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# Determination of the discount rate for the conditions of enterprises of the mineral resources sector: argumentative issues

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***The relevance of this study*** is the need to improve the accuracy of calculations of indicators characterizing the value of companies and the effectiveness of investments in various projects. The discount rate should accurately reflect market trends. The correctly calculated discount rate should play a special role in assessing the market capitalization of enterprises of the mineral resources sector; securities of the largest companies are the most popular among investors.

***The aim of the work*** is a comparative analysis of definitions and methods for calculating the discount rate to identify its basic characteristics that contribute to obtaining an objective value.

***Results of work and their application***. The authors analyzed various definitions of the discount rate and made the following conclusions. The discount rate should be understood as the minimum rate of return which a typical investor can expect while investing his own money in an asset that generates income at the current time (and/or assumes its receipt in the future). At the same time, it is necessary to have alternative (comparable) investment options on the market. Thus, the discount rate is not a return on the asset being valued, but an alternative return. The core statements of the specified definition of the discount rate are as follows: "Minimum rate of return", "alternative investment options", "alternative yield". When taking into account the most significant aspects of this definition, the authors of this paper analyzed the existing methods of its calculation, which are most often used in the framework of the valuation and investment analysis of enterprises of the mineral resources sector. The Capital Assets Assessment Model (CAPM) was highlighted among other models, which most closely matches the specified definition of the discount rate. The model is based, firstly, not on subjectivism when calculating risk premiums, but on statistically confirmed market data; secondly, it takes into account the average market yield, providing for alternative options for capital investment and, accordingly, alternative yield; thirdly, it implies a minimal, reasonable yield barrier for potential investors. In addition, this model applies the coefficient β, which takes into account non-systemic risks of a particular field of activity, allows to consider the peculiarities and specific risks of enterprises of the mineral resources sector.

***Conclusion***. Theory-based definitions of the discount rate (confirmed by statistical data) will allow building viable financial models of companies, which in turn will contribute to increasing the objectivity of investment analysis and valuation.

*Keywords*: discount rate, enterprise of the mineral resources sector, cumulative building model, capital asset pricing model, investment analysis, company valuation.

## Introduction

Currently, the mineral industry plays an extremely important role in the Russian economy. Eight blue-chip companies on the Russian stock market out of fifteen are enterprises of the mineral resources sector. In addition to these eight, there are many other enterprises (the largest ones) that develop mineral deposits. Their activity is associated with a large number of risks, especially if the deposits are located in hard-to-reach places. Hence there is the uncertainty of the value of money flows received from the enterprise's activities and the need to increase the objectivity and accuracy of the calculation of indicators characterizing the efficiency of investments in projects for the development of new mineral deposits and securities of enterprises of the mineral resources sector.

The determination of the discount rate is an integral part of the calculation within the framework of the evaluation of investment projects, as well as the valuation of enterprises of the mineral resources sector. It is necessary to note the correctness of its calculations as an important issue. As we know, any method of calculation should be based on the theoretical basis of the indicator being defined. Otherwise, any calculations will not make economic sense, giving distorted results. This situation also applies to the discount rate that is widely used in financial calculations.

**The aim of the work** is a comparative analysis of definitions and methods for calculating the discount rate to identify its basic characteristics that contribute to obtaining an objective value.

**Results of the work and their application.** Conceivably, there are a number of definitions of the concept of "discount rate". At the same time, it can be stated that many formulations reflect only the mathematical essence of the indicator under consideration, which means that they are only of secondary importance. However, there are definitions of the discount rate that convey its economic content.

For example, I. M. Kamnev and A. Yu. Zhulin gave several formulations at once [1]:

– "the discount rate is the interest rate used to recalculate future money flows into a single present value";

–"the discount rate is a tool that is used to transfer the expected money flows generated by the asset into the present value of this asset";

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–"the discount rate is the rate of return on invested capital required by investors in investment objects of comparable risk level or it is the required rate of return on existing investment alternatives with a comparable risk level at the date of valuation; the discount rate should include the minimum guaranteed level of profitability not dependent on the directions of investments, correction for inflation rates and the degree of risk of a specific investment (the risk of this type of investment, the risk of inadequate investment management, the risk of loss of liquidity of this investment, etc.)". Thus, in the first and second options, the discount rate is considered from the standpoint of mathematical calculations. The third option reflects the economic essence of the concept and includes the important phrase "the required rate of return on the available alternative investment options with a comparable level of risk at the date of valuation". Thus, the authors of this paper do not consider the discount rate as a return on the asset being valued (or a business), but as some kind of alternative yield in the presence of comparable investment options on the market. According to this, it can be assumed that any asset will be useful to an investor if his profitability exceeds certain alternative profitability or at least equals to it. Otherwise, a wise investor will leave the project in favor of alternatives available on the market. The phrase "comparable risk level" used by the authors means a high level of investment requirements for invested capital leading to an overestimation of the calculated values of the discount rate.

Yu. V. Kozyr in his monograph [2] gives the following definitions:

– "the discount rate is a tool that allows you to compare different money flows and bring them to their present value";

– "the discount rate is the cost of raising equity capital, that is, the return on investment in equity capital desired by shareholders, taking into account the possibilities of the market and expectations for its change."

The first version of the definition contains only the mathematical essence of the discount rate. The second version implies the phrase "shareholders' desired return on equity investments" that reflects the economic essence of the concept. However, it causes uncertainty due to the lack of substantiation of the degree (or barrier) of profitability, which is necessary to enter the project for a would-be shareholder. This is important because the desires or motives of different investors (average investor, cautious investor, and risky investor) are different.

Yu. V. Efimova in her article [3] considers the economic content of the discount rate and defines it as the "rate of return on invested capital required by the investor". However, it does not specify which rate of return and which investor is required. Further, there is a phrase "the discount rate should reflect the following economic parameters: minimum guaranteed rate of return, independent of the type of investment, inflation rate and risk (risk ratio)". It can be concluded that the discount rate should include risk-free return, inflation rate, and risk premium. The authors would like to note that the risk-free return, as a rule, is nominal that is, it indirectly includes inflation. Therefore, a separate assessment of inflation seems superfluous.

O. V. Malinovskaya, E. A. Sapko and A. V. Borovkina in their work [4] define the discount rate as "a specific economic standard that reflects the growth rate of the relative value of money when it is received earlier (or later spent)". We consider it is incorrect since it does not imply the presence of an investor, alternatives, income standards and etc. They note that the discount rate is an "exogenously defined key economic standard used in assessing the profitability of a specific investment project" (equating it to the inflation rate).

A number of scientists, for example, A. N. Titov, R. F. Taziev, E. P. Fadeeva in their work [5] consider the discount rate as "the comparison rate, the discount percentage rate, the opportunity cost, or the required rate of return". Their phrase "the discount rate reflects the alternative cost of capital, so it depends on the company's capital investment opportunities" needs to be clarified, since questions arise about the manner in which this dependence manifests itself and what it is about.

The most correct definition of the discount rate from all those reviewed was presented by a well-known expert in the field of valuation activity S. V. Gribovsky, the author of [6]: "The discount rate is the minimum rate of return that an investor expects when investing money in the purchase of a profitable asset." The "minimum rate of return" indicates a barrier of the rate of return, and does not imply excessive demands, and therefore, high calculated values of the discount rate. In addition, profit seems to be more significant for an investor than gross income, therefore the "rate of return" more accurately reflects his intentions compared to the "rate of return". The definition under consideration also implies the existence of alternatives on the market. Similar characteristics of the discount rate are contained in the articles of foreign scientists and experts [7–9].

According to the authors of this paper, the discount rate should be understood as the minimum rate of return which a typical investor can expect while investing his own money in an asset that generates income at the current time (and/or assumes its receipt in the future). At the same time, it is necessary to have alternative (comparable) investment options on the market. Thus, the discount rate is not a return on the asset being valued, but an alternative return (!).

The core statements of the specified definition of the discount rate are as follows:

– "minimum rate of return";

– "alternative investment choice";

– "competing earning power".

When taking into account the most significant aspects of this definition, the authors of this paper analyzed the existing methods of its calculation, which are most often used in the framework of the valuation and investment analysis of enterprises of the mineral resources sector.

I. V. Filimonova, L. V. Eder, A. A. Babikov [10] described in detail the model of the cumulative building of the discount rate expressed in the formula

$$r = r_f + r_{\text{risk}},$$

where $r$ is the discount rate, %; $r_f$ – risk free rate, %; $r_{\text{risk}}$ – cumulative risk premium, %.

When determining the cumulative risk premium, the following factors are taken into account: company size, financial structure, diversification of customers, profitability of the enterprise and the predictability of its income, quality of management, and other risks.

The authors of this paper propose to use the generally accepted boundaries of risk premium ranges used in this model (0–3%, 0–4%, 0–5%) and directly calculate risk premiums for oil and gas companies by ranking based on financial information for a number of companies in the sector. In this case, in their opinion, the largest companies should accrue the smallest values and vice versa. If we consider this model from the point of view of the theory, then, in this case, the types of risks do not take into account either alternative returns, or alternative investments, or the minimum rate of return. Calculations are carried out on the basis of the data of the estimated company, i.e. the discount rate is close to (or equal to) the return on equity, which contradicts its very definition. So, the analysis of the compliance of the presented model of the cumulative building of the discount rate to its previously selected key characteristics showed that it does not correspond to any of them: the minimum rate of return, alternative investment options, alternative yield are not available.

V. I. Nazarov in his work [11] also considers the model of the cumulative building of the discount rate. He proposes to add to the base rate, which reflects "the usual industry-accepted rate of return on invested capital" (10%), the "risk rate of capital characteristic of mining industries." Geographical, economic and geological risks are considered as additional risks when charging premiums for which the following factors should be taken into account:

– infrastructure of the location of the mineral deposit (geographical and economic risk);

– categories of reserves (geological risk).

The range of premiums for risks offered by the author based on expert estimation. Thus, the geographic and economic risk premium is recommended from 0 to 8%, the geological risk premium is from 0 to 7%. Once again, the model under consideration does not correspond to the selected key aspects of determining the discount rate. In addition, risk premiums, based only on expert estimation, make the discount rate too high and hardly grounded (up to 25%).

O. V. Eremenko in the work [12] specifies the main factors affecting the range of discount rates, including: the level of dependence on suppliers and consumers; the level of innovation risk; capital structure; market returns; calculation method; financial state; type and form of innovative technology; scope and duration of the project; the degree of depreciation of fixed assets; type of cash flow, the purpose of innovation. It is clear from the list of factors that the range of the discount rate depends on various indicators (financial, production, technology) of a particular enterprise or investment project for which it is calculated. Similar to previous models, it is not supposed to take into account alternative returns. In addition, it indicates such a subjective factor as the method of calculation. We can conclude that it is possible to calculate completely different discount rates for the same situation by changing the calculation method (thus managing investment calculations).

Ukal Sari [13], S. A. Fokina [14] describe in their works the most well-known models for determining the discount rate: the cumulative building model and the capital asset pricing model (CAPM). O. V. Eremenko in the mentioned article characterizes many other models, including:

– modified capital asset pricing model (MCARM);

– model by E. Fama and K. French;

– M. Carhart four-factor model;

– Gordon growth model;

– models for calculation of a rate based on return on assets, net profitability of equity;

– market multiplier model;

– expert estimation model;

–methodology of the Government of the Russian Federation No. 1470, etc.

At the same time, the range of risk premiums calculated in different ways ranges from 1.8 to 61%. It can be assumed that the overwhelming number of investment projects will fall into the number of ineffective ones with such overvalued discount rates (50% or more).

For projects of development of hydrocarbon deposits, the author of the article [12] justifies the model of cumulative building (as the most acceptable way to calculate the discount rate) taking into account the following types of risks: financial and economic, technological and geological ones. Unfortunately, in terms of geological risks, the range of changes in premiums (3.75–7.54%) is not supported by any calculated evidence-based materials. It should be noted that, in general, the presented risk-based model does not meet the previously highlighted criteria of the definition of the discount rate: the minimum rate of return, alternative investment options, alternative yield.

The works [15, 16] reveal the problems of risk analysis in the oil and gas sector of the mineral resources sector with regard to exceeding the terms of investment projects and their appreciation under the influence of various factors. The main attention is paid to the methods of expert risk estimation; the topic of estimating the discount rate is not affected. It can be assumed that the influence of risks on an investment project, in the opinion of the authors of the works, consists of the forecasting of its future cash flows. The authors encompass a risk-based problem when evaluating investments in the oil and gas sector of the Russian economy.

The following conclusions can be drawn from the analysis of the above scientific works:

– when calculating the discount rate for investment projects and business valuation within the mineral sector, the model of cumulative building is mainly considered;

– the cumulative building model takes into account the risks of a particular project or business and is slightly linked to such basic characteristics of the discount rate as the minimum rate of return, alternative investment options, alternative yield;

– risk estimation of an investment project can be carried out through the calculation of the discount rate (the accrual of the corresponding risk premiums), as well as by direct accounting for forecasting of cash flows.

According to the authors of this paper, the most appropriate way of calculating the discount rate is the Capital Asset Pricing Model (CARM) developed by W. Sharp:

$$i = R_f + \beta\,(R_m - R_f),$$

where $R_f$ is the risk-free rate of return; β is the degree of market risk reflecting the sensitivity of changes in the value of assets

depending on market profitability; $(R_m - R_f)$ is the premium for the risk of investing in stocks, equal to the difference in the rates of market return and risk-free rate.

The presented model most closely matches the previously defined definition of the discount rate, since it is based, firstly, not on subjectivism when calculating risk premiums, but on statistically confirmed market data; secondly, it takes into account the average market yield, providing for alternative options for capital investment and, accordingly, alternative yield; thirdly, it implies a minimal, reasonable yield barrier for potential investors. In addition, this model applies the coefficient β, which takes into account non-systemic risks of a particular field of activity, allows to consider the peculiarities and specific risks of enterprises of the mineral resources sector. Additional risks of non-receipt of income should be considered directly while forecasting of cash flows.

## Conclusion

Thus, the determination of the discount rate is an important stage of work carried out when building models of cash flow in the framework of the valuation of enterprises of the mineral resources sector and analysis of the effectiveness of investments in the development of mineral deposits. The discount rate should be understood as the minimum rate of return which a typical investor can expect while investing his own money in an asset that generates income at the current time (and/or assumes its receipt in the future). At the same time, it is necessary to have alternative (comparable) investment options on the market. The most appropriate way to calculate the discount rate is the capital asset pricing model, which involves gathering objective market data. Theory-based definitions of the discount rate (confirmed by statistical data) will allow building viable financial models of companies, which in turn will contribute to increasing the objectivity of investment analysis and valuation.

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# Определение ставки дисконтирования для условий предприятий минерально-сырьевого комплекса: дискуссионные вопросы

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***Актуальность данного исследования*** заключается в необходимости повышения точности расчетов показателей, характеризующих стоимость компаний и эффективность инвестиционных вложений в различные проекты. Ставка дисконтирования должна точно отражать рыночные тенденции. Особую роль корректно рассчитанная ставка дисконтирования должна играть при оценке рыночной капитализации предприятий минерально-сырьевого комплекса, ценные бумаги крупнейших из которых являются наиболее востребованными среди инвесторов.
***Целью работы*** является сравнительный анализ определений и способов расчета ставки дисконтирования для выявления ее базовых характеристик, способствующих получению объективной величины.
***Результаты работы и их применение***. Авторами статьи проанализированы различные определения ставки дисконтирования и сделаны следующие выводы. Ставку дисконтирования следует понимать как минимальную норму прибыли, на которую рассчитывает средний инвестор с типичной мотивацией на рынке, инвестируя собственный капитал в покупку актива, приносящего доход в текущее время и/или предполагающего его получение в будущем. При этом необходимо наличие на рынке альтернативных (сопоставимых) вариантов инвестиций. Таким образом, ставка дисконтирования представляет собой не доходность оцениваемого актива, а альтернативную доходность. Ключевыми фразами уточненного определения ставки дисконтирования являются следующие: «минимальная норма прибыли», «альтернативные варианты инвестиций», «альтернативная доходность». При учете наиболее существенных аспектов указанной формулировки авторами статьи был проведен анализ существующих способов ее расчета, наиболее часто используемых в рамках стоимостной оценки и инвестиционного анализа предприятий минерально-сырьевого комплекса. Среди многих других была выделена модель оценки капитальных активов (CAPM), которая наиболее точно соответствует уточненному определению ставки дисконтирования. Модель основывается, во-первых, не на субъективизме при начислении премий за риск, а на статистически подтвержденных рыночных данных; во-вторых, учитывает среднерыночную доходность, предусматривая альтернативные варианты вложения капитала и, соответственно, альтернативную доходность; в-третьих, предполагает минимальный, обоснованный барьер доходности для потенциальных инвесторов. Кроме того, данная модель путем применения коэффициента $\beta$, учитывающего несистемные риски той или иной сферы деятельности, позволяет учесть особенности и специфические риски предприятий минерально-сырьевого комплекса.
***Заключение***. Подтвержденные статистическими данными, теоретически обоснованные значения ставки дисконтирования позволят строить реалистичные финансовые модели компаний, что в свою очередь будет способствовать повышению объективности инвестиционного анализа и стоимостной оценки.

*Ключевые слова*: ставка дисконтирования, предприятие минерально-сырьевого комплекса, модель кумулятивного построения, модель оценки капитальных активов, инвестиционный анализ, оценка стоимости компании.

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