt indicates several things. At first, there is a high chance the bank will get the maximum value of debt as probability of default (and thus earning lower PV) is not high – around 13%. As we have discussed earlier, this default rates holds for various loan terms (Figure 2). Second, the distribution of loan values in the default scenarios is left-skewed with the mass of the figure concentrating on the right side. Even if the default strikes, the lender has a good chance of getting relatively high loan value. However, low PV values in the left tail indicate that extreme losses are probable in no-covenant scenario, even though their relative frequency is extremely low (less than 0,1%).

Table 2 represents the expected debt values for different loan conditions with the volatility of payoffs in percent. The difference in percent between the expected value and maximum possible value is less than 5% through all agreement terms. It seems that in case of our borrower the bank is capable of obtaining substantial amounts of debt value without usage of covenants. Figure 2 showed that majority of defaults happens right before the loan maturity. With larger part of interest paid in the first periods, the low amount of outstanding debt is easier to cover if the borrower defaults.

Table 2. The expected loan value and related parameters for the covenant-free debt

Agreement terms	Expected loan value	Maximum loan value	Difference (%)	Volatility of loan values (%)
N=$3000,00; i=7%	$3 132,78	$3 163,19	0,97%	3,1304%
N=$3000,00; i=9%	$3 422,54	$3 461,84	1,14%	3,5273%
N=$7000,00; i=7%	$7 303,12	$7 380,77	1,06%	3,3122%
N=$7000,00; i=9%	$7 987,37	$8 077,62	1,13%	3,5854%
N=$15000,00; i=7%	$15 632,27	$15 815,93	1,17%	3,3656%
N=$15000,00; i=9%	$17 093,78	$17 309,19	1,26%	3,7454%

The expected debt values will be later compared to their counterparts from loans with DSCR covenant in place.

In the covenant-free loan contracts, the lender still has an option to observe possible violations of the covenant like if there were any. This may be a valuable experience even if the lender has no power in case of the violations, as management of the borrower will act normally and will not make any decisions that affect the accounting ratios of the firm. Thus, the bank can compare the obtained frequencies of different violation types, distributions of violations, etc. with the same data of the loan with DSCR covenant to evaluate the effectiveness of its strategy.

In the next sections, we are going to use the term "violation probability" regularly. According to the frequentist interpretation of probability, probability of a certain event is the limit of its relative frequency in a large number of trials. (Friedman 1999) This definition forms the foundation of modern statistics and supports its need for experimentation. In our case, we conduct runs of the simulation, collect the results after each run and then estimate the frequency of certain events (defaults, covenant violations, etc.) According to the definition above, the limit of the frequency is statistical probability. In our case, we will not estimate the limit, but we suggest, that number of simulation runs is high enough to estimate the statistical probability with sufficient accuracy. Further, we will use both words "frequency" and "probability" in the same meaning.

Figure 4 represents the possible distributions of technical and material breaches over time for DSCR threshold of 2.

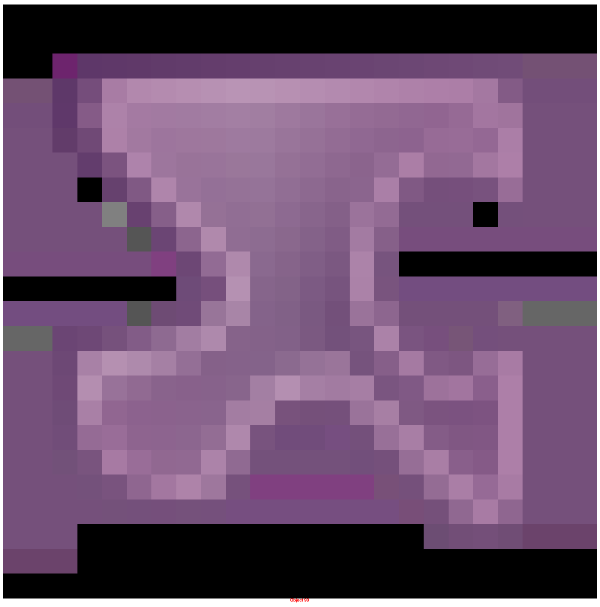


Figure 4. Distribution of possible covenant violations for different agreement terms of covenant-free debt.

The threshold is quite low so, as we expected, violations become common only at the end of the loan and combined frequency barely exceed 15%. The share of material breaches in total breaches rises the closer the contract is to maturity – for $7000,00 9% loan it is 0% in Y1-2, but 19% in Y9. There could not be any material breaches in Y10 as the only two possible options are default (which is not a material breach for Y10) or technical violation. If the borrower is able to make debt payments in Y10, no matter if there is a breach, or not, the lender will get the debt payments on schedule and in full amount. We see, that for the contract terms with higher interest rate and principal amount the frequency of violations increases.

We test the sensitivity of violations frequency and distribution to various parameters by running simulation with different loan agreement terms. It turned out that threshold value has the biggest effect on probability of a covenant breach at certain period. Figure 5 represents the distribution of possible covenant violations for different DSCR thresholds (N=$7000,00; i=7%)

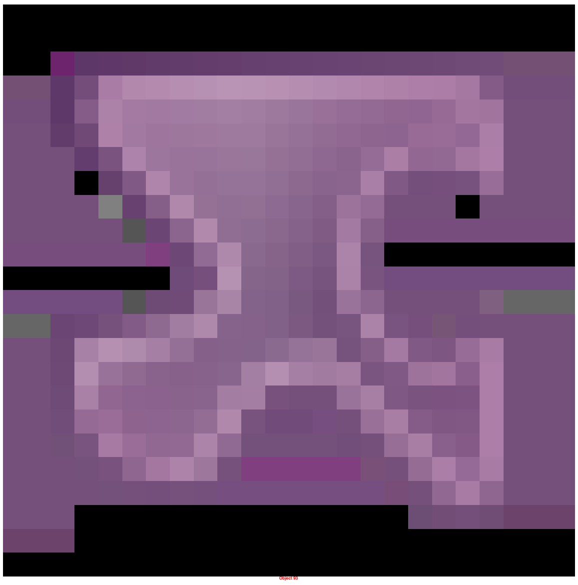


Figure 5. Distribution of potential covenant violations over time for DSCR thresholds from 1 to 4,5 for covenant-free debt (principal equal to $7000,00 and interest rate 7%)

The evidence presented on the graph (Figure 5) indicates that rising the threshold of DSCR ratio even by 0,5 can drastically increase the frequency (and thus, the probability) of covenant breaches at certain time periods – sometimes even more than 15%. These violations are purely hypothetical as lender can only observe them, but does not have any right to engage. Interestingly, extremely high thresholds (4-4,5) guarantee that breaches will be more common for earlier periods. The explanation, however, is simple – if the threshold does not match the empirical value of the DSCR ratio in period Y1-1, then the borrower has limited capability to produce good results right from the start. The probability of the violation is even lower for 4,5 threshold in the later periods, as it takes time for borrower to reach the necessary profitability levels. According to some high-level corporate banking executives, in real world lenders use the rule of thumb for threshold determination, being:

$$Threshold_t = Value_{t-1} - 25 \quad (18)$$

We also see that even with a very loose threshold the violations happen significantly more often than defaults of the borrower. Thus, we make a hypothesis that even a low DSCR threshold can help the lender capture extra debt value and help negotiate lower cost of debt.

The maximum probability of a violation at certain period slightly exceeds 50% for a very tight covenant (4,5). Of course, the lender can theoretically offer debt with even more tight covenants; however, the borrower is very unlikely to agree on a contract terms he is going to violate with >50% chance in the first period. Another hypothesis that we make at this point is that there are optimal threshold values that maximize the positive effect for the lender and they are not too punishing for the borrower. The issue of optimal threshold is regularly raised in academic literature and our hypothesis is not contradicting the findings (e.g. Yu 2010).

Interest rate and principal amount of loan both have a minor positive impact on the frequency of covenant violations. The rise of interest payment amount is not drastically affecting the DSCR ratio and effect of high loan principal is offset by the company's ability to repay other debt obligations and issue equity to secure the D/E ratio in the period. Figure 6 represents the probabilities of covenant breach for loan with N=$7000,00, covenant threshold of 2 and variable interest rate.

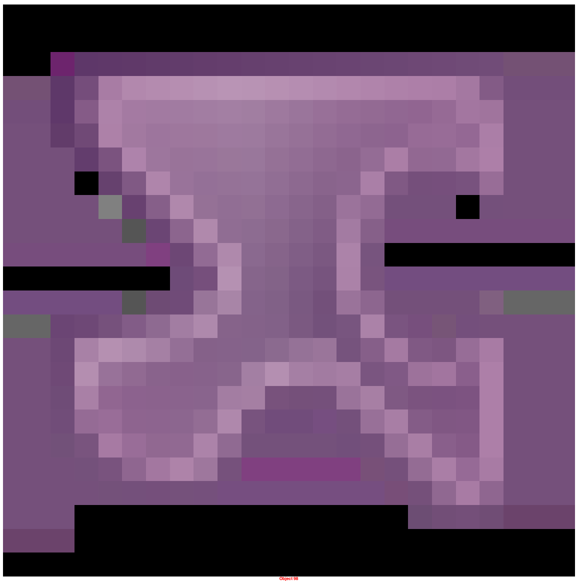


Figure 6. Distribution of potential covenant violations over time for interest rates from 5% to 12% covenant-free debt (principal equal to $7000,00 and DSCR threshold equal to 2)

At first, interest rate increase does not affect the skewness of distribution of covenant breaches over time – periods that are more distant are still having higher probability of a violation. Second, loans with higher interest rate generally showed higher frequencies of violations (which is partly seen on the graph); however, for almost 2x increase in interest the differences more than 3% were extremely rare. We do not have any solid proof that the overall effect is significant and not a result of randomness and imperfections in the simulation procedure.

The same graph for the loan with changing principal value can be found in the Appendix 4. The analysis of sensitivity of covenant violations to changes in principal amount produces almost the same outcome as its interest rate analogue: even significant changes in N result in relatively small changes in violation frequencies, although graph shows a positive relation between principal amount and covenant breach probability. The effect, again, is ambiguous and relies more on the common sense and assumption 3 of the model.

The evidence suggests that DSCR threshold has a major impact on the covenant violation probability, while the interest rate and principal play a minor role. We argue that under assumption 3 of our model the effect of interest rate and principal is the same fundamentally –

while company adjusts the capital structure after the loan was taken, rising N and i basically increases the annual debt payment. If so, the volatility of revenues and costs in our model is offsetting the magnitude of change in interest payment. The positive effect of increase in threshold is observable and quite substantial. While firm's cash flow is volatile, it needs time to rise above the certain threshold and that result in high violation rates in early periods for loans with tight thresholds. When thresholds are more loose, then most of the violations happen in later periods, which matches the borrower default probability distribution curve. As the strategy of the lender is to maximize loan value with certain strategies for each violation type, then covenants that are too loose or too tight may be destructive for the bank. We will observe the empirical proof for this proposition in the next sections.

If the threshold is the main factor affecting the violation frequencies, then it is useful to observe the distribution of technical and material violations for different thresholds. Figure 7 shows this distribution for loan with N=$7000,00 and i=7%

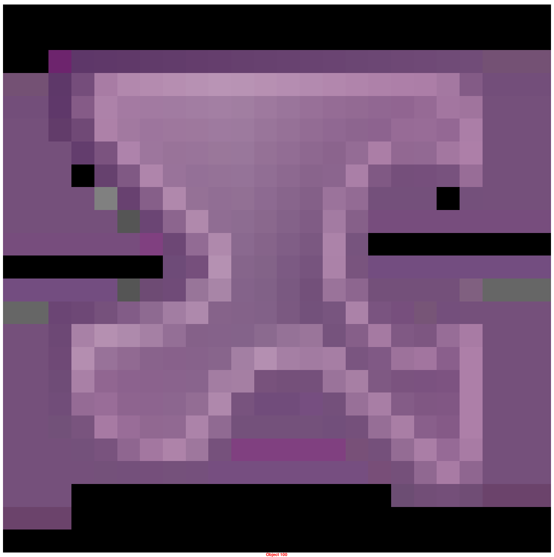


Figure 7. Distribution of hypothetical covenant breaches for various thresholds in covenant-free debt, N=$7000,00; i=7%

Results of the analysis show that when thresholds reach values higher than 3, material breaches become the very precise predictor of the future default. When the threshold is high enough, the amount of material breaches is equal to almost 99% of the amount of defaults. The discrepancies on the graph for the material breaches are caused by the uncertainties of the outcome that are incorporated in the simulation procedure. The amount of technical violations, however, increases dramatically. In real world, the bank would be swarmed with irrelevant data on constant breaches and will suffer losses from nonstop demand for decision-making and negotiations with the borrower. While these costs are not incorporated in our model, the lender would still suffer losses, but in a different way. As the bank uses cash sweep strategy in case of a technical violation, high volume of these violations will stimulate artificial acceleration of principal repayment. Thus, lender will lose part of the interest when no default was in sight.

Again, quite intuitively, the outcome suggests that there should be an optimal threshold ratio. It will enable the lender capture greatest value of loan. If the threshold is too low, we see that material breaches only capture part of future defaults (and do not protect the lender from sudden borrower nonpayment). If the threshold is too high, then defaults are less surprising, but numerous technical violations of covenants become a problem and prevent the borrower from capturing the optimal value of debt.

We have analyzed the covenant-free loan, obtained the expected values for several different loan terms, and observed the hypothetical covenant breaches. The results suggest that threshold value is the main factor of violation probabilities and that there should be an optimal threshold value that would maximize the expected value of loan with covenants for the lender.

3.3 Loan with DSCR covenant

If the borrower is taking out a loan with DSCR provision, then bank will do cash sweeps if the violation is technical and will demand early repayment of the loan if the breach is material.

It is worth mentioning that our model allows to see the possible violations even if the loan has been fully repaid and we will include them in the analysis. If, on average, the loan with covenant is fully repaid by Y9 and we do not consider possible breaches at Y10, then sharp drop of probability will be falsely attributed to bank's option strategy.

In order to test the effectiveness of DSCR provision incorporation, we will observe how default rates are different in the new model. Figure 8 shows cumulative and snapshot default probabilities for loans with and without covenants. (N=$7000,00; i=7%). The same analysis for loans with different interest payments can be found in the Appendix 5.

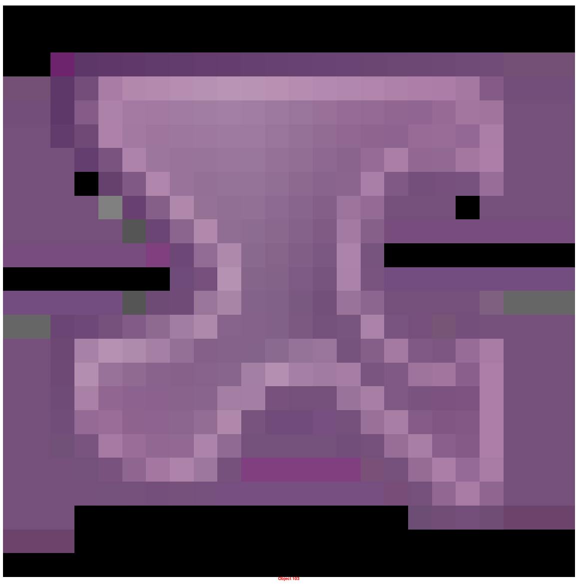


Figure 8. Default probabilities for loan with and without covenant (DSCR threshold=2, N=$7000,00; i=7%)

The default probabilities for no covenant debt are higher than for loan with DSCR provision. The higher is the annual interest payment, the bigger will be the discrepancy. If the debt payment is low (for instance, N=$3000,00, i=7%), the difference between the cumulative default probabilities at Y10 will be less than simulation error (>1%). However, for N=$15000,00 the cumulative default probability at Y10 decrease is 3,5% (as seen in the appendix 5). This outcome has an intuitive explanation: if the debt payment is high and lender protects from default by demanding early repayment at material breach, then potential decrease debt payments in subsequent periods will result in lower chance of default (cash flow and quick assets will be the same but debt service will be lower, than for the no covenant case).

It does not mean that lender's strategy is beneficial for the borrower. In fact, to make a default payment in case of the material breach, the borrower would have to rise liquidity through short-term debt, equity or asset sale. All three of these may have a detrimental effect on financial health of the borrower. However, we can't incorporate all specifics in the theoretical model so in our case the default rate is lower for DSCR covenant debt and management is qualified to make the early repayment of the loan in case of material breach with no negative consequences for firm's operations. However, if the firm is in default already, then obtaining the financing is becoming almost impossible.

Figure 9 shows the distribution of technical and material breach frequencies with various DSCR thresholds for loan with and without covenants. The effect of covenant on amount of breaches is unidentifiable in our model. The discrepancies were tested and results showed that they are attributable mostly to randomness in the simulation procedure.

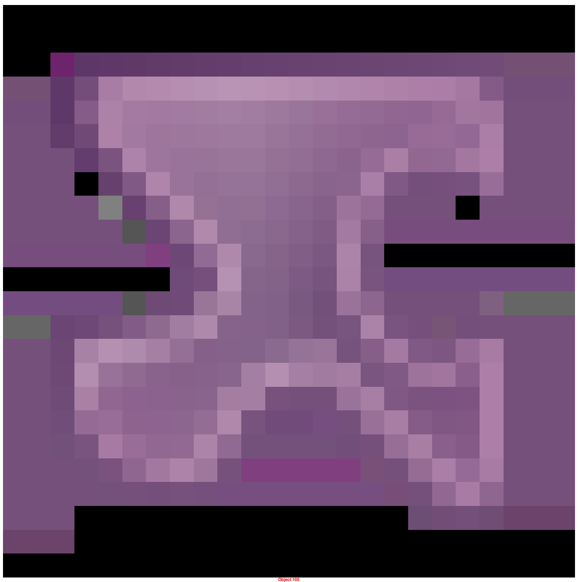


Figure 9. Distribution of covenant breaches for various thresholds in DSCR covenant and covenant-free debt, N=$7000,00; i=7%

We suggest that due to assumption 3 of the model and its specification the effect of covenant on the amount of breaches is unobservable. If the company is focusing on the leverage ratio, then the option of the early loan repayment will slightly lower the default rates but the amount of breaches will be unaffected – managers will simply adjust the capital structure in the next period so that more loans are taken/redeemed or more equity is issued/bought back. Moreover, following this logic, accelerated redemption of our loan may trigger issuance of new debt securities with higher interest rate and longer maturities. In real life, however, accounting theories of covenants teach us that managers will make revenue-generating, cost-cutting accounting decisions in order to avoid breaches and we omit this proposition in our model.

We have observed the distribution of loan values for covenant-free debt. In a case where DSCR covenant is present, the distribution of values will depend on the threshold. Figure 10 shows the value distribution of covenant debt with DSCR threshold of 2.

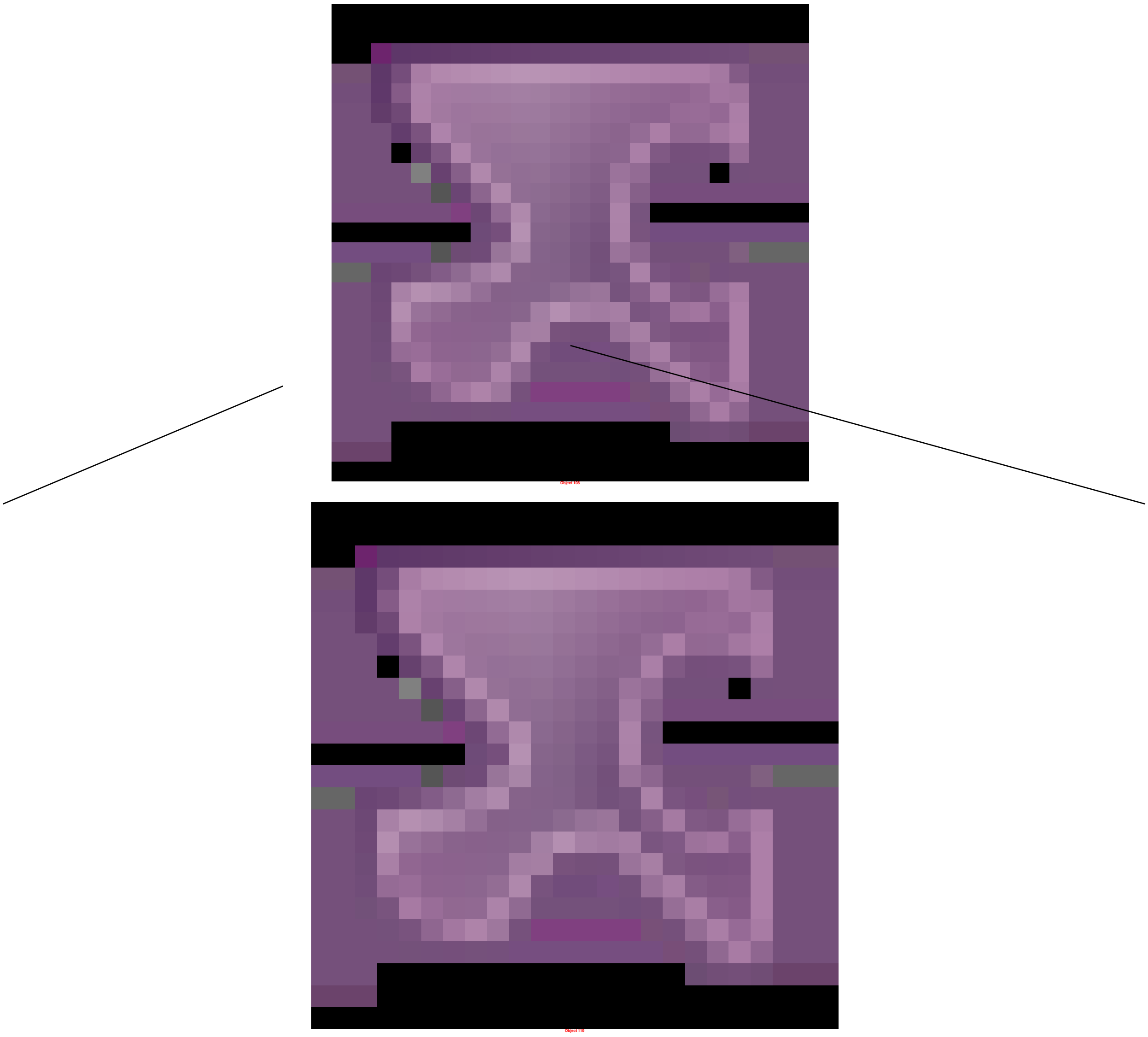


Figure 10. Distribution of loan values in case of the DSCR covenant threshold equal to 2

The empirical distribution of loan values of debt with covenants indicates several things. At first, there is a lower chance the lender will obtain maximum value of debt comparing to no covenant distribution, as the probability of value being lower due to covenant violations is higher than default rate at Figure 3. Second, the distribution of loan values in the covenant breach scenarios is left-skewed with the mass of the figure concentrating on the right side. Moreover, the potential values are very close to the actual maximum value, comparing to the no-covenant scenario. The analysis indicates that for the loan with covenant it is likely to obtain the value that is 95% or 99% of the maximum value. The PV values on the left tail of the distribution are also higher than their counterparts from no-covenant debt (Figure 3); they are also quite high with lowest being around 90% of the maximum value.

The results of the analysis show that distribution of values for covenant and no-covenant debt are different. For no-covenant loan, the lender is more likely to obtain maximum loan value; however, there is also a chance to get a significantly lower value represented with the left tail of the distribution. If there is a DSCR provision, then the chances of getting maximum is lower; however, the risk of extreme loss is also lower. Two debt types belong to different risk profiles; so, they should be compared based on expected debt value and payoff volatility.

Tables 3 and 4 compare the expected debt values of DSCR covenant and no-covenant debt for two cases (N=$7000,00; i=7% and N=$15000,00; i=9%). Comparison for other cases can be found in the Appendix 6.

Table 3. The expected loan value and volatility for covenant and covenant-free debt (N=$7000,00; i=7%). Maximum loan value is $7380,77

Threshold	Expected loan value with covenant	Volatility (%) with covenant	Expected loan value without covenant	Volatility (%) no covenant	Difference
1,50	$7 365,60	1,3788%	$7 303,12	3,3122%	$62,48
2,00	$7 368,93	0,7688%			$65,81
2,50	$7 363,42	0,5637%			$60,30
3,00	$7 350,82	0,5249%			$47,69
3,50	$7 328,51	0,7245%			$25,39
4,00	$7 294,21	0,8935%			-$8,91
4,50	$7 255,59	0,9385%			-$47,53

Table 4. The expected loan value and volatility for covenant and covenant-free debt (N=$15000,00; i=9%). Maximum loan value is $17309,19

Threshold	Expected loan value with covenant	Volatility (%) with covenant	Expected loan value without covenant	Volatility (%) no covenant	Difference
1,50	$17 254,65	1,2397%	$17 093,78	3,7454%	$160,87
2,00	$17 233,74	0,8443%			$139,96
2,50	$17 157,46	1,0643%			$63,68
3,00	$17 016,12	1,3658%			-$77,66
3,50	$16 827,63	1,4850%			-$266,15
4,00	$16 650,42	1,3566%			-$443,36
4,50	$16 533,60	1,1670%			-$560,18

The outcome clearly indicates that the expected value of loan with covenants is higher for thresholds from 1,5 to 2,5. Then the results show ambiguity – for some loan terms the value decreases, for others it increases. At first, it provides strong supporting evidence that a certain threshold will help to maximize the loan value for the lender that uses covenants. In our case, this optimal threshold varies from 1,5 to 2,5, where the positive difference between expected loan values is the highest. Second, the positive difference itself is the value of options embedded in the covenant, according to the Monte-Carlo method of option pricing. Thus, combination of options that we analyze (*option to terminate the loan* and *flexibility option*) have positive value for some thresholds. When the covenant threshold is too high, then the difference is negative – indicating that lender will lose money if DSCR provision is used. Nevertheless, we argue that options embedded in the covenant are still "in the money" in that case. Why? The model that we've built is limited in terms of lender's actions – we do not consider him increase the interest rate, waive the violation, ask for violation fee, take control of the operations, etc. in case of a breach. However, if the threshold is too high, giving a waiver or asking for an extra fee would probably be the beneficial strategy for a technical breach, not the cash sweep. As we've discussed earlier, if the lender is doing cash sweeps regularly, then instead of lowering the risk of default he would artificially accelerate the loan repayment for no good reason and fail to capture a large portion of interest. This is displayed in tables 3-4, when expected loan values with covenants decrease while the threshold rises. Therefore, if the option is still in the money, while the threshold is high, the negative difference between expected payoffs should be caused by suboptimal *option execution* and rising costs of dealing with frequent violations.

The value distribution of covenant loan is also different from covenant-free distribution in terms of payoff volatility. As seen in tables 3 and 4, the volatility of covenant loan values is 2x-3x times lower than volatility of no-covenant debt. Figure 11 shows the loan value volatility distribution over different thresholds for various loan terms:

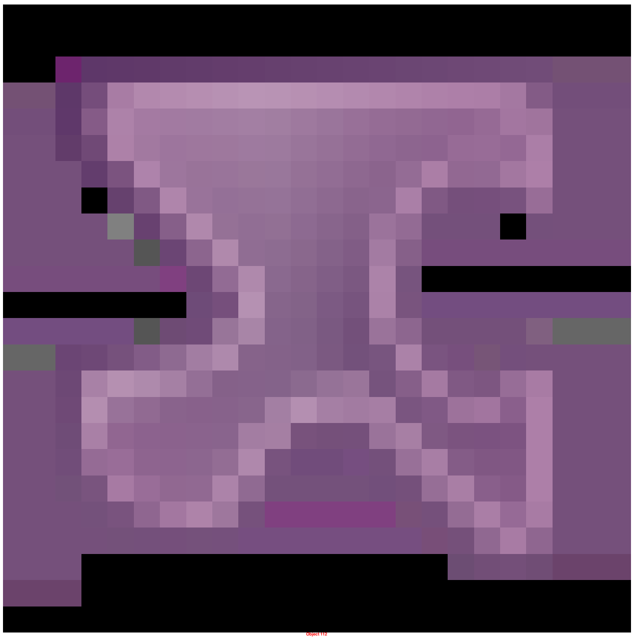


Figure 11. Volatility of loan values for loan with DSCR covenant

The volatilities of covenant-free debt all exceed 3%; we observe much lover numbers for loan with DSCR covenant, exclusive of the loan terms. There is a range of thresholds from 2 to 3 that provide minimum value volatility; then it usually starts to rise with threshold tightness. Very loose thresholds have a value volatility higher than minimum as they fail to capture some of the unexpected defaults that produce low value outcomes. Very tight thresholds sometimes have an increase in volatility; there is no exact explanation for that but we suppose that it is a result of increased payoff uncertainties due to cash sweeps. When the thresholds are set too tight, the borrower is doing cash sweeps regularly. Amount of cash collected is not stable – in fact, cash sweeps are related to potential dividends and they are as volatile as revenues and earnings.

The evidence is solid: by using the DSCR provision, the lender not only can shift the payoff distribution structure to more "loss-averse" (and less risky, one can argue), but also increase the expected payoff from the borrower and decrease the volatility of loan values.

If the execution of options that are implemented in the covenant is giving these benefits to the borrower, then there should be a premium for that in the loan contract. As we suggested, the borrower pays the lender with the decreased costs of debt. If the option price is the difference between the expected values of two loan types, then interest rate for covenant-free debt should be higher in order to match the increased value of loan with DSCR provision. We estimated the interest rate discount the lender has to make for covenant debt. The values we have obtained can be referred as minimum: in fact, they can be higher in real life as some option premiums were omitted in the model.

At first, bank actions in the model are limited. We argue that given full range of strategies, the lender will further increase the expected payoff from the borrower thus making options more valuable and interest rate discount higher. Second, covenant drastically decreases the loan payoff volatility and thus makes the risk profile of the borrower more favorable for the bank. In that case, the lender should obtain cheaper financing by definition – as its debt becomes less risky. Third, the covenant has other embedded options that we do not consider – for instance, a follow-up loan option. In our case, if the loan is repaid earlier due to cash sweep or material breach happening, the lender is simply left with the money. However, he would probably reinvest them into less risky securities or offer another loan to a different client until the end of the 10Y period. Thereby option is in the money as additional value is captured, option price is higher, and debt cost for the borrower is lower. The introduction of these elements to the analysis is a good topic for future research.

Final step of the analysis was the estimation of interest rate reduction potential for debt with DSCR covenant. In order to obtain the values for different loan terms we ran the simulations for the covenant-free loan, got its expected value and then ran the simulations for covenant debt using brute-force – we tried every possible interest rate variation to get the expected values of loans match. As a result, we got the loans with different interest rates but all else being equal. The difference in interest rates is the reduction potential for a certain threshold. For instance, if the expected loan value of covenant-free loan is equal to *E*, and the value of the same loan with DSCR provision and threshold of 2,5 is equal to *C,* we simulated the outcomes of this loan for different interest rates i_n to find such i when *C=E*. The difference between interest rates for two loans is the reduction potential (given the nominal value, term and DSCR threshold).

Figure 12 shows, what is the minimum amount of interest rate reduction the borrower should be able to negotiate for debt with various terms and DSCR thresholds.

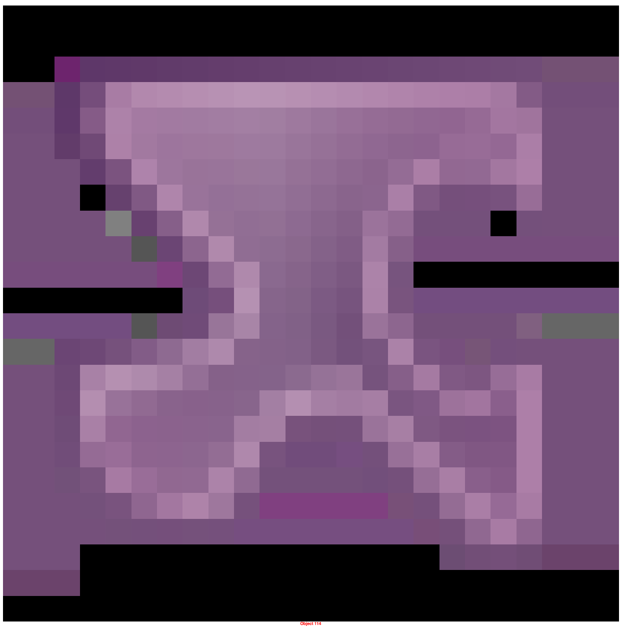


Figure 12. Interest rate reduction potential for different loan terms & thresholds

Results show that in case of our standard, “generic” borrower, the interest rate can be lowered at least by 0,19%-0,22% for optimal thresholds. By setting the threshold very loose (1-1,5), the lender will fail to exploit some the volatility decrease potential. If the threshold is too tight, then potential cost of debt decrease is ambiguous, as lender needs to have more decision-making flexibility that we fail to provide in our model.

The research goal of the paper was to calculate the potential of interest rate decrease for Russian borrowers that is achieved by implementing covenants in the contract. We have obtained evidence that helps us answer this question positively: indeed, the company can ask for a lower interest rate if there is a DSCR covenant in the contract. If the threshold for DSCR is set optimally (captures future default and not triggering technical violations too frequently), then the reduction amount can be at least 0,2% for a normally operating borrower.

3.4 Abnormal leverage and volatility cases

In previous sections, we have modelled the generic company that has attributes of the Russian oil industry players. The results of the analysis indicated that DSCR provision allows the borrower to ask for lower costs of debt under normal conditions. In this section we are going to make one step further and analyze the situation, when conditions are not “normal” or “stable” anymore. Imagine, the bank gave a loan to the company under principal amount N and interest rate i. The borrower’s risk level was assessed based on set of parameters. However, soon after the loan was given the borrower decided to increase its credit risk – by either increasing the leverage or volatility. Will the DSCR provision help the bank capture more loan value?

For simplicity we are going to analyze only one case in this part, where N=$7000,00 and i=7%. We will consider two stress scenarios – where the volatilities for revenues, costs, and assets are increased by 20% and where the mean leverage ratio increases by 1. We will also test the scenario when the volatility decreases by 10% – assuming that the company decided to become less risky. Drift rates for this scenario will be also eliminated (company doesn’t grow)

For simplicity, only the thresholds of 2; 2,5 and 3 will be considered (as they proved to be most effective for normal scenario).

Let us consider the low-volatility scenario first. The volatility rates were lowered by 10%, making the revenue, cost and asset volatility equal to 11%, 12% and 8%. The simulation procedure of the no-covenant model showed only 45 breaches out of 40000 possible for DSCR threshold of 2, no defaults and expected payoff equal to maximum possible payoff. It turned out that serious volatility decrease together with “no-growth” strategy eliminated all possible default risk for the company and turned it into a “perfect” borrower – statistically speaking, the bank has zero chance of not getting the maximum loan value if the company parameters remain. The use of covenants here was not beneficial at all – while breaches still counted and cash sweeps were made, the expected loan value for covenant loan represented only 99% of the maximum value for all thresholds. The profitability levels of the borrower remained high (as they were taken from Russian oil industry) and low volatility with no growth ensured the profit margin holds. Thus, the company was always able to make debt payments. The whole case, obviously, is almost impossible in real life – the world is changing, management makes investment decisions that are not always good, financial crises occur and volatility skyrockets, etc.

The results of the analysis of this scenario show that a low-volatility borrower can agree on a wide range of accounting covenants with tight thresholds. If the violation risk is too low, then bank is most likely to continuously "waive" the breaches, as it will be in its own interest.

Table 5 shows results of the stress scenarios modelling.

Table 5. The expected loan value and volatility for covenant and covenant-free debt in stress scenarios 1 and 2. N=$7000,00; i=7%). Maximum loan value is $7380,78

Threshold	Expected loan value with covenant	Volatility (%) with covenant	Expected loan value with covenant	Volatility (%) no covenant	Interest rate reduction potential
Stress scenario 1 (extreme volatility)					
2	$7 244,43	4,88%	$6 924,46	9,55%	-1,00%
2,5	$7 275,55	3,97%			-1,10%
3	$7 293,79	2,68%			-1,20%
Stress scenario 2 (extreme leverage)					
2	$7 362,06	0,54%	$7 282,42	1,92%	-0,25%
2,5	$7 341,89	0,61%			-0,20%
3	$7 296,76	0,89%			-0,08%

The results of scenario 1 show the true power of covenant use for borrower with high risk of default. We assumed that initial valuation of the borrower was incorrect and volatility of assets, costs and revenues was underestimated. When the true volatility figures turned out to be higher by 20%, the default probability on a 10-year horizon was calculated to be around 43%. High default risk made the expected payoff of the covenant-free loan less than initial ($7000,00) principal, thus making the current loan not profitable – it was not generating any value. The DSCR provision helped to avoid the destructive conditions of poor evaluation of the borrower. As the bank was able to demand cash sweeps and early repayment, the expected loan value exceeded principal, so the bank at least did not lose the money. The conditions held even for loose threshold of 2. In line with the previous findings, the volatility of payoffs for covenant-free debt was almost 2 or 3 times higher than volatility for covenant loan. The interest rate reduction potential was calculated differently here, as reducing the covenant loan to a value below principal is pointless – no money is generated for the bank. Thus, we looked for the interest rate *increase* that was sufficient for covenant free-loan to match the expected value. It turned out that covenant-free loan required at least 1% interest rate increase to get its value equal to covenant loan. This is a substantial number for a USD debt in Russia. However, this figure is purely fictional – no bank would agree to negotiate any potential cost of debt decrease for such a risky client.

Stress scenario 2 turned out to be not dangerous for the lender, as the potential increase in default probability was minimal – around 2%-3%. The difference between expected values was slightly higher than for a normal case. The potential decrease in interest rates was also comparable to normal conditions. We can say that either our leverage increase was not sufficient or proportion of debt is not affecting the value of DSCR covenant in a severe way in our model.

The results of analysis of the three abnormal scenarios show that volatility is the main determining factor of the option value for the DSCR covenant. When volatility of the firm parameters was decreased to the negligible levels, covenant was not providing any benefits to the lender – the default risk was almost equal to zero. If the company can sustain stable profitability levels throughout the duration of the loan (apparently, by sacrificing its growth), then it can agree on any covenants the bank is offering. When volatility of the firm is extremely low, then covenant breaches would likely be waived by the bank. If the volatility of the parameters is extremely high, then even loose thresholds can capture significant loan values for the bank. The importance of volatility in our model is similar to importance of volatility in financial options theory. Historical volatility of the underlying is crucial for pricing of options on stocks, indices, etc.

While abnormal volatility of the firm's parameters proved to be significant factor of the value of options embedded in the DSCR covenant, we could not estimate meaningful effect of abnormal leverage. Overall, the results of this section confirm the findings that we got when analyzing the regular scenario. The lender can capture extra loan value by including the DSCR covenant in the loan contract. The borrower can also negotiate lower costs of debt if the covenant is included, as we assume that lender offers same loan value for the same borrower. In our model if the values of the firm's parameters are normal (or represent the real-life situation), then the interest rate reduction potential can be up to around 0,2%. If the volatility of the borrower increases dramatically, then option value and reduction potential increases as well. However, when volatility is unrealistically low, then covenant does not capture extra value. Options become more expensive when the uncertainties rise and lose their value when the uncertainties are low. From the viewpoint of financial theory, this makes perfect sense – if the default risk of the borrower is negligible, the bank does not need any additional provisions to protect the debt payments. However, if the company's future performance is highly uncertain, then default risk is massive and lender needs certain provisions incorporated in the contract to protect the loan value. Our model captures this relation. We proved that the results of our analysis hold under both normal and irregular conditions given the assumptions we have made earlier.

3.5 Managerial implications

In previous sections, we determined that loan covenants actually have real options embedded in them. These options allow the bank to capture additional loan value in the face of potential borrower's default. In fact, value of the loan contract increases when DSCR covenant is included. We assume, that bank should only offer the contracts of the same value to the same borrower, so it pays the price of including the covenant by agreeing to lower the costs of debt (interest rate in our case). In this section, we are going to discuss the implications of our theoretical model that can be used in real world.

At first, we ascertained that when DSCR covenant is included in a loan agreement, a reduction potential for the interest rate exists. Moreover, we have estimated this potential – in the normal scenario, it can be up to around 0,2%. If the company decides to increase its risk level by boosting the volatility of its parameters, then this number can increase further to more than 1%. The first direct managerial implication of our work is the following: *the company should be able to negotiate lower interest rate for the debt contract with covenants than it will have for covenant-free debt with the same terms.* In part one of the thesis we have already discussed how it is justified from the theoretical viewpoint and how empirical works confirm the connection using the sample of real loan contracts. In this Thesis we used modelling, simulation and real options approach to come up to results that uphold the same claim.

A more specific conclusion that we came to: *the generic borrower from Russian oil industry should be able to negotiate at least 0,2% interest rate decrease if the Debt Service Covenant Ratio is included and optimal threshold is set up.* We used the industry data of Russian oil producers for our model and analyzed the effects of DSCR covenant. The average optimal reduction potential we obtained was around 0,2% if the covenant is included (number heavily depends on the loan terms and threshold). We say that this is the smallest discount borrower should get, as in our model only part of the bank's actions were captured and not all real options analyzed. We assume that interest rate discount for loan with DSCR covenant should be higher in real life, but at this point, this is the most we can get.

Another real-life implication is: *company with stable profitability levels and low volatility of main parameters should agree on DSCR covenant even with tight thresholds.* As we observed in the case of abnormally low volatility, the default risk becomes negligible and it is costly for the bank to apply particular strategies. Thus, lender is likely to waive any potential violations. The borrower may get certain benefits (like possible lower interest rate) without suffering consequences of covenant breaches.

Banks (lenders) can also use the results of the paper for their own benefit. As the interest rates have increased in the past two years and foreign financing is limited for Russian companies for various reasons, local lenders should stay both profitable and supportive for their clients. The Russian interbank lending rate in RUB for the period up to 1 year is currently around 11% (Bank of Russia 2016) and average commercial bank lending rate is even higher, so borrowers will be open for any opportunity to lower their costs of debt. At the same time, results of our research imply that banks can offer these interest rate discounts without loss in loan value or taking additional credit risk. The main implication for the lenders is the following: *by including certain covenants in the loan contract, Russian banks can offer lower costs of debt for particular clients without losing loan value; thus, banks can become more competitive among other players and provide support for their clients*.

Another finding of the paper that is relevant for the lender is the *potential ability to decrease the volatility of loan values when DSCR covenant is introduced to the contract, even if the threshold is not tight*. We have estimated that while the difference in loan values can be small for covenant and covenant-free loan, potential volatility of loan values, that bank gets, can be two or even three times lower in our model. As covenants protect the lender from negative consequences of borrower default, the distribution of loan values becomes denser and left tail of this distribution becomes less "fat."

Finally, if the banks know they can provide an interest rate discount, they should be able to calculate the interest reduction potential for a specific loan. In our thesis, we analyzed only one covenant (DSCR) and a limited set of bank's actions. However, it is clear that each client needs unique set of assumptions and set of covenants for the loan contract. Bank may use the structure of our model to create a particular framework for each client, simulate future performance of the borrower, and estimate probabilities of default, material and technical breaches. After the simulation procedure is done, the lender can determine optimal set of responses for violation of each covenant in the set. Thereby the real options approach can be employed to estimate the covenant value and interest rate reduction potential. According to the Citibank St. Petersburg Branch Manager R. Belyaev, banks in Russia work really well with the risk analysis and modelling when they assess their clients, but real options approach is not widely employed. The example of this paper may motivate some to use this approach and price the options inside particular covenants to calculate extra loan value.

4. Conclusion and Areas for Future Research

In this Master Thesis, we applied the real options framework to explore the connection between presence of covenants in the loan contract and potential costs of debt for the borrower. On the basis of a set of assumptions we created a model of a borrower, incorporated a loan with Debt Service Coverage Ratio covenant in it and estimated the potential decrease in interest rate that borrower can negotiate by referring to the option value that covenant provides.

Our work is based on the wide range of academic research on the subject. During the literature analysis, we discovered several relevant lines of research. The Agency Theory of Covenants primarily focuses on covenants' ability to mitigate agency conflict between shareholders and debtholders inside the firm. If a covenant is included in debt terms, both parties enjoy decreased agency costs and associated benefits, like more transparent monitoring process, but have to pay the price for that. While management activity will be more limited, creditors will need to offer lower spread on debt securities. Various accounting theories on the subject focus primarily on the impact of covenants on firms' reporting. The highest effect both ex post and ex ante is achieved via covenant violations. Accounting research provides substantial proof that managers make earnings-increasing and cost-cutting accounting choices around violations while both systematic and unsystematic risk increases at that point. Banks are often eager to waive the violation and set tight covenants to act as "trip wires" and provide effective monitoring. Hence, covenant breaches can be divided into material (effective predictor of future default) and technical (accidental violation). Finally, the incomplete contracts theory treats covenants as renegotiation options in debt contracts that help to increase contract effectiveness in the future. We adopted this vision in our work but broadened the understanding of options embedded in the covenant – we claim that covenants contain a set of real options the lender benefit on. While these options are "in the money" and have certain option value, lender needs to pay the premium for their use by providing a lower interest rate for covenant loan.

In the paper, we have estimated the value of some real options that DSCR covenant provides the lender according to our model. The results of the simulation procedure indicate that, given a coherent bank strategy for different violation types, even the covenant with loose threshold brings extra loan value as lender becomes more protected against borrower default. We also find empirical proof that given the set of assumptions an optimal threshold exists for the loan with particular terms. If the DSCR threshold is set below the optimal levels, then covenant fails to capture some the violations that indicate serious credit risk increase and hence fails to capture some of the option value. If the threshold is set too tight, then coherent bank strategy is not effective anymore and lender is swarmed with information on covenant breaches that is not relevant.

We also evaluated the volatility of loan values that lender gets for both covenant and covenant-free debt. There is significant evidence that payoff volatility becomes from two to three times lower if the DSCR provision is introduced in the contract. Covenant changes the loan value distribution – in light covenant debt there are usually more chances to capture maximum loan value, while in covenant loan the value distribution is much denser near the maximum. Moreover, the left tail of the distribution (low loan values) is much "fatter" for covenant free loan, indicating that bank can obtain the payoff even smaller than initial principal amount.

Finally, we calculated the potential of interest rate decrease when DSCR covenant is introduced to loan terms. According to our model, the reduction potential for normally operating borrower given the consistent bank strategy (cash sweeps for technical violations, early repayment for material violations) and optimal threshold value can be around 0,2% for USD loan. This value may not be impressive, but for current economic conditions, even such small discount can be relevant for borrower. Moreover, we refer to this value as minimal, as some of the real options were not considered in the analysis, limited lender strategy was taken, and only one covenant analyzed. If the whole set of different covenants is included, then reduction potential can be higher.

We tested our model for abnormal scenarios with extreme volatility and high leverage. The results generally hold. The reduction potential in abnormal scenarios can be up to 1,2%, but obviously this value is not feasible in reality – the relations between a bank and such anomalous client are too complicated to assume that such big interest discount will simply be given.

Our model is not a perfect representation of real world, it has its own drawbacks, and future research on the subject should develop it in order to create a more serious contribution in field of real options and covenants.

At first, we omit some important findings of the accounting research – particularly, accounting decisions of managers near the breach. While we build the model upon accounting data, it is necessary to incorporate at least some of the managerial activity, either through creating algorithms or introducing investment function in the analysis. We decided to leave it for future research in order to obtain results that are more reliable at the current moment.

Second, model is built with a set of assumptions (can be found in the methodology part). As assumptions do not truly represent the real world, future research on the subject may substitute the assumptions with equation models, functions, and other more reliable methods of analysis.

Third, Geometric Brownian Motion has its advantages as a way of simulating future values, but also has its drawbacks. Being one of the simplest stochastic processes, GBM is not intuitively applicable in this case. Future research may test other simulation procedures to check the results of this Master Thesis, provide adjustments where required in order to make findings more relevant and reliable.

Fourth, the classification of violations into technical and material requires the optimal behavior of the lender at given point in time, and that means the banks knows exactly what type of breach it is. We stepped away from classifying the violations through comparing current DSCR ratio values with two thresholds. We argue that the approach utilized in this Thesis is better, but again it omits some of the uncertainties of the real world. In our opinion, implementation of control theory methods will greatly improve the model and results.

Finally, future research can incorporate more real options in the analysis and create a better lender strategy for violations. At the moment, the results become ambiguous when the covenant threshold is set too tight. Also, our procedures were too "heavy" for the methods of VBA programming that we used, so outcome generation was taking its time. Some other coding language can be used by future research (like R or Python) to speed up the process.

Overall, findings of this Master Thesis are relevant for both the modern business and financial theory. Managerial implications exist for borrowers – they can refer to option value to negotiate lower interest on debt, and for banks – they can become more competitive if they use the real options embedded in loan covenants. The results are reliable, but can be further improved by future research on the subject.

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Appendix 1. Russian oil industry players

FIRM NAME (Bloomberg 2016)

Public Joint Stock Oil Company Bashneft

Open Joint Stock Company Surgutneftegas

Open Joint-Stock Oil and Gas Company Slavneft

Open Joint Stock Company Rosneft Oil Company

Public Joint Stock Company Oil Company LUKOIL

PJSC Tatneft

PJSC Gazprom Neft

Appendix 2. Simulation Assumptions

CONSOLIDATED (mln USD)

Revenues	Gneft	Tatneft	Lukoil	Rosneft	Slavneft	Surgut	Bashneft	Average
2004	8796	7180	34058	4628	5938	10699	1877	10454
2005	14332	10619	56215	18332	6331	15780	2462	17724
2006	19931	11714	67684	24004	6348	19382	3503	21795
2007	22428	13936	81891	41727	5937	24146	3777	27692
2008	33205	17860	107680	51113	5717	23175	4710	34780
2009	23773	12004	81083	46422	3505	16608	6433	27118
2010	32176	15411	104956	63057	4023	20274	11707	35943
2011	35032	14205	133650	92461	5329	27951	16544	46453
2012	39694	14301	139171	99472	6398	27358	17148	49077
2013	39789	14281	141452	147340	6059	26296	17681	56128
2014	36500	12347	144167	142632	5117	23083	16517	54338

Opex	Gneft	Tatneft	Lukoil	Rosneft	Slavneft	Surgut	Bashneft	Average
2004	5645	5851	21976	4979	3026	7734	2159	7339
2005	11127	8848	39748	15143	2735	11294	2803	13100
2006	11249	10088	49023	27799	2818	15471	3670	17160
2007	13187	11450	57761	32986	2997	19407	3906	20242
2008	19720	16267	79463	42858	3726	19840	4854	26675
2009	16413	9685	58536	32577	2274	13852	3748	19584
2010	21371	13244	78818	43102	2889	16611	9936	26567
2011	27863	8361	103124	68715	5329	8874	13869	33734
2012	32396	8115	109237	77704	5413	9573	14507	36706
2013	32528	8171	111636	117080	5210	9644	14940	42744
2014	30745	6824	118175	114562	4685	8975	14383	42621

Assets	Gneft	Tatneft	Lukoil	Rosneft	Slavneft	Surgut	Bashneft	Average
2004	10262	11171	29761	25093	5224	26469	2169	15736
2005	10639	9817	40345	30658	5505	31201	2483	18664
2006	14102	12136	48237	34191	5694	36006	2962	21904
2007	16609	15068	59632	57351	6806	42539	3433	28777
2008	20205	12874	71461	83931	7455	39579	3140	34092
2009	29912	16355	79019	89900	7518	43401	12664	39824
2010	31251	18267	84017	98621	7713	52110	14944	43846
2011	34732	18867	91192	107568	7441	58895	13573	47467
2012	42553	20640	98961	129975	8821	67784	15171	54844
2013	47540	20495	109439	228972	8581	72513	13614	71593
2014	36137	12626	81638	150495	5184	56954	9021	50294

CONSOLIDATED (proportion)

D/E	Gneft	Tatneft	Lukoil	Rosneft	Slavneft	Surgut	Bashneft	Average
2004	0,43	0,82	0,43	3,88	1,08	0,06	0,11	0,97
2005	0,39	0,42	0,51	1,88	0,96	0,06	0,16	0,63
2006	0,42	0,38	0,47	1,77	0,89	0,06	0,16	0,59
2007	0,59	0,40	0,45	2,88	1,09	0,07	0,10	0,80
2008	0,45	0,51	0,42	0,89	1,13	0,05	0,18	0,52
2009	0,85	0,62	0,41	0,83	1,10	0,06	1,39	0,75
2010	0,76	0,73	0,42	0,71	1,58	0,12	1,84	0,88
2011	0,63	0,62	0,35	0,67	2,08	0,13	1,42	0,85
2012	0,56	0,47	0,35	0,74	2,30	0,14	0,91	0,78
2013	0,64	0,40	0,39	1,41	2,11	0,16	0,90	0,86
2014	0,97	0,32	0,56	2,04	3,34	0,14	1,67	1,29

Mean: 0,81; Standard Deviation: 0,21

Quick assets	Gneft	Tatneft	Lukoil	Rosneft	Slavneft	Surgut	Bashneft	Average
2004	0,11	0,08	0,05	0,07	0,02	0,09	0,02	0,06
2005	0,03	0,08	0,04	0,07	0,01	0,13	0,01	0,05
2006	0,10	0,07	0,02	0,05	0,02	0,21	0,10	0,08
2007	0,04	0,07	0,01	0,04	0,02	0,15	0,07	0,06
2008	0,11	0,06	0,04	0,04	0,04	0,33	0,14	0,11
2009	0,03	0,05	0,03	0,05	0,04	0,31	0,11	0,09
2010	0,04	0,05	0,03	0,11	0,02	0,19	0,07	0,07
2011	0,03	0,06	0,03	0,09	0,03	0,21	0,06	0,07
2012	0,07	0,04	0,03	0,09	0,12	0,18	0,04	0,08
2013	0,09	0,06	0,02	0,04	0,10	0,20	0,04	0,08
2014	0,06	0,08	0,03	0,04	0,05	0,23	0,10	0,08

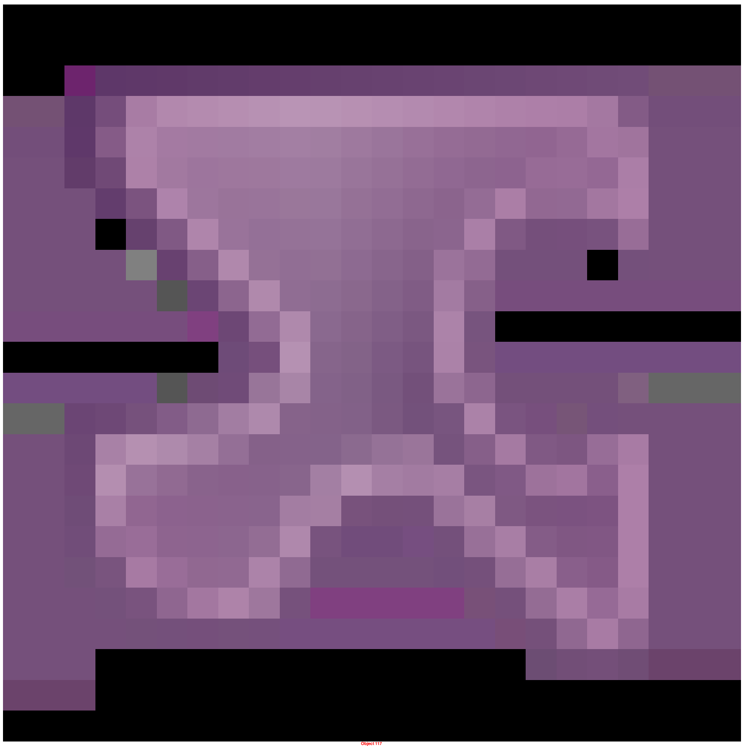
Mean: 0,08; Standard Deviation: 0,02

Dividend payout ratio (average)	20,00%
Interest as part of debt	9,00%

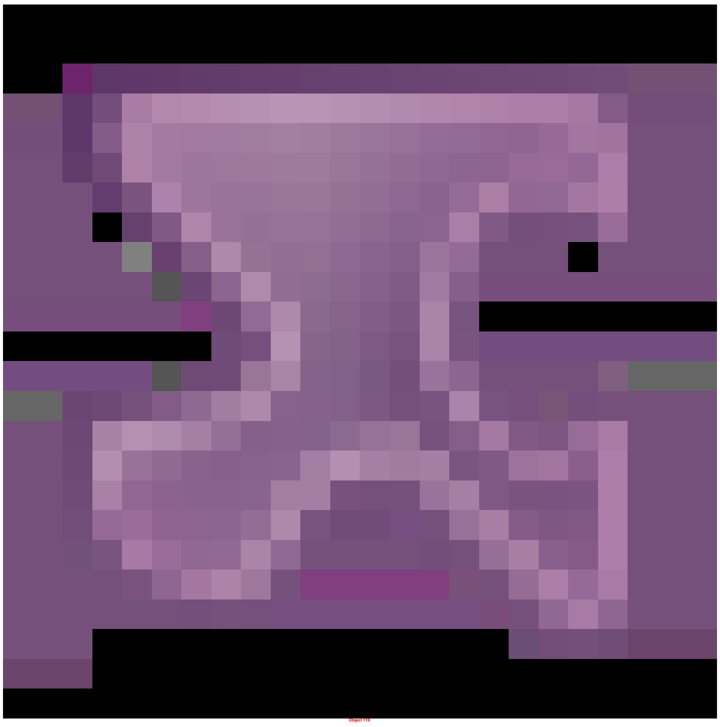
GEOMETRIC BROWNIAN MOTION PARAMETERS

Parameters:	Revenue	Costs	Assets
Sigma	0,21	0,22	0,18
Drift	0,09	0,11	0,05
Time step	1,00	1,00	1,00
Risk-free rate	4,87%		

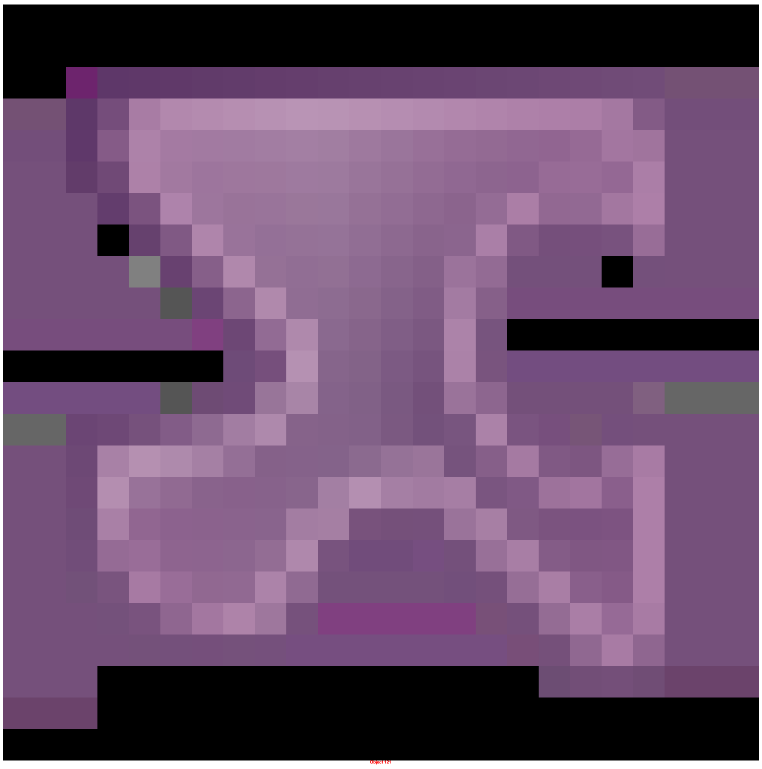
Appendix 3. Default probabilities of the firm (i=9%, various principal)

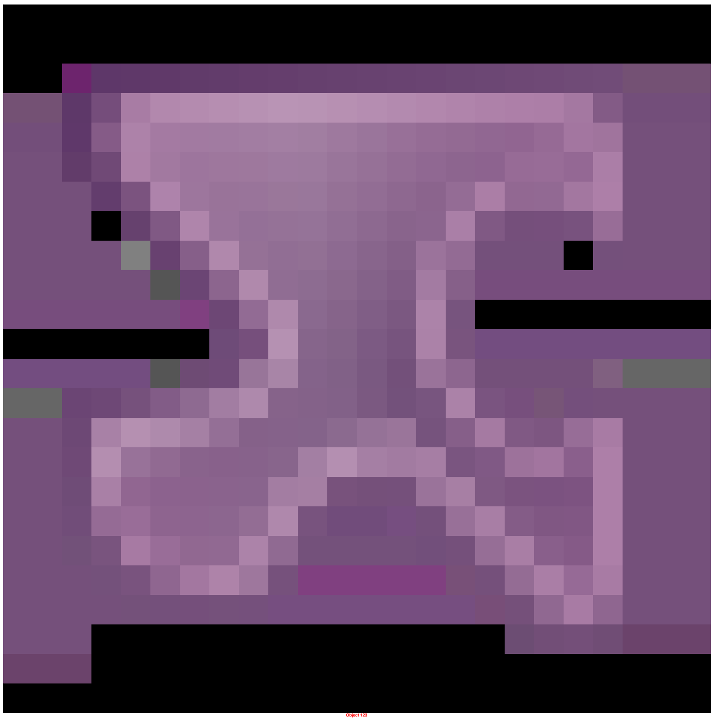


Appendix 4. Distribution of covenant violations over time (various principal)



Appendix 5. Default probabilities for loan with and without covenant





Appendix 6. Expected values and volatilities for covenant and covenant free loan

N=$3000, i=7%

Threshold	Expected loan value with covenant	Volatility (%) with covenant	Expected loan value without covenant	Volatility (%) no covenant	Difference
1,50	$3 156,95	1,2967%	$3 132,78	3,1304%	$24,17
2,00	$3 157,35	0,8217%			$24,57
2,50	$3 155,03	0,8764%			$22,25
3,00	$3 150,87	0,6005%			$18,09
3,50	$3 142,11	0,8746%			$9,33
4,00	$3 129,93	1,1342%			-$2,85
4,50	$3 111,58	1,3434%			-$21,20

N=$3000, i=9%

Threshold	Expected loan value with covenant	Volatility (%) with covenant	Expected loan value without covenant	Volatility (%) no covenant	Difference
1,50	$3 452,08	1,1326%	$3 422,54	3,5273%	$29,54
2,00	$3 449,19	1,0108%			$26,65
2,50	$3 440,52	1,2455%			$17,97
3,00	$3 424,13	1,7038%			$1,59
3,50	$3 400,09	2,3311%			-$22,46
4,00	$3 358,16	3,1011%			-$64,38
4,50	$3 307,40	3,6023%			-$115,14

N=$7000, i=9%

Threshold	Expected loan value with covenant	Volatility (%) with covenant	Expected loan value without covenant	Volatility (%) no covenant	Difference
1,50	$8 051,28	1,4561%	$7 987,37	3,5854%	$63,90
2,00	$8 048,22	1,0590%			$60,84
2,50	$8 028,23	1,0799%			$40,86
3,00	$7 987,93	1,4542%			$0,56
3,50	$7 913,55	2,0028%			-$73,83
4,00	$7 809,97	2,4393%			-$177,40
4,50	$7 696,30	2,4895%			-$291,08

N=$15000, i=7%

Threshold	Expected loan value with covenant	Volatility (%) with covenant	Expected loan value without covenant	Volatility (%) no covenant	Difference
1,50	$15 790,92	0,9201%	$15 632,27	3,3656%	$158,65
2,00	$15 791,73	0,3679%			$159,45
2,50	$15 769,85	0,4107%			$137,57
3,00	$15 726,73	0,4957%			$94,45
3,50	$15 661,88	0,5755%			$29,61
4,00	$15 597,22	0,5329%			-$35,06
4,50	$15 551,53	0,4620%			-$80,74