

Translated Article[†]

IMPROVEMENT OF RATING METHODOLOGY



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Abstract

Importance The article focuses on rating methodologies, their drawbacks and improvement methods.

Objectives The research generalizes the new approach to the rating methodology adjusting it for the Brusov – Filatova – Orekhova modern theory of capital cost and capital structure in relation to corporations of any age.

Methods The research is based on the Brusov – Filatova – Orekhova modern theory of capital cost and capital structure (BFO theory).

Results The article analyzes methodological and systemic drawbacks of the existing credit ratings of non-financial issuers. We incorporate financial ratios used for rating into the general case of the BFO theory. The article also examines how the Weighted Average Cost of Capital depends on coverage and leverage ratios.

Conclusions and Relevance The proposed approach will make ratings more accurate and unbiased. The findings may prove useful to international and Russian rating agencies to evaluate the solvency of issuers.

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Introduction

In our previous article, we set out a conceptually new approach to the rating methodology. It provides for an appropriate application of discounting to cash flows, which is almost neglected in the existing rating methodologies, use of rating ratios while discounting, correct assessment of discount rates in line with financial ratios. The research delved into the perpetuity limit of the Brusov – Filatova – Orekhova modern theory of capital cost and capital structure (BFO theory), which was modified for rating purposes.

As noted in researches referred to hereinafter [1–27], the Modigliani–Miller theorem, the perpetuity limit of the BFO theory, underestimates the cost of capital, thus resulting in overstated estimates of the corporate capitalization. Furthermore, the perpetuity limit fails to account for a timing factor, which is very critical. Hence it omits the concept of corporate age, the life cycle of a company being taken as indefinite (perpetuity).

In this research, we generalize the earlier proposed approach¹ and fit it to the BFO theory and corporations of arbitrary age, i.e. a general case of the BFO theory. This made us considerably modify the BFO theory, which is much more complex than the perpetuity limit², since the concept of leverage in financial management (a ratio of loan to equity) substantially differs from the leverage in rating practices (a ratio of loan, loan interests to various amounts of generated income) and inverse ratios are used (ratios of different amounts of generated income to loan or loan interests), i.e. the so called coverage ratios (debt, interests).

If modified for rating purposes, the BFO theory allows to adequately discount financial flows at correct discount rates, in accordance with rating ratios while discounting, and timing factor, which is missing on the perpetuity limit, through being critical. Therefore, the company's age (as per BFO-1) or its life cycle (BFO-2) shall be taken into consideration.

[†]For the source article, please refer to: Брусов П.Н., Филатова Т.В., Орехова Н.П., Кулик В.Л. Совершенствование методологии рейтингования. *Финансы и кредит*. 2018. Т. 24. № 3. С. 652–678. URL: <https://doi.org/10.24891/fc.24.3.652>

¹Brusov P.N., Filatova T.V., Orekhova N.P., Kulik V.L. [Incorporation of rating parameters into the perpetuity range of the Brusov–Filatova–Orekhova modern theory of capital structure]. *Finansy i kredit = Finance and Credit*, 2017, vol. 23, no. 40, pp. 2378–2397. URL: <https://doi.org/10.24891/fc.23.40.2378> (In Russ.)

²Ibid.

Existing Credit Rating of Non-Financial Issuers: Analysis of Methodological and Systemic Weaknesses

We analyzed methodological and systemic weaknesses of the existing credit rating of non-financial institutions, covering the methodologies of the Big Three credit rating agencies (Standard & Poor's, Fitch and Moody's) and national rating agency.

Discounting

Despite being ample and detailed, the existing rating methodologies do still have many drawbacks. As mentioned in our previous research, what *inter alia* impairs all the rating methodologies is that they do not arrange for discounting or envisage it for a very narrow usage. Even if the discounting procedure is in place, it is performed not quite correctly since the discount rate is erroneously chosen to discount cash flows. The timing factor shall evidently be taken into consideration because it relates to the time value of money. In the financial part of the rating process, proceeds (generated income) are compared with debt and interests paid. Whereas there is a time gap between the moment income is received and debt and interests are repaid, the discounting proves to be vital to compare the income, debt and interest and assign appropriate credit ratings to issuers. Hence it raises the question about the discount rate used. The question has always been on the agenda and complicated in many aspects, i.e. corporate finance, investment, business valuation, where it is especially important as even a slight change in the discount rate significantly influences the company's capitalization. *Mala fide* appraisers make use of it for making companies artificially bankrupt. The question is also crucial in rating practices in assigning credit ratings to issuers and forecasting.

Hence once financial flows are concerned, discounting shall be taken into account. Otherwise, the time value of money is neglected. Therefore, discounting shall be an inevitable aspect to consider as part of analysis of financial flows.

Discounting shall be taken into account, when rating practices require that financial statements for a three or five years' time are used (under GAAP), assuming the flat behavior of indicators outside the purview of the period.

Dividend Policy of Company

Dividend policies shall be kept in mind for rating purposes since ratings always refer to financial policies. However, the existing rating methodologies evaluate the stability of dividend policies only, without questioning its reasonableness and correspondence of dividends paid with their economically adequate amount.

Dividend policies are evaluated by comparing the amount of dividends paid and their economically adequate amount, that is the cost of the company's equity. The cost of equity is rather difficult to calculate. The BFO theory allows to adequately evaluate the cost of equity and hereby compare the amount of dividends paid by the company with their economically adequate amount. Therefore, the reasonableness of dividend policies is reviewed, which definitely relates to the creditworthiness of the issuer.

For instance, discretionary cash flow (DCF, S&P) shall be compared with the economically adequate amount, thus influencing the rating.

Leverage Level

Currently, rating agencies refer to leverage ($L = D / S$) solely to evaluate the financial stability and bankruptcy risk. In fact, it influences the principle financial indicators of corporate performance, i.e. the cost of equity, WACC. In other words, it has an impact on the cost of fundraising and capitalization. If this impact is overlooked as part of financial reporting analysis, this will lead to incorrect conclusions.

Investment projects and investment programs of companies can be rated in accordance with the effect of leveraged finance, which is assessed by the BFO theory, on the efficiency of investment projects for various cost of capital.

Taxation

Taxation significantly influences issuers' ratings. Companies and their investment programs can be assigned ratings in accordance with the effect of taxation (corporate income tax rate) on financial results of the company, efficiency of investment projects, which is assessed by the BFO theory. In case of changes in the corporate income tax rate, the assessments also apply to forecast estimates and analysis of the country risk.

Forecasts and analysis of the country risk can be based on the effect of the base interest rate of the Central Bank of Russia, loan interest rates of commercial banks

on the efficiency of investment projects, creation of the favorable investment climate in the country, which is assessed by the BFO theory.

Attention to Sectoral Distinctions of the Issuer

The existing rating methodologies provide for sectoral distinctions of the issuers, especially in case of newly incorporated businesses drawing upon predecessors' experience. As per the ACRA Methodology for Credit Ratings Assignment to Regional and municipal Authorities of the Russian Federation, the company's creditworthiness shall be determined in line with sectoral distinctions of the company. To assess the sectoral risk factor, ACRA classifies sectors into five groups by their cyclicity, entry barrier, sectoral risk statistics, development trend and prospect. The sectoral risk profile factor is weighted individually for each group, varying by credit risk level. This creates the ceiling of ratings for companies operating in sectors with high risk exposure, providing premiums to sectors with lower risk exposure.

However, sectoral distinctions of issuers obviously need to be considered more thoroughly. Rating methodologies shall focus on sectoral distinctions of issuers' financial flows more profoundly. In particular, it is very important to determine whether the entity needs working capital, which directly contributes to financial stability, solvency and creditworthiness. The latter is a key metric in rating.

Inattention to Issuer's Distinctions

The existing methodologies disregard the issuer's salience, specifics of its financial reporting, taxation, regulatory and financial systems, sacrificing it to a full comparability of financial reports and smoothing the differences (Moody's).

Financial Ratios

How many financial ratios are needed? How many ratios would be enough? What particular financial ratios shall be in place? Such questions seem to have been left behind. However, the quantity and quality of financial ratios, their correlation or independence significantly determine the financial risk and state of the issuer.

Some ratios fail to give a definite view of the issuer. For example, the cash flow to leverage ratio is high no matter whether cash flow is high or leverage is low. The thing is that to what extent the two states of the issuer equally correlate with the credit risk, considering that there are associated with the same financial risk.

As admitted in the ACRA methodology, in certain cases some characteristics of a factor/subfactor may formally be attributed to several categories for evaluation, being typical of qualitative factors. In such circumstances, rating is assigned on the basis of expert opinion accounting for the most crucial parameters.

In this respect, it is worth mentioning that it is of paramount importance *inter alia* to formalize experts' opinions in order to improve the rating methodology and hereby make the expert judgment more unbiased and reliable. There may be several options to address the issue, i.e. the use of the modern measurement theory and its results, reliance on the formalism of fuzzy sets and fuzzy logic, etc.

Tabulating the composition of different risks (for instance, in Corporate Industry and Country Risk Assessment – CIRCA (S&P methodology) results in a 6x6 matrix comprising 36 elements. That is, CIRCA shall have 36 different values, but their total number is 6. Is that reasonable? We believe it is evidence of unreasonableness or existence of other reasons, but they should be very well substantiated.

We may refer to a myriad of identical cases. Indeed, as per the ACRA Methodology for Credit Ratings Assignment to Microfinancial Organizations on the National Scale for the Russian Federation, *Table 1* presents a 5x5 matrix comprising 25 elements, i.e. there shall be 25 different states, but only five states are observed. The same question of reasonableness arises. The presence of the five states indicates the lack of reasonableness.

As per S&P methodology, compositions of different ratios have been tabulated not quite correctly so as to determine the financial risks:

– FFO/debt(%), Debt/EBITDA(x), FFO/cash interest(x), EBITDA/interest(x), CFO/debt(%), FOCF/debt(%), DCF/debt(%);

– minimal: 60+, Less than 1.5, More than 13, More than 15, More than 50, 40+, 25+;

– modest: 45–60, 1.5–2, 9–13, 10–15, 35–50, 25–40, 15–25;

– intermediate: 30–45, 2–3, 6–9, 6–10, 25–35, 15–25, 10–15;

– significant: 20–30, 3–4, 4–6, 3–6, 15–25, 10–15, 5–10;

– aggressive: 12–20, 4–5, 2–4, 2–3, 10–15, 5–10, 2–5;

– highly leveraged: less than 12, greater than 5, less than 2, less than 2, less than 10, less than 5, less than 2.

The relations are at least not correlated completely, being used as such though. So, we can see that the two line *Minimal* and *Models* do not let parameters of the lines mix, though such cases are quite possible. For example, 60+, 1.5–2, More than 13, More than 15, More than 50, 40+, 25+.

Such aspects constrain the applicability of rating agencies' methods. Rating agencies adopt them in order to simplify the rating procedure, intentionally or not, and unify methods for various systems of financial reporting, countries, for purposes of comparable results.

The said ambiguity of assessments has already been noticed when assigning ratings to Gazprom (S&P).

Modification of the BFO Theory for Corporations of Arbitrary Age for Rating Purposes

We hereinafter modify the BFO theory for corporations of arbitrary age for rating purposes. This appears to be a much more complicated task than the modification of the perpetuity limit of the BFO theory.

The BFO formula proves to be inapplicable in this case [1]:

$$\frac{[1-(1+WACC)^{-n}]}{WACC} = \frac{[1-(1+k_0)^{-n}]}{k_0[1-\omega_d T(1-(1+k_d)^{-n})]}.$$

The formula does not account for cash flows CF and loan D , while the leverage level $L = D/S$ (as though it is understood in financial management) is presented only through the percentage of borrowings $wd = L / (L + 1)$.

To modify the BFO general theory for rating purposes, we shall refer to initial assumptions underlying the BFO formula.

According to the Modigliani–Miller theorem providing for corporate taxes [3–5], which we generalize [1] for the final period of time, i.e. companies and corporations of arbitrary age, the capitalization of a leveraged company, which uses debt financing, V_L equals that of a non-leveraged company, which is free from debt financing V_0 , plus a tax shield amount for the final period of time TS_n .

$$V_L = V_0 + TS_n, \quad (1)$$

where the capitalization of a financially dependent company is as follows:

$$V_L = \frac{CF}{WACC} (1 - (1 + WACC)^{-n}); \quad (2)$$

capitalization of a financially independent company is as follows:

$$V_0 = \frac{CF}{k_0} (1 - (1 + k_0)^{-n}); \quad (3)$$

and the tax shield for n years:

$$TS_n = tD(1 - (1 + k_d)^{-n}). \quad (4)$$

CF is income for the period, D is an amount of loan, k_d is the loan interest rate, k_0 is the cost of the financially independent's equity and n is the company's age.

Inserting the formulas (2)-(4) into (1), we get the formula (5), which will be used subsequently to modify the BFO theory for rating purposes:

$$\frac{CF(1 - (1 + WACC)^{-n})}{WACC} = \frac{CF}{k_0} (1 - (1 + k_0)^{-n}) + tD(1 - (1 + k_d)^{-n}). \quad (5)$$

Let us call the equation (5) the BFO-3 model (the BFO theory for rating purposes). BFO-1 applies to companies of the ultimate age remaining in the market, while BFO-2 refers to those ones of the final life cycle that left the market [1]. Afterwards we make the first attempt to incorporate rating parameters into the BFO modern theory of capital cost and capital structure³.

In this research, two types of rating ratios are considered, i.e. coverage ratios and leverage ratios.

We suggest starting with debt coverage ratios and respective interests.

Coverage Ratios

We examine three types of coverage ratios, i.e. debt-service coverage ratio, interest coverage ratio and debt-and-interest coverage ratio. Please note that we introduced the latter type of the coverage ratios for the first time to more comprehensively describe the issuer's ability to pay off debts and respective interests.

³ Brusov P.N., Filatova T.V., Orekhova N.P., Kulik V.L. [Incorporation of rating parameters into the perpetuity range of the Brusov-Filatova-Orekhova modern theory of capital structure]. *Finansy i kredit = Finance and Credit*, 2017, vol. 23, no. 40, pp. 2378–2397. URL: <https://doi.org/10.24891/fc.23.40.2378> (In Russ.)

Debt-Service Coverage Ratio

Dividing the both parts of the formula (5) by the loan D , we introduce the debt-service coverage ratio into the BFO general theory:

$$\frac{CF}{D} = i_1;$$

$$i_1 A = i_1 B + tC;$$

$$\frac{i_1 * (1 - (1 + WACC)^{-n})}{WACC} = \frac{i_1 (1 - (1 + k_0)^{-n})}{k_0 + t(1 - (1 + k_d)^{-n})}.$$

Therefore,

$$A = \frac{(1 - (1 + WACC)^{-n})}{WACC};$$

$$B = \frac{(1 - (1 + k_0)^{-n})}{k_0};$$

$$C = (1 - (1 + k_d)^{-n}).$$

The coverage ratio i_1 can be used to assess such rating parameters as $DCF/Debt$, $FFO/Debt$, $CFO/Debt$, $FOCF/Debt$, etc.

The following denotations are used:

EBITDA stands for earnings before interests, taxes, depreciation and amortization;

EBITDAR stands for earnings before interests, taxes, depreciation, amortization and restructuring or rent costs;

FFO stands for operating cash flows before changes in working capital;

Debt is the outstanding amount;

CFF is cash flows from financing activities;

FCF is free cash flow;

NCF is net cash flow;

DCF is discounted cash flow;

CFO is cash flow from operations.

We suggest analyzing the dependence of $WACC$ on the debt-service coverage ratio i_1 for companies aged $n = 3$ and $n = 5$ provided that $k_0 = 8\%$; $k_d = 4\%$; $t = 20\%$; i_1 ranges from 0 to 10.

Fig. 1 and *2* depict the dependence of $WACC$ on the coverage ratio i_1 .

Interest Coverage Ratio

We suggest analyzing the dependence of WACC on the loan interest coverage ratio i_2 . Dividing both parts of the formula (5) by the amount of loan interests $k_d D$, we introduce the loan interest coverage ratio i into the BFO general theory.

$$i_2 = \frac{CF}{k_d D}.$$

$$i_2 A = i_2 B + \frac{tC}{k_d}.$$

$$\frac{i_2(1-(1+WACC)^{-n})}{WACC} = \frac{i_2(1-(1+k_0)^{-n})}{k_0} + \frac{t(1-(1+k_d)^{-n})}{k_d}. \quad (6)$$

The loan interest coverage ratio i_2 is used to assess such rating parameters as *FFO/cash interest*, *EBITDA/interest*, etc.

Based on the equation (6), we study the dependence of WACC on the loan interest coverage ratio i_2 for companies at age three ($n=3$) and five ($n=5$).

Fig. 3 and 4 depict the dependence of WACC on the loan interest coverage ratio i_2 .

Debt-and-Interest Coverage Ratio

The next step is to scrutinize the dependence of WACC on the debt-and-interest coverage ratio i_3 . Please note that we introduced this ratio for the first time to more comprehensively describe the issuer's ability to pay off debts and respective interests.

Dividing the both parts of the formula (5) by the amount of debt and interests $(1+k_d)D$, we insert the debt-and-interest coverage ratio into the BFO general theory.

$$\frac{CF}{D(1+k_d)} = i_3.$$

$$i_3 A = i_3 B + \frac{tC}{1+k_d}.$$

$$\frac{i_3(1-(1+WACC)^{-n})}{WACC} = \frac{i_3(1-(1+k_0)^{-n})}{k_0} + \frac{t*(1-(1+k_d)^{-n})}{1+k_d}. \quad (7)$$

Based on the equation (7), we examine the dependence of WACC on the debt-and-interest coverage ratio i_3 for companies at age three ($n=3$) and five ($n=5$).

Fig. 5 and 6 depict the dependence of WACC on the debt-and-interest coverage ratio i_3 .

Fig. 7 and 8 show the dependence of WACC on the debt coverage ratio, interest coverage ratio and debt-and-interest coverage ratio totally.

Conclusions. Having analyzed Tables 2–4 and Fig. 1–5, we see WACC increase as debt coverage ratios i_1 , i_2 , i_3 grow in all the companies of any age. We considered those ones at age three and five. However, companies of other age are obvious to face a similar situation. The more debt coverage ratios grow, the more WACC values converge. $WACC(i_1)$ and $WACC(i_3)$ are close to one another, albeit not being equal, but $WACC(i_2)$ significantly differs from them. These conclusions stem from a low interest rate on the loan k_d , an increase of which will make $WACC(i_1)$ and $WACC(i_3)$ more divergent, while $WACC(i_2)$ becomes less different from them. Curves of dependencies $WACC(i_j)$ for older companies are located higher. If we compare the results with cases of perpetuity companies⁴, it is evident that curves of dependencies $WACC(i_j)$ reach the saturation point more smoothly in case of companies at definite age, than in case of perpetuity companies, where they reach the saturation point provided coverage ratios are about 1. This is certainly true for $WACC(i_1)$ and $WACC(i_3)$, while $WACC(i_2)$ smoothly depends on the interest coverage ratio even within the perpetuity limit. As a result, real (rather than perpetuity) companies need to assess dependencies of $WACC(i_j)$ in case of companies of definite age and apply them as discount rates to financial flows for rating purposes.

Leverage Ratios

This part of the research is devoted to three types of leverage ratios, i.e. the leverage ratio of the loan (debt), leverage ratio of loan interests and leverage ratio of debt and interests. We hereinafter analyze how WACC depends on leverage ratios (l_1 , l_2 , l_3) in case of companies at age three and five and cost of capital accounting for $k_0 = 10\%$, $k_d = 6\%$ under $t = 20\%$, with leverage ratios l_i ranging from 0 to 10.

⁴ Brusov P.N., Filatova T.V., Orekhova N.P., Kulik V.L. [Incorporation of rating parameters into the perpetuity range of the Brusov–Filatova–Orekhova modern theory of capital structure]. *Finansy i kredit = Finance and Credit*, 2017, vol. 23, no. 40, pp. 2378–2397. URL: <https://doi.org/10.24891/fc.23.40.2378> (In Russ.)

Leverage Ratio of Debt

As per the BFO theory, the dependence of WACC on the leverage ratio of debt l_1 is expressed with the following formula:

$$\frac{(1-(1+WACC)^{-n})}{WACC} - \frac{(1-(1+K_0)^{-n})}{K_0} - t[1-(1+K_d)^{-n}]l_1 = 0,$$

where $l_1 = \frac{D}{CF}$,

where l_1 is the leverage ratio of debt;

t is the corporate income tax rate;

k_0 is the cost of a non-leveraged (financially independent) company's equity;

k_d is the cost of debt;

n is age of a company;

CF is income for the period;

D is the amount of debt.

This ratio can be used to assess such rating parameters as *Debt/EBITDA*, etc.

We make a table visualizing the dependence of WACC on l_1 .

Fig. 9 and 10 illustrate the dependence of WACC on the leverage ratio of debt (l_1) in case of companies at age 3 ($n = 3$) and five ($n = 5$) respectively.

Leverage Ratio of Loan Interests

As per the BFO theory, the formula below expresses the dependence of WACC on the leverage ratio of loan interest l_2 :

$$\frac{(1-(1+WACC)^{-n})}{WACC} - \frac{(1-(1+K_0)^{-n})}{K_0} - \frac{(t \cdot l_2 [1-(1+K_d)^{-n}])}{K_d} = 0,$$

where $l_2 = \frac{K_d D}{CF}$;

$K_d D$ stands for loan interests in kind.

Let us measure the dependence of WACC on the leverage ratio of loan interests l_2 .

Fig. 11 and 12 illustrate the dependence of WACC on the leverage ratio of loan interests l_2 as per the BFO

theory in case of companies at age three ($n = 3$) and five ($n = 5$) respectively.

As per the BFO theory, the dependency of WACC on the leverage ratio of debt and interests l_2 is expressed with the following formula:

$$\frac{(1-(1+WACC)^{-n})}{WACC} - \frac{(1-(1+K_0)^{-n})}{K_0} - \frac{t \cdot l_3 [1-(1+K_d)^{-n}]}{K_d + 1} = 0,$$

where $l_3 = \frac{(k_d + 1) D}{CF}$, $(k_d + 1) D$ is the amount of debt and respective interests.

We make a table visualizing the dependence of WACC on l_3 .

Fig. 13 and 14 illustrate the dependence of WACC on the leverage ratio of debt and interest l_3 as per the BFO theory in case of companies at age three $n = 3$ and five $n = 5$.

Fig. 15 and 16 depicts consolidated graphs of the dependency of WACC on l_1 , l_2 , l_3 in case of $n = 3$ and $n = 5$.

Conclusions. Having analyzed Tables 5–7 and Fig. 6–16, we concluded that the higher the leverage ratios l_1 , l_2 , l_3 in case of company of any age (we consider companies at age three and five, but the situation will definitely be identical in case of companies of other age), the lower WACC. The more the leverage ratios grow, the more divergent WACC-values (they spring from the point $(0, k)$). $WACC(l_1)$ and $WACC(l_3)$ are close to one another, albeit not being equal, decreasing almost in a linear way as the leverage ratios increase. The dependence of $WACC(l_2)$ significantly differs from $WACC(l_1)$ and $WACC(l_3)$. Both conclusions stem from a low interest rate on loan k_d , an increase of which will make $WACC(l_1)$ and $WACC(l_3)$ more divergent, while $WACC(l_2)$ becomes less different from them. Curves of dependencies of $WACC(l_j)$ for older companies run higher, signifying their slower decrease. If we compare the results with cases of perpetuity companies⁵, it is evident that the negative slope coefficient of dependencies of $WACC(l_j)$ is more than twice as high (by

⁵ Brusov P.N., Filatova T.V., Orekhova N.P., Kulik V.L. [Incorporation of rating parameters into the perpetuity range of the Brusov–Filatova–Orekhova modern theory of capital structure]. *Finansy i kredit = Finance and Credit*, 2017, vol. 23, no. 40, pp. 2378–2397. URL: <https://doi.org/10.24891/fc.23.40.2378> (In Russ.)

module) as the identical slope coefficient of companies with definite age. It means that $WACC(I)$ decreases faster in case of companies with definite age that in perpetuity cases⁶.

Conclusion

In this research, we analyzed methodological and systemic drawbacks of the way ratings are assigned to non-financial issuers. We modified the Brusov–Filatova–Orekhova modern theory of capital cost and capital structure for rating purposes. As part of the modified BFO theory, we incorporated financial ratios used for rating purposes (rating ratios) into the general case of the BFO theory. We investigated the dependence of $WACC$ on two types of rating ratios, i.e. coverage ratios

and leverage ratios, and substantiated the importance of discounting for rating of issuers.

Following the devised method for assessing discount rates in line with rating ratios, it is possible to apply correct discount rates to financial flows for rating purposes. The findings of the two researches we presented herein allow to bridge a gap between fundamental theories of capital structure and rating methodologies. Methods of well elaborated and verified theories open new opportunities for the rating sector, enabling it to abandon the qualitative method of creditworthiness evaluation and opt for quantitative ones, thus enhancing the quality and accuracy of ratings. Both researches we release herein frame a new approach to rating methodologies.

⁶ Ibid.

Table 1
Assessment of funding and liquidity

Funding assessment	Liquidity assessment				
	1	2	3	4	5
1	1	2	2	3	4
2	1	2	3	3	4
3	2	2	3	4	5
4	3	3	3	4	5
5	3	3	4	5	5

Source: Authoring based on the Analytical Credit Rating Agency (ACRA) data

Table 2
Dependence of WACC on i_1 for companies at age three ($n=3$) and five ($n=5$)

t	k_0	k_d	i_1	WACC ($n=3$)	WACC ($n=5$)
0.2	0.08	0.04	1	0.075356711	0.07663868
0.2	0.08	0.04	2	0.077705469	0.0783126
0.2	0.08	0.04	3	0.078412717	0.0788732
0.2	0.08	0.04	4	0.078808879	0.079154
0.2	0.08	0.04	5	0.079046807	0.07932264
0.2	0.08	0.04	6	0.079205521	0.07943518
0.2	0.08	0.04	7	0.079318935	0.0795156
0.2	0.08	0.04	8	0.079404022	0.07957594
0.2	0.08	0.04	9	0.079470216	0.07962287
0.2	0.08	0.04	10	0.07952318	0.07966043

Source: Authoring

Table 3
Dependence of WACC on i_2 for companies at age three ($n=3$) and five ($n=5$)

t	k_0	k_d	i_2	WACC ($n=3$)	WACC ($n=5$)
0.2	0.08	0.04	1	-0.021238089	0.00793717
0.2	0.08	0.04	2	0.02529016	0.04111354
0.2	0.08	0.04	3	0.042483465	0.0533843
0.2	0.08	0.04	4	0.051456351	0.05974575
0.2	0.08	0.04	5	0.056965593	0.06365738
0.2	0.08	0.04	6	0.060692181	0.06630611
0.2	0.08	0.04	7	0.063380861	0.06821315
0.2	0.08	0.04	8	0.065412245	0.06966377
0.2	0.08	0.04	9	0.067001115	0.07078076
0.2	0.08	0.04	10	0.068277865	0.07168658

Source: Authoring

Table 4Dependence of WACC on k_s for companies at age three ($n=3$) and five ($n=5$)

t	k_0	k_d	i	WACC ($n=3$)	WACC ($n=5$)
0.2	0.08	0.04	1	0.075536724	0.07676703
0.2	0.08	0.04	2	0.077796177	0.07837722
0.2	0.08	0.04	3	0.078473634	0.07891638
0.2	0.08	0.04	4	0.078854621	0.07918642
0.2	0.08	0.04	5	0.079083426	0.07934861
0.2	0.08	0.04	6	0.079236052	0.07945683
0.2	0.08	0.04	7	0.079345114	0.07953417
0.2	0.08	0.04	8	0.079426934	0.07959218
0.2	0.08	0.04	9	0.079490586	0.07963732
0.2	0.08	0.04	10	0.079541516	0.07967343

Source: Authoring

Table 5Dependence of WACC on k_l for companies at age three ($n=3$) and five ($n=5$)

k_l	t	k_0	k_d	WACC (k_l) ($n=3$)	WACC (k_l) ($n=5$)
0	0.2	0.1	0.06	0.1	0.1
1	0.2	0.1	0.06	0.0928	0.0948
2	0.2	0.1	0.06	0.0857	0.0898
3	0.2	0.1	0.06	0.0787	0.0848
4	0.2	0.1	0.06	0.072	0.0799
5	0.2	0.1	0.06	0.0654	0.0752
6	0.2	0.1	0.06	0.0587	0.0705
7	0.2	0.1	0.06	0.0523	0.066
8	0.2	0.1	0.06	0.0461	0.0615
9	0.2	0.1	0.06	0.0399	0.0571
10	0.2	0.1	0.06	0.0339	0.0528

Source: Authoring

Table 6Dependence of WACC on l_2 for companies at age three ($n=3$) and five ($n=5$)

l_2	t	k_0	k_d	WACC(l_2) ($n=3$)	WACC(l_2) ($n=5$)
0	0.2	0.1	0.06	0.0998	0.1
1	0.2	0.1	0.06	-0.0036	0.0259
2	0.2	0.1	0.06	-0.0804	-0.0296
3	0.2	0.1	0.06	-0.1403	-0.0732
4	0.2	0.1	0.06	-0.1888	-0.1089
5	0.2	0.1	0.06	-0.2289	-0.1388
6	0.2	0.1	0.06	-0.2629	-0.1643
7	0.2	0.1	0.06	-0.2922	-0.1865
8	0.2	0.1	0.06	-0.3178	-0.2061
9	0.2	0.1	0.06	-0.3404	-0.2235
10	0.2	0.1	0.06	-0.3605	-0.2391

Source: Authoring

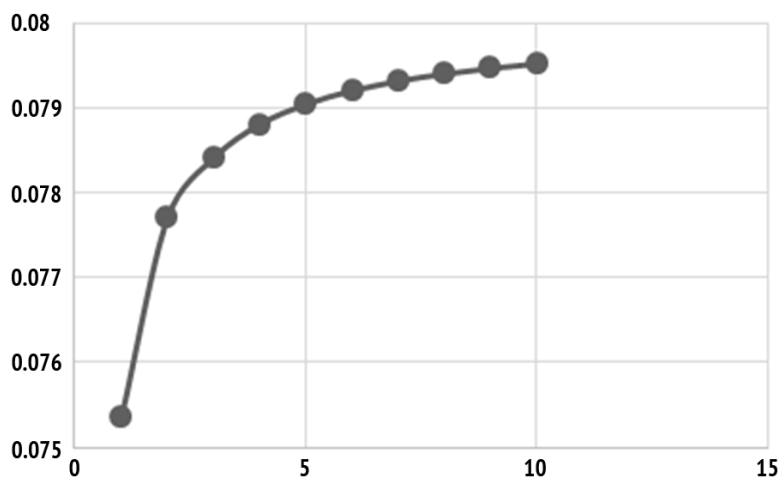
Table 7Dependence of WACC on l_3 for companies at age three ($n=3$) and five ($n=5$)

l_3	t	k_0	k_d	WACC(l_3) ($n=3$)	WACC(l_3) ($n=5$)
0	0.2	0.1	0.06	0.1	0.1
1	0.2	0.1	0.06	0.093	0.0951
2	0.2	0.1	0.06	0.0864	0.0903
3	0.2	0.1	0.06	0.0798	0.0856
4	0.2	0.1	0.06	0.0734	0.081
5	0.2	0.1	0.06	0.0671	0.0765
6	0.2	0.1	0.06	0.0608	0.0721
7	0.2	0.1	0.06	0.0548	0.0678
8	0.2	0.1	0.06	0.0489	0.0635
9	0.2	0.1	0.06	0.043	0.0593
10	0.2	0.1	0.06	0.0371	0.0552

Source: Authoring

Figure 1

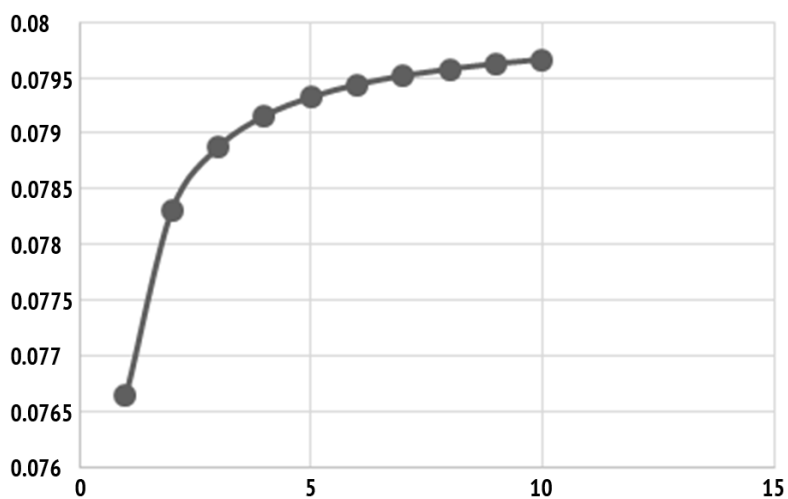
Dependence of a company's weighted average cost of capital (*WACC*) on the debt-service coverage ratio i_1 for a company at age three ($n=3$)



Source: Authoring

Figure 2

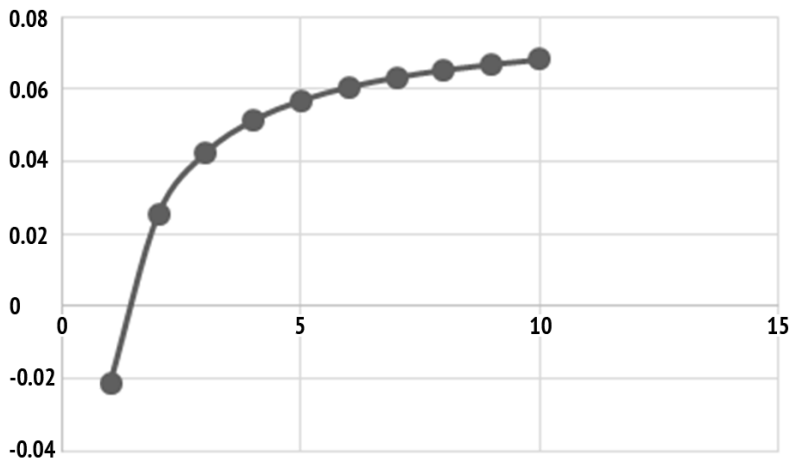
Dependence of a company's weighted average cost of capital (*WACC*) on the debt-service coverage ratio i_1 for a company at age five ($n=5$)



Source: Authoring

Figure 3

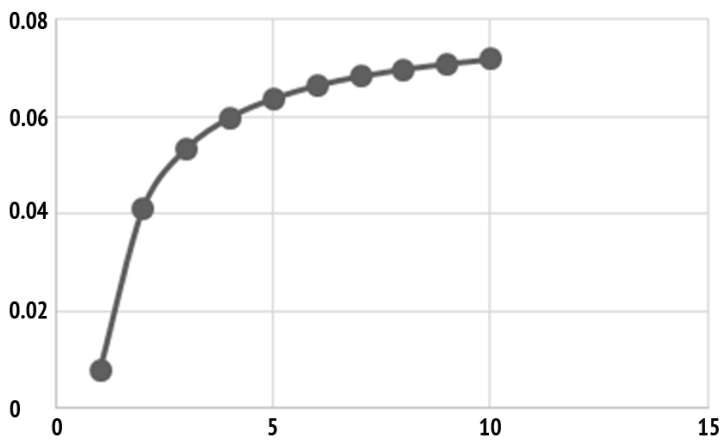
Dependence of a company's weighted average cost of capital (*WACC*) on the debt-service coverage ratio l_2 for a company at age three ($n=3$)



Source: Authoring

Figure 4

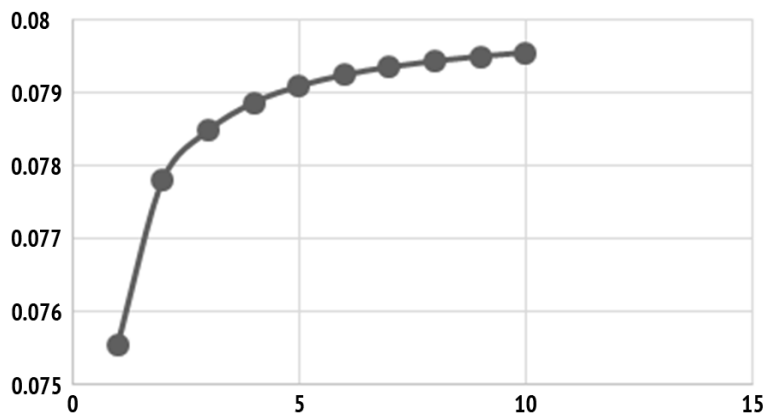
Dependence of a company's weighted average cost of capital (*WACC*) on the debt-service coverage ratio l_2 for a company at age five ($n=5$)



Source: Authoring

Figure 5

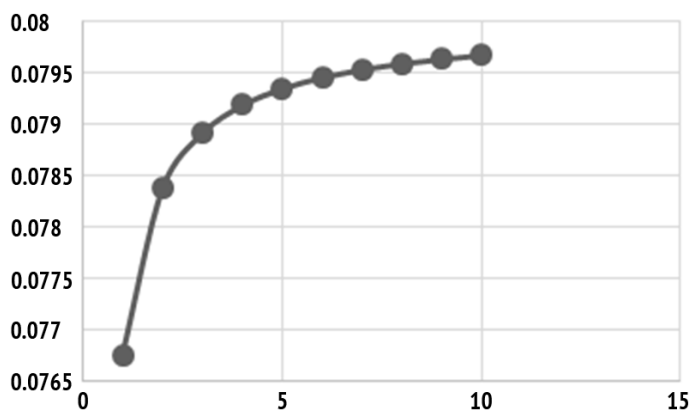
Dependence of a company's weighted average cost of capital (*WACC*) on the debt-service coverage ratio I_3 for a company at age three ($n=3$)



Source: Authoring

Figure 6

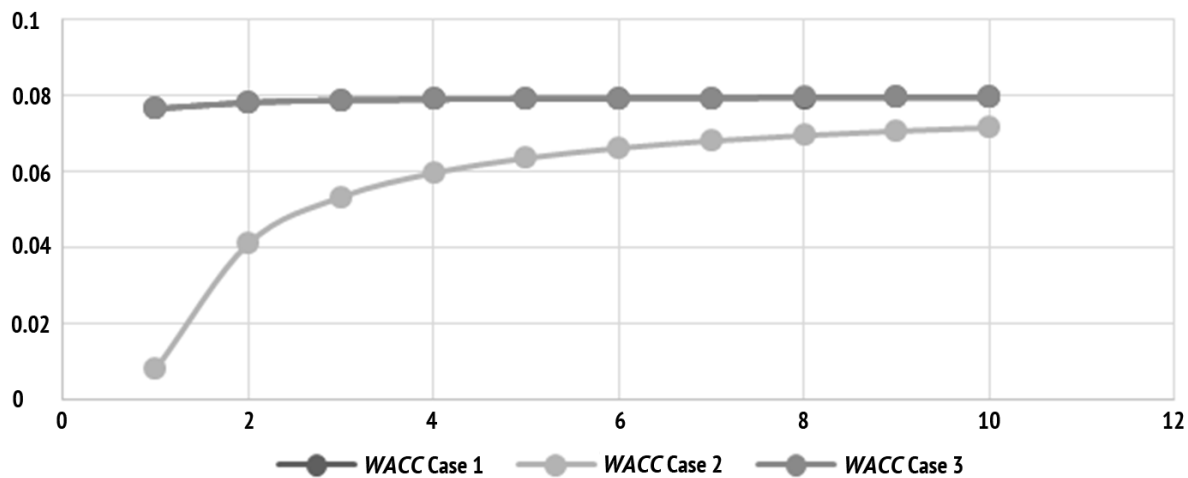
Dependence of a company's weighted average cost of capital (*WACC*) on the debt-service coverage ratio I_3 for a company at age five ($n=5$)



Source: Authoring

Figure 7

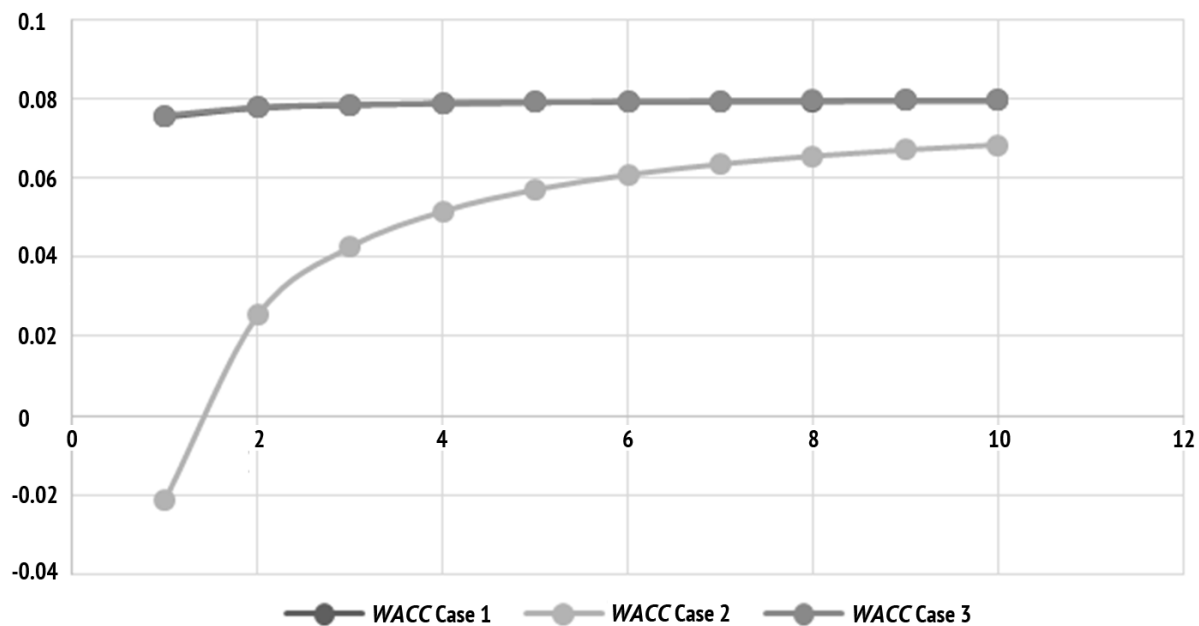
Dependence of a company's weighted average cost of capital (WACC) on the debt-service coverage ratios l_1, l_2, l_3 for a company at age three ($n=3$)



Source: Authoring

Figure 8

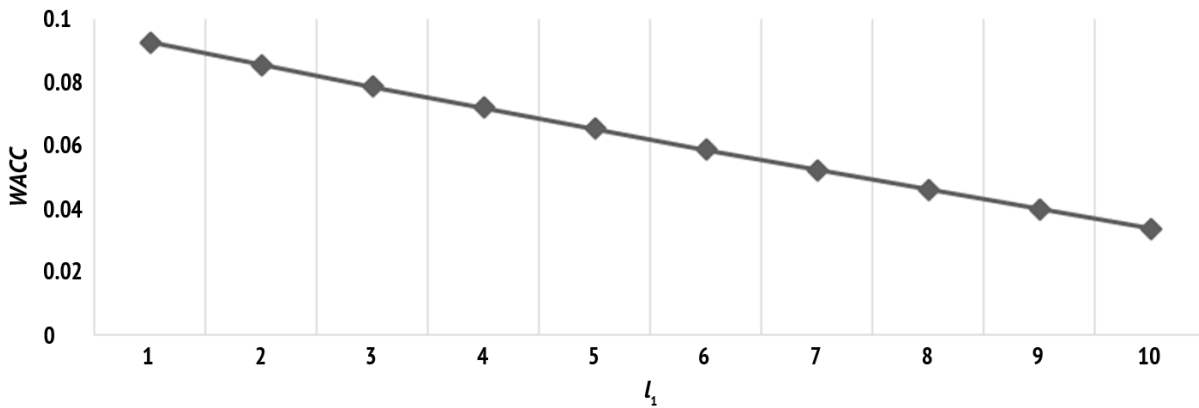
Dependence of a company's weighted average cost of capital (WACC) on the debt-service coverage ratios l_1, l_2, l_3 for a company at age five ($n=5$)



Source: Authoring

Figure 9

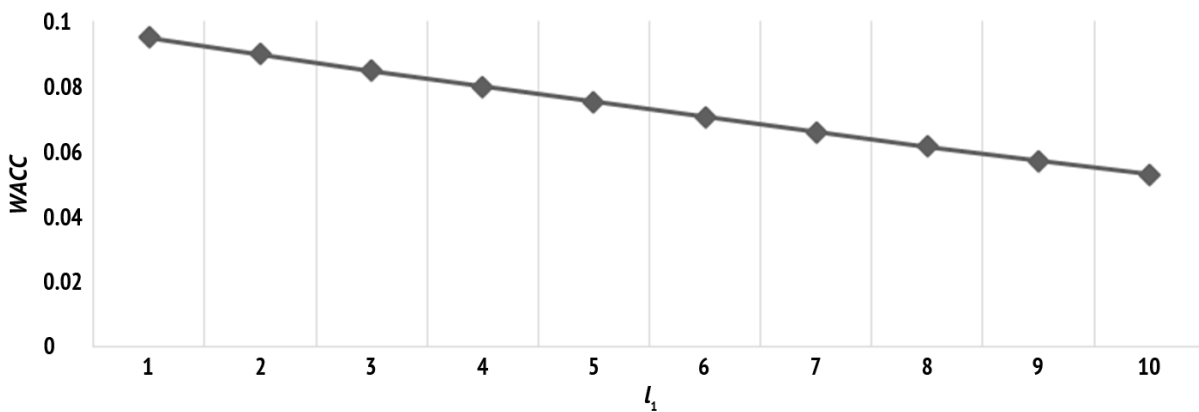
Dependence of a company's weighted average cost of capital (*WACC*) on the leverage ratio of debt l_1 for a company at age three ($n=3$)



Source: Authoring

Figure 10

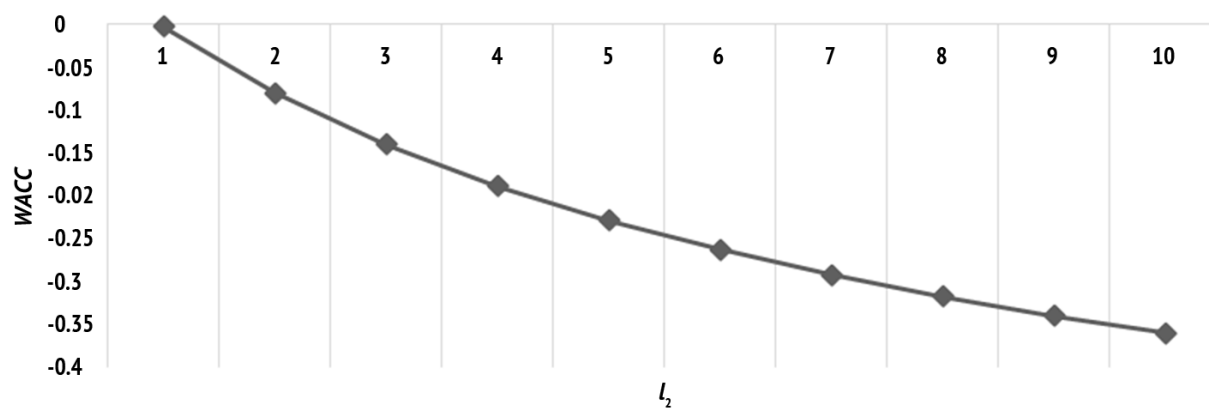
Dependence of a company's weighted average cost of capital (*WACC*) on the leverage ratio of debt l_1 for a company at age five ($n=5$)



Source: Authoring

Figure 11

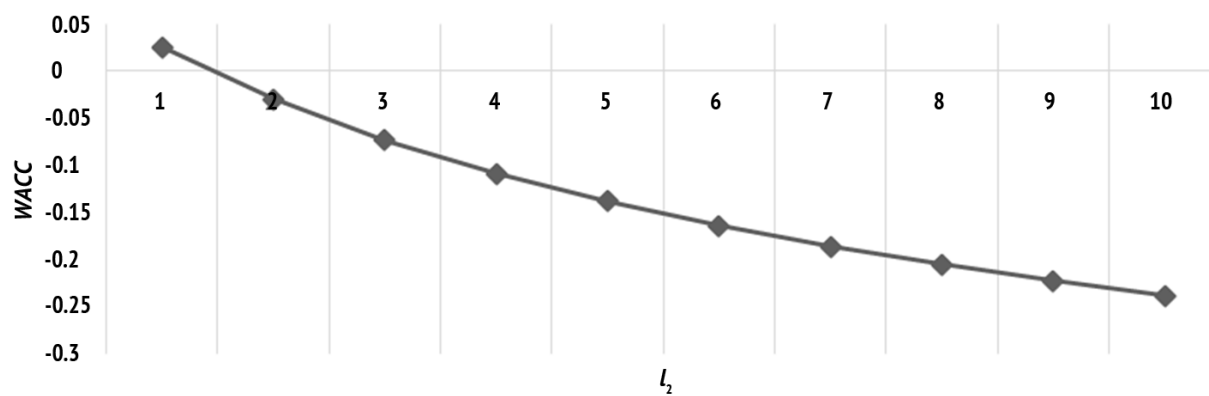
Dependence of a company's weighted average cost of capital (*WACC*) on the leverage ratio of loan interests l_2 for a company at age three ($n=3$)



Source: Authoring

Figure 12

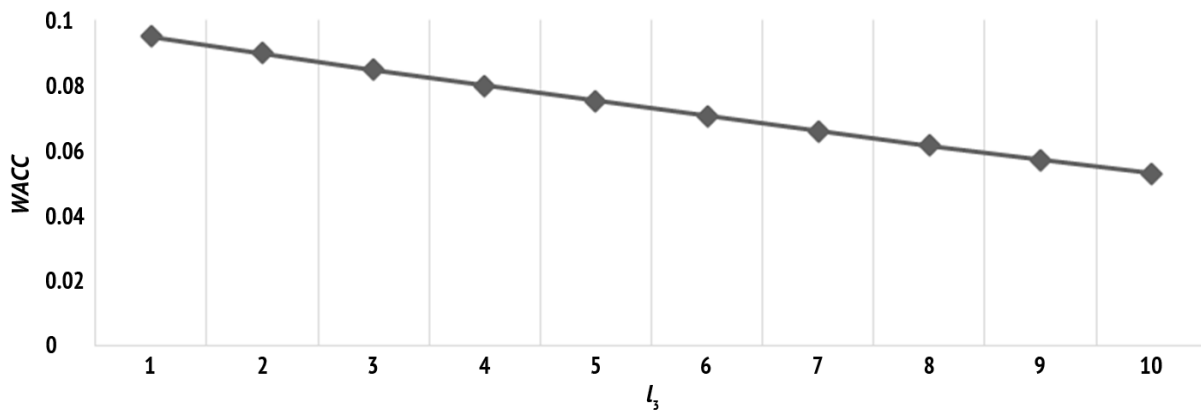
Dependence of a company's weighted average cost of capital (*WACC*) on the leverage ratio of loan interests l_2 for a company at age five ($n=5$)



Source: Authoring

Figure 13

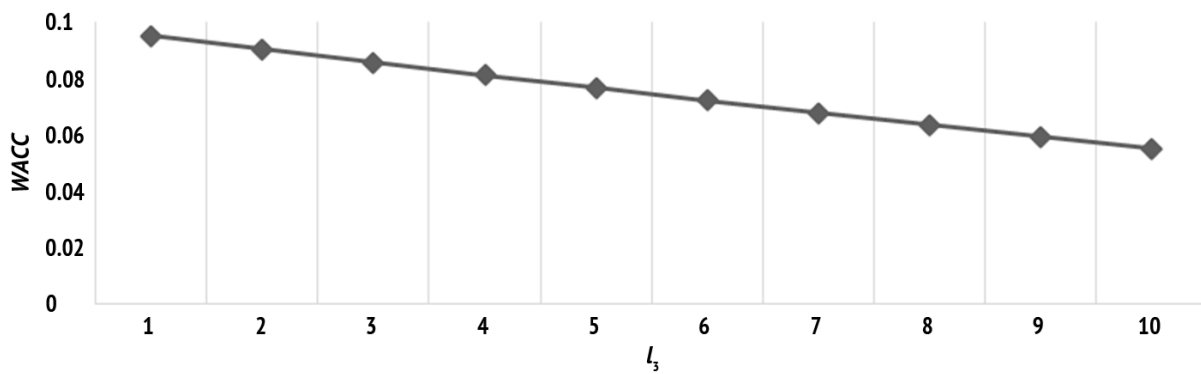
Dependence of a company's weighted average cost of capital (*WACC*) on the leverage ratio of debt and interest l_3 for a company at age three ($n=3$)



Source: Authoring

Figure 14

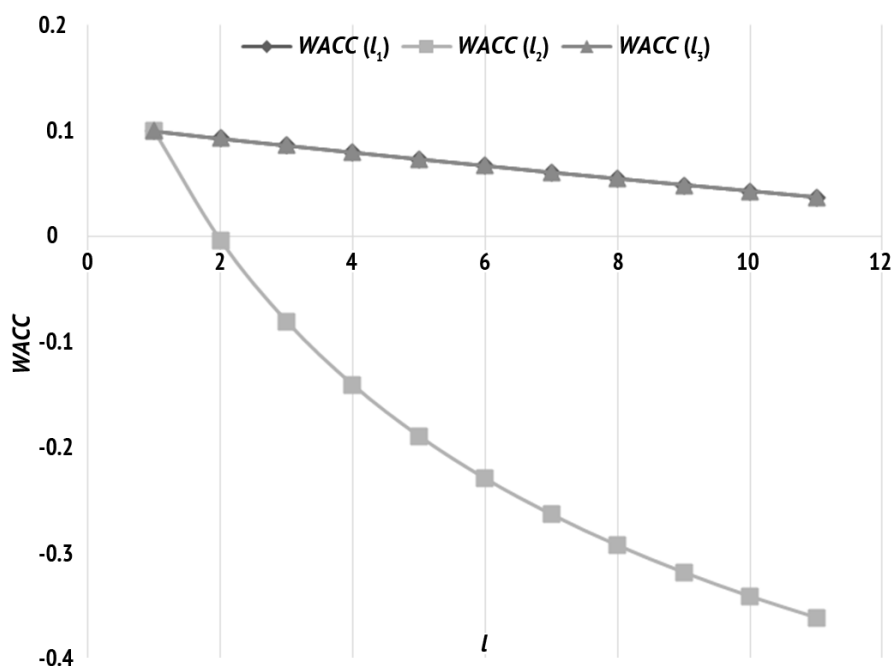
Dependence of a company's weighted average cost of capital (*WACC*) on the leverage ratio of debt and interest l_3 for a company at age five ($n=5$)



Source: Authoring

Figure 15

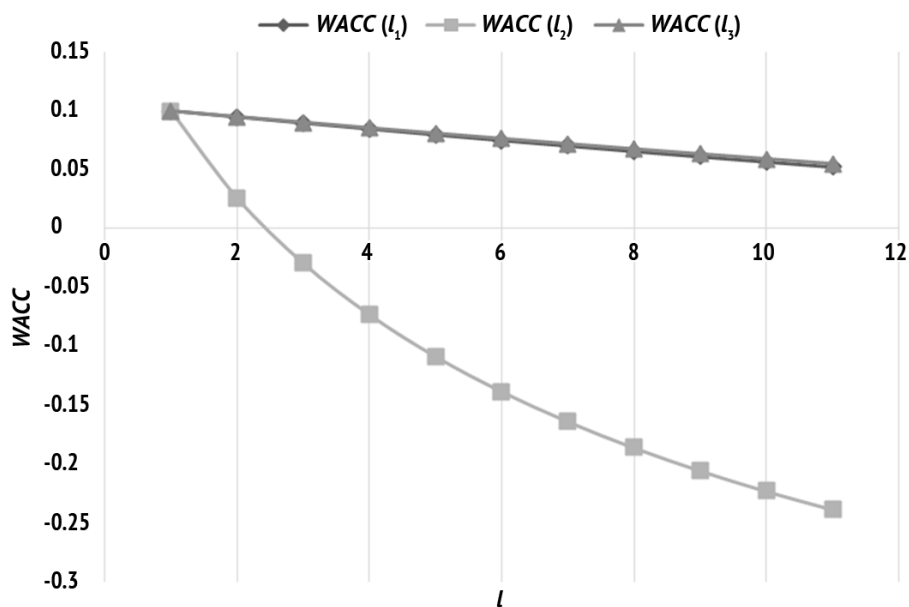
Consolidated graphs of dependencies of a company's weighted average cost of capital (*WACC*) on the leverage ratios l_1, l_2, l_3 for a company at age three ($n=3$)



Source: Authoring

Figure 16

Consolidated graphs of dependencies of a company's weighted average cost of capital (*WACC*) on the leverage ratios l_1, l_2, l_3 for a company at age five ($n=5$)



Source: Authoring

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