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The use of mathematical calculations to determine the feasibility of borrowing in the planning period

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Abstract. The article presents mathematical calculations, conclusions and results obtained on the effectiveness of attracting borrowed resources into the economic activities of a commercial organization. In the presented calculations, the statistical method was used - Student's criterion for assessing the upper limit of the allowable amount of debt. The calculations were carried out as exemplified by a small enterprise LLC "Elektrika" (conditional name), Krasnoyarsk, Russia. As a result of the experiments, the values of the level of allowable debt load for the enterprise were calculated. The resulting totals unequivocally indicate that the level of the debt burden of a commercial organization is high and the attraction of additional resources in the planning period is impractical.

1. Introduction

Effective financial and production activities of any commercial enterprise and organization are almost impossible without borrowing capital. Borrowing funds allow one to significantly expand the volume of business activities of a commercial organization, which improves the efficiency of the use of the total capital of the company, and ultimately has a positive impact on the market capitalization of the company.

According to the current legislation, borrowed capital in the Russian Federation most often consists of the following elements:

- Long-term loans and borrowings.
- Short-term loans and borrowings.
- Bond loans.
- Various forms of leasing.
- Short-term liabilities.

2. Purpose of the study

Basically, debt capital is attracted on terms of payment and repayment. Due to this, attracting borrowed resources carries considerable risks. The main risks include:

- Loss of independence of a commercial organization.
- Decrease in financial performance due to inefficient use of borrowed resources.



The relevance of the presented work is to use a variety of methods of financial and economic analysis to build a consolidated model to assess the appropriateness of using borrowed resources in the current activities of a commercial organization. After the calculations, the managerial staff of the enterprise must receive reliable comprehensive information for calculating the effectiveness of attracting additional borrowed funds (taking into account its current parameters) for the enterprise.

3. Materials and research methods

The research methods using which it is proposed to evaluate the effectiveness, from the authors' point of view, are the following:

- Operating profit method.
- Finding the amount of borrowed capital through the effect of financial leverage.
- Determination in the amount of borrowed capital through minimizing the total cost of capital.

4. Results and discussion

The exact formula, using which we can determine the optimal capital structure, does not exist. The approach to each organization should be individual and take into account both the industry specifics of the business and the stage of development of the organization [1-3]. Studying the issue of the effectiveness of attracting borrowed resources in financial and economic activities in the economic literature [4–7], the authors of the study propose to present the process of obtaining the necessary assessment in the form of the model algorithm shown in figure 1.

When implementing the model proposed by the authors, it will be possible to evaluate the effectiveness of borrowing, as it seems possible to isolate the object of analysis and to reliably compare them with the costs.

Analyzing the available results of financial research on this topic [8-10], the authors note their following feature – the analysis is carried out according to the annual reporting. For this period, companies can receive mixed results in financial activities. As a result, in order to get a real picture, the presented paper proposes to process the data and present it in the context of each quarter for one calendar year. Such a formulation of the question will help to give an adequate assessment of the effectiveness of the decision on the need to attract borrowed funds. From the authors' point of view, such an assessment is primarily necessary for small and medium enterprises.

The following indicators can be attributed to the information base for assessing the effectiveness of borrowing to finance the current activities of an enterprise:

- The amount of borrowed funds taken by the organization in the form of long-term and short-term loans and credits.
- Parameters of loans received (interest rates and terms).
- Quarterly revenue from the sale of goods.
- Net profit of the organization (in the context of each quarter).
- Estimated figures based on financial information.

The object of study in the work is LLC "Elektrika" (conditional name). This commercial organization conducts its business activities in the territory of the city of Krasnoyarsk and the Krasnoyarsk region. The information base of the results of the financial and economic activities of the enterprise in 2018 for the assessment is presented in table 1.

Based on the opinion of Russian scientists and practitioners, the optimal value of the effect of financial leverage takes a value in the range from 0.33 to 0.5 [11, 12].

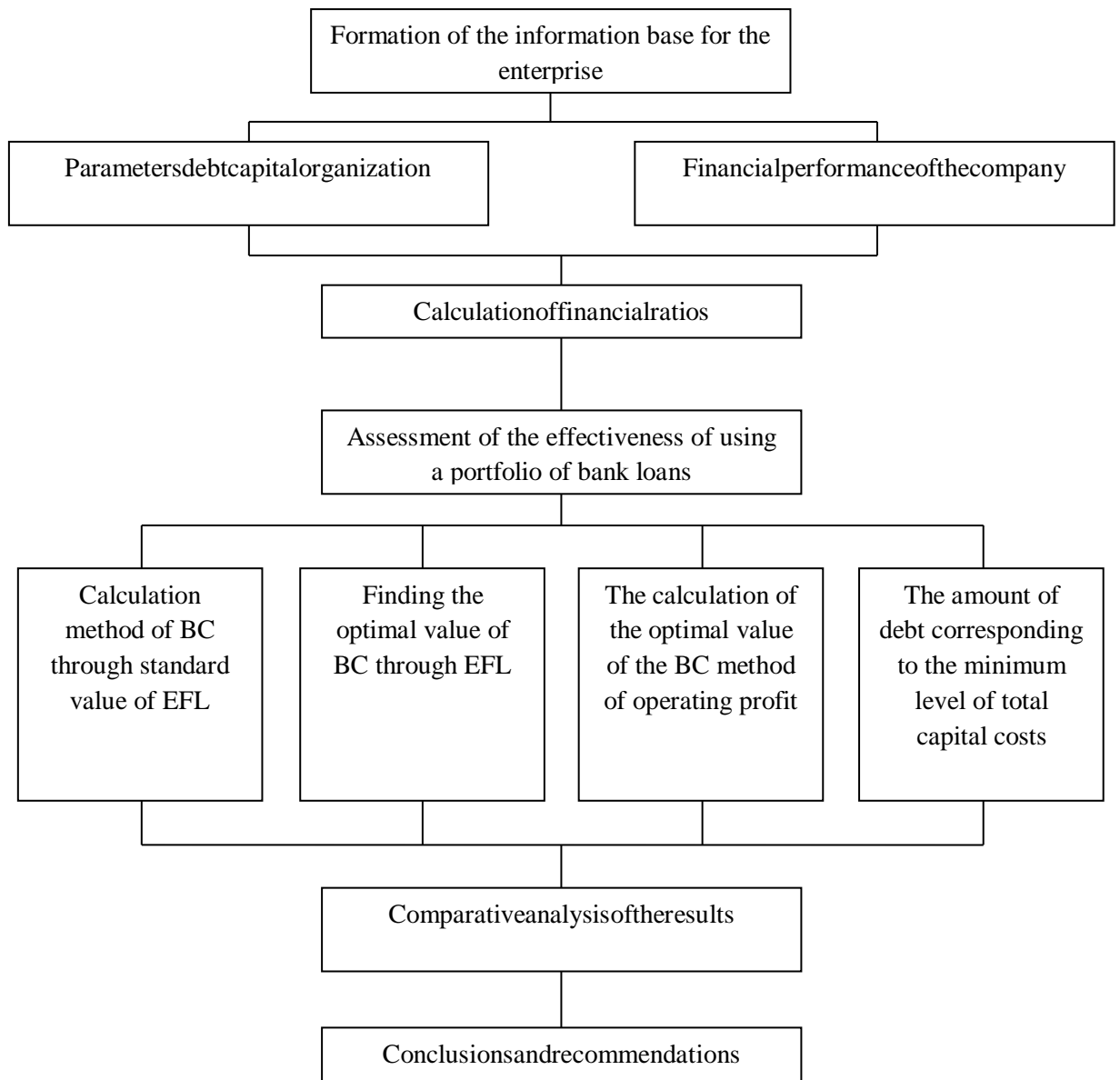


Figure 1. Model for assessing the effectiveness of borrowing.

If we take the normative value of the effect of financial leverage as the boundary values of the range, and the amount of borrowed capital as an unknown amount, then the formula allows calculating the size of the allowable debt in 2018. The obtained calculation results are presented in table 2.

$$EFL = (1 - IT) * (Ra - \%) * \left(\frac{BC}{EQ}\right), \quad (1)$$

where: EFL – the effect of financial leverage; IT – the income tax; Ra – return on assets; % – interest rate on received credit resources; BC – borrowed capital; EQ – equity.

Table 1. Data on the activities of LLC "Elektrika" in 2018 (rubles).

	1st quarter	2nd quarter	3rd quarter	4th quarter
The total amount of loans and credits, taking into account % (rubles)	19406748.5	17578586.1	18890802.7	26135939.9
Revenue from sales (rubles)	14288000	21820300	24667700	21857700
Net profit (rubles)	-2453000	686200	2315500	2601100
Return one quity, %	1.75	-0.96	1.45	0.62
Return on assets, %	-5	1	4	5
Profit before interest and taxes (EBIT), rubles	72437	1625754	2162704	2538942
Debt and interest payable (DP), rubles.	1877740	1877740	3682804	1760021
Interest rate on received credit resources (estimated value), %	11.32	11.43	9.36	9.13

Table 2. The results of calculating the optimal amount of borrowed capital in 2018 according to the standard value.

No.	Name of indicator	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter
1	Borrowed capital, rubles	18872600	17090200	18458800	25552800
2	The effect of financial leverage	2.36	3.01	-1.21	-0.65
3	The standard value of the effect of financial leverage (option 1)			0.33	
4	Estimated amount of borrowed capital, rubles (option 1)	2162126	3300826	-14125293	-30060337
5	The standard value of the effect of financial leverage (option 2)			0.5	
6	Estimated amount of borrowed capital, rubles (option 2)	-14990142	-23455204	-45632502	-59261883

Using the following approach, we find the optimal amount of borrowed capital through the extremes of the financial leverage effect function, where we take the value of borrowed capital as an unknown variable. In this case, it is necessary to paint Ra, through the ratio, where the amount of borrowed capital appears. The results obtained, in the form of a comparison with the actual amount of borrowed capital, are presented in table 3.

Table 3. The results of determining the optimal amount of borrowed capital (rubles).

Name of indicator	1 st quarter 2018	2 nd quarter 2018	3 rd quarter 2018	4 th quarter 2018
Actual loan capital	18872600	17090200	18458800	25552800
Optimal loan capital	274559	-276095	-4673172	-519443

As can be seen from the indicators presented in the table, the amount of available borrowed capital significantly exceeds its calculated optimal value.

A quantitative assessment of the optimal capital structure can be determined using the operating profit method, which is aimed at determining the acceptable level of debt in the capital structure.

Bankruptcy in this case can be seen in the form of an expression that describes the inability of the company to make current payments on debts. Formally, the bankruptcy condition is as follows:

$$EBIT < DP, \quad (2)$$

where: DP – debt payment; EBIT – earnings before interest & tax.

Assume operating profit (EBIT) is normally distributed and independent of capital structure. It is determined by factors external to the problem under consideration, arising from the organization's activities: technology, resource efficiency, marketing, market conditions, etc. Then you can build a statistical indicator based on Student's distribution (t) with (n-1) degrees of freedom, which has the following form:

$$\frac{EBIT_{cp} - DP}{\sqrt{\sigma^2}} : t_{n-1}, \quad (3)$$

where: σ – the variance of profit.

Having calculated the value of the statistical indicator from the Student's distribution tables, it is necessary to determine the probability of bankruptcy, and then compare it with the threshold value [13]. In turn, it is possible to calculate the upper limit of the allowable amount of debt if you build a calculation algorithm and start from the threshold value of the probability of bankruptcy. The results are shown in table 4.

Since for a given amount of debt, the probability of bankruptcy (from 75% to 100%) for the analyzed period from the 1st quarter to the 3rd quarter of 2018 is higher than the 70% limit (a threshold value selected for the Student's distribution table with a certain step), then financial leverage should be reduced so that the existing share of borrowed funds in the capital structure is acceptable.

Table 4. The results of determining the acceptable level of debt in the capital structure.

No.	Indicator	1 quarter 2018	2 quarter 2018	3 quarter 2018	4 quarter 2018
1	Profit before interest and taxes (EBIT), rubles	72437	1625754	2162704	2538942
2	Debt and interest payable (DP), rubles	1877740	1877740	3682804	1760021
3	t– Student's criterion	-0.314974	-0.255994	-1.919487	-0.147507
4	Bankruptcy probability, %	100%	100%	75%	100%
5	Bankruptcy threshold level, %			70	
6	The upper limit of the allowable amount of debt, rubles	497761	1581347	1193905	922427

Also, to quantify the capital structure and create a model of its optimal structure, you can use the method of cost of capital. The main idea of the method is to minimize the total cost of capital (WACC). The total cost of capital (formula 4) is calculated as a weighted average:

$$WACC = \frac{D}{D+E} K_d + \frac{E}{D+E} K_e, \quad (4)$$

where: WACC – the weighted average cost of capital; D – debentures; E – sales profit; K_d – loan price; K_e – equity costs.

The minimum cost of capital to solve this problem, the authors decided to accept the equal rate of the Central Bank of the Russian Federation, in table 5, also shows the amount of debt corresponding to the minimized level of total capital costs.

The CBR refinancing rate at the end of the reporting period was adopted as a risk-free rate [14]. All obtained calculation results are grouped in table 6.

Table 5. Weighted average cost of capital and expected profit.

No.	Indicator	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter
1	Cost of equity	0.65	0.29	0.66	0.02
2	The price of borrowed capital (estimated value), %	11.32	11.43	9.36	9.13
3	Weighted average cost of capital, %	-62.66%	17.53	59.15	66.45
4	Risk-free rate*, %	7.25	7.25	7.5	7.75
5	The amount of debt corresponding to the minimum level of total capital costs	-4368353	1189951	9329403	14624626

Table 6. Comparison of the results obtained (rubles).

2018 quarter number	Actual amount of borrowed capital (BC)	Estimated indicators				
		BC value through the standard value of EFL		Optimal BC value through the extremum of the EFL function	The upper limit of the allowable amount of debt	The amount of debt corresponding to the minimum level of total capital costs
		Normative -0.33	Normative 0.5			
1	18872600	2162126	-14990142	274559	497761	-4368353
2	17090200	3300826	-23455204	-276095	1581347	1189951
3	18458800	-14125293	-45632502	-4673172	1193905	9329403
4	25552800	-30060337	-59261883	-519443	922427	14624626

5. Conclusion

As can be seen from table 6, the actual amount of borrowed capital in 2018 exceeds the permissible values calculated by various methods. The negative values obtained indicate that the organization LLC "Elektrika", in the current financial situation, is not recommended to attract a bank loan. To correct this situation in the planning period, it is recommended to pay off all arrears on existing loans and borrowings.

The data obtained according to mathematical calculations allow the company in the planning period to outline ways to reduce and calculate the necessary and sufficient amount of debt.

References

- [1] Pendar M, Tayar H and Karimeh S 2019 The impact of financial flexibility on capital structure decisions: Some empirical evidence *Management Science Letters* **9(1)** 133-8
- [2] Tynchenko V S, Fedorova N V, Kukartsev V V, Boyko A A, Stupina A A and Danilchenko Y V 2019 Methods of developing a competitive strategy of the agricultural enterprise *IOP Conference Series: Earth and Environmental Science* **315(2)** 022105
- [3] Yuniningsih Y, Pertiwi T K and Purwanto E 2019 Fundamental factor of financial management in determining company values *Management Science Letters* **9(2)** 205-16
- [4] Fedorova N V, Kukartsev V V, Tynchenko V S, Nikiforova C E, Sadovskiy I D and Ogol A R 2019 Analysis of the agroindustrial enterprise competitive strategy tools *IOP Conference Series: Earth and Environmental Science* **315(2)** 022104

- [5] del Rocío Vega Zavala M and Salgado R J S 2019 Empirical evidence on the relationship of capital structure and market value among Mexican publicly listed companies *Contaduría y Administración* **64**
- [6] Kukartsev A V, Boyko A A, Kukartsev V V, Tynchenko V S, Bukhtoyarov V V and Tynchenko S V 2019 Methods of business processes competitiveness increasing of the rocket and space industry enterprise *IOP Conference Series: Materials Science and Engineering* **537(4)** 042009
- [7] Fedorova N V, Kukartsev V V, Tynchenko V S, Danilchenko Y V, Ezhemanskaya S N and Sokolovskiy N V 2020 Methodology for the formation of indicators balanced system for marketing activities of an industrial enterprise *IOP Conference Series: Materials Science and Engineering* **734(1)** 012084
- [8] Dakua S 2019 Effect of determinants on financial leverage in Indian steel industry: A study on capital structure *Int. J. of finance and economics* **1(24)** 427-36
- [9] Kalimulin M M, Men'shova N A, Usok I M, Shahmatova E S, Shvecov D O, Shipulina Yu S 2014 Determining the optimal capital structure of Russian companies using the example of JSC "Magnit" and "Lukoil" *Corporate finance* **2(30)** 59-76
- [10] Zadorozhnaya A N 2015 The procedure for using the EBIT volatility method and the EBIT-EPS analysis model in making financial decisions *Financial analytics: problems and solutions* **36** 24-37
- [11] Savitskaya G V 2017 *Analysis of the Economic Activity of the Enterprise* p 378
- [12] Financial leverage of an enterprise, formula and calculation on the example of JSC RusHydro *Financial analysis*, Available at: <http://finzz.ru/finansovyj-rychag-predpriyatiya-formula.html/>
- [13] Ivashkovskaya I and Kupriyainov A 2005 Capital structure - a strategic parameter of a company *Company management* **2(45)** 34-8
- [14] Refinancing rate (discount rate) of the Bank of Russia *GUARANTOR.ROO*, Available at: https://www.garant.ru/doc/busref/spr_refinans/