

# Analysis of Methods for Calculating the Weighted Average Cost of Capital of a Company on the Example of an Industrial Enterprise

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**Abstract.** The weighted average cost of capital (WACC) is used to estimate the profitability of the company's capital, the rate of return of the investment project and business. Within the framework of the article, an analysis of the methods for calculating the weighted average cost of capital of a company was presented. It was found that the existing methods are not suitable for all Russian companies. In this regard, it was proposed to use two versions of the capital asset pricing model (CAPM): with the calculation of the beta coefficient by comparing the dynamics of ROE and the RTS index, as well as the dynamics of ROE and prices for raw materials or produced products. Models were evaluated on the example of PJSC Koks, which is one of the largest producers and exporters of metallurgical coke in Russia. During the analysis, it was concluded that it is advisable to use both WACC calculation models.

## 1. Introduction

One of the priority spheres of the organization's functional management is the capital management policy, which allows making decisions on the formation and allocation of capital. The most important aspect of the effective formation of the organization's capital is the estimation of its cost. Capital, like any other factor of production, has a price. At the same time the cost of capital is understood as the price that an enterprise pays for financial resources attracted on the capital market, both its own and borrowed. As a rule, the price of equity is always higher than borrowed capital, that is explained by a higher level of risk when using borrowed funds. Due to the fact that any organization is financed from several sources that differ fundamentally in cost, an average indicator is introduced as an integral estimation of the cost of capital – the weighted average cost of capital (WACC) [1].

In investment analysis WACC is used as the discount rate in calculating the performance indicators of an investment project. In strategic management WACC allows to estimate the dynamics of an organization's value by comparing it with return on assets (ROA). If WACC is less than ROA, then the company's added value is growing. In estimating M&A WACC of the company after the merger are compared with the sum of the WACC of all companies before the merger [2].

In this study, WACC is considered as the minimum rate of return, which is that part of the profit that the organization must pay for the use of generated or attracted capital [1]. If the profitability of operating activities does not cover the cost of attracting capital, this will lead to its consumption and bankruptcy of the organization.

Many authors, both foreign and Russian, drew attention to the problem of calculating the weighted average cost of capital. Among foreign authors, it can distinguish Aswath Damodaran, T. J. Gallagher, R. A. Brealey, S. C. Myers, J. Van Horn and others. The Russian authors involved in the problem of calculating the WACC indicator include: M. A. Limitovsky, E. N. Lobanova, I. Ya. Lukasevich, A. K. Solodov, T. V. Teplova and others.

In modern practice, many models for estimating the cost of capital are used, however, difficulties arise in their application. Firstly, the presence of a large number of methods for calculating WACC leads to the fact that the results can vary significantly. Secondly, many models are not suitable for unprofitable companies or those in the process of bankruptcy, however, during this period, companies need to collect the most complete information to get out of this situation. Thirdly, an expert approach is often used, that gives a subjective result [2].

The problems discussed above lead to the fact that it is impossible for many Russian companies to select the appropriate method. They are forced to refuse to calculate WACC or use insufficiently accurate methods. During the study, the purpose was set to analyze various WACC calculation methods and offer the most optimal method for an industrial enterprise.

## 2. Results and discussion

Economic models that are used to estimate the weighted average cost of capital have the main difference in the methods of calculating the cost of equity (table 1) [2, 3].

**Table 1.** Models for estimating the cost of equity of a company.

Model	Ways of application
CAPM (capital asset pricing model) and its modifications: Blume method, DCAPM (Estrada), Bottom up method, Hybrid CAPM	It applies to companies placing ordinary shares in the stock market
Gordon's model (dividend discount model)	It applies to companies making dividend payments on ordinary shares
Return on equity model	It applies to companies that don't have stock issues
Risk premium model	It applies to startups and venture businesses

Determining the cost of equity is the most difficult step in calculating WACC, because existing methods are not applicable to most Russian companies. The most common model is the capital asset pricing model (CAPM), but its use is limited to companies whose shares are listed on the stock exchange, because the beta coefficient in this model is calculated by comparing the dynamics of the securities market with stock returns. In addition, CAPM uses a single factor to estimate future stock returns – market risk, not taking into account the size of the company and its industry, the impact of taxes and transaction costs. At the same time, forecasting the level of risk is carried out only on the basis of a retrospective analysis, which makes the forecast inaccurate [3]. An alternative to CAPM is the Gordon's model, the key factor of which is the size of dividend payments. The model hasn't found wide application, because few Russian companies pay dividends, or payments are uneven. Another model is based on return on equity and can be used by most companies if they get a positive financial result. In addition, in Russian practice, a risk premium model is used, but its use is limited to startups and venture companies [2].

The cost of borrowed capital is determined by the ratio of expenses on the formation of borrowed sources (loan interest, interest on bonds, etc.) to its total amount. At the same time, both a generalized and a differentiated approach can be applied, taking into account each component of borrowed capital [1].

The functioning industrial enterprise PJSC Koks was selected to estimate the practical applicability of the above-mentioned methods. PJSC Koks issues shares because it is a joint-stock company, but doesn't place them on the stock exchange [4]. Due to this fact, the cost of equity of this enterprise can't be estimated using CAPM. From 2016 to 2018, the company didn't pay dividends to shareholders, so the Gordon's model also cannot be used for estimation. The return on equity model could be used for PJSC Koks, because it has open financial reporting and its shares aren't traded on the stock market. However, in 2018, the company received a loss, therefore this model cannot be applied [5].

Thus, none of the available models for estimating the cost of equity can be applied to this enterprise. Based on the above-mentioned factors, it was proposed to use the CAPM variation, in which the beta coefficient is calculated by comparing the dynamics of the securities market (RTS index) with return on equity [6]. The cost of equity in this model is found by the formula (1):

$$R_i = R_f + \beta * (R_m - R_f) \tag{1}$$

The risk-free rate was determined as the RUGBITR10Y indicator adjusted for the sovereign default spread; its average annual value for 2018 was 7.91% [7]. The beta coefficient value was found using the "Regression" analysis tool in MS Excel and amounted to 1.19 (figure 1) [5, 8, 9].

CONCLUSION							
<i>Regression statistics</i>							
Multiple R		0,070676995					
R-square		0,004995238					
Normalized R-square		-0,160838889					
Standard error		3,334447456					
Observation		8					
<i>Dispersion analysis</i>							
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Value F</i>		
Regression	1	0,334911453	0,334911453	0,030121892	0,867921284		
Balance	6	66,711239	11,11853983				
Total	7	67,04615045					
	<i>Factors</i>	<i>Standard error</i>	<i>t-stats</i>	<i>P-Value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95%</i>
Y-crossing	-0,740552227	1,184182746	-0,625369885	0,554752803	-3,638143023	2,157038569	-3,638143023
Variable X 1	1,189532839	6,853861343	0,173556595	0,867921284	-15,58126171	17,96032738	-15,58126171

**Figure 1.** The results of calculating the beta coefficient by comparing the dynamics of ROE and the RTS index on the example of PJSC Koks.

The rate of market profitability was determined as the average ROE for the entire foreseeable period of existence of the company. This indicator for PJSC Koks is lower than the weighted average cost of borrowed funds, therefore it is more rational to use the average interest on bank loans of the company – 9 %. Based on the reporting data of PJSC Koks, the weighted average cost of capital was calculated in 2018 (table 2) [5].

**Table 2.** Calculation of the weighted average cost of capital of PJSC Koks in 2018 (using the beta coefficient for ROE and the RTS index).

Indicator	Share (%)	Cost (%)
Equity	20.01	9.21
Borrowed capital	79.99	7.61
Total	100	-
<b>WACC</b>	-	<b>7.93</b>

PJSC Koks is an industrial enterprise, which largely depends on the situation in the market for ferrous metals, therefore its value, and hence the cost of equity, is determined by the dynamics of coke prices, taking into account changes in prices of both coking coal and cast iron [5]. In this regard, to determine the beta coefficient, it is more rational to compare the dynamics of return on equity with the dynamics of prices for metallurgical domain coke [6]. With this calculation method, the beta coefficient was 1.49 (figure 2) [5, 9, 10].

CONCLUSION							
<i>Regression statistics</i>							
Multiple R	0,148189579						
R-square	0,021960151						
Normalized R-square	-0,14104649						
Standard error	3,305898941						
Observation	8						
<i>Dispersion analysis</i>							
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Value F</i>		
Regression	1	1,472343608	1,472343608	0,134719365	0,726185572		
Balance	6	65,57380685	10,92896781				
Total	7	67,04615045					
	<i>Factors</i>	<i>Standard error</i>	<i>t-stats</i>	<i>P-Value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95%</i>
Y-crossing	-0,723162286	1,173097573	-0,616455359	0,560240153	-3,593628641	2,147304069	-3,593628641
Variable X 1	1,493499999	4,069023633	0,367041367	0,726185572	-8,463042153	11,45004215	-8,463042153

**Figure 2.** The results of calculating the beta coefficient by comparing the dynamics of ROE and coke prices on the example of PJSC Koks.

The WACC calculation results are presented in the table (table 3).

**Table 2.** Calculation of the weighted average cost of capital of PJSC Koks in 2018 (using the beta coefficient for ROE and coke prices).

Indicator	Share (%)	Cost (%)
Equity	20.01	9.53
Borrowed capital	79.99	7.61
Total	100	-
<b>WACC</b>	-	<b>7.99</b>

Thus, both models show approximately the same result, which is associated with the use of annual average values for calculating the beta coefficient. If the frequency of observations increases (by using monthly or weekly data), then the accuracy of the models will increase and the difference in WACC value will be more significant. At the same time, a model with calculation of beta coefficient by ROE and coke prices is more suitable for PJSC Koks, due to a higher value of correlation and determination coefficients than in the calculation method for ROE and the RTS index. This fact indicates that the change of ROE is more affected by the dynamics of coke prices than the dynamics of the RTS index. It should be noted that in both models the beta coefficient exceeds one, that indicates a strong relationship of indicators and, accordingly, a high level of risk. However, the correlation and determination coefficients are less than one, that doesn't allow the use of models for accurate forecasting. Therefore, both models can be applied in practice, however, for enterprises that are significantly dependent on market changes, such as PJSC Koks, a model with a calculation of the beta coefficient for ROE and prices for raw materials and products is more suitable. For other companies

whose shares aren't quoted on the stock exchange, it is advisable to use a model with the calculation of the beta coefficient for ROE and the RTS index.

### 3. Conclusion

The analysis of WACC calculation methods revealed the need for a model that can be applied in companies that don't place shares on the stock exchange or have a loss in the reporting period. For such companies, it was proposed to change the method of calculating the beta coefficient in two ways: by comparing the dynamics of ROE and the RTS index, or the dynamics of ROE and prices for raw materials (or produced products). Such enterprises include PJSC Koks, which at the end of 2018 received a negative financial result, that was caused by a decrease in revenue and the influence of exchange differences. Despite the fact that the company received a loss, the calculation of the cost of capital has practical importance, because it allows to estimate the change of the indicator in the crisis and post-crisis period.

The calculation of the indicator based on these methods on the example of the selected enterprise showed that both models can be applied in practice. Nevertheless, it was recommended to use the second model for PJSC Koks, as it takes into account the industry specifics of the enterprise. The price of coke often changes and directly depends on supply and demand in the market, that has a direct impact on the company's activities, therefore, this factor should be taken into account in estimating risks using a beta coefficient. For companies that are independent of market fluctuations, a model with the calculation of the beta coefficient for ROE and the RTS index is more suitable.

Thus, in modern conditions enterprises should calculate the WACC based on the features of attracting capital, industry, organizational legal form, that will rise the accuracy of the estimation and increase the efficiency of capital formation, and subsequently – the effectiveness of its management.

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