Assessment of the required profitability of metallurgical companies based on a subject-oriented approach

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Abstract. In this paper a developed subject-oriented approach to determining the required return is presented. A subjective risk measure is proposed that takes into account the peculiarities of risk perception by the investor and its awareness. Based on the concept of matching risk and profitability, an equation was developed that reflects the relationship between the subjective measure of risk and the level of profitability. All this allows the determination of the required return to the full individually for each investor to be approached.

1. Introduction
The key to sustainable development of any – including metallurgical – company is the fulfillment of all its obligations and meeting the expectations of investors. This is what gives the company the opportunity to attract financial resources on favorable terms and, thus, implement projects that ensure the growth of volumes and quality of products, optimize resource consumption, compliance with environmental standards, etc. In turn, any projects at the stage of substantiating their feasibility need criteria that can separate effective initiatives from ineffective ones. The required rate of return, showing the minimum acceptable risk-adjusted return on invested capital that meets the expectations of the investor, is one of the most important indicators, without which it is virtually impossible to assess the effectiveness of any project and, accordingly, make an informed management decision.

2. Problem statement
There is no single universal methodology for determining the required return. To calculate this parameter, the following are used: capital asset pricing model (CAPM), incl. with a variety of adjustments; discounted dividend model; data on current or historical dividend return adjusted for estimated growth rate; leverage adjusted for the risk premium; risk-adjusted market returns; multiplier “price/profit” and many other methods. According to studies [1-4], both in the Anglo-Saxon countries (USA, UK, Canada) and in countries of Continental Europe (Germany, France, the Netherlands), the most popular way to determine the required return is the CAPM. Similar conclusions are confirmed on the basis of local studies devoted to studying the situation in individual countries – for example, Australia [5] or the Czech Republic [6].

However, according to the above studies, often the required return is determined precisely on the basis of investor expectations: in France and the Netherlands this method turned out to be the second most popular, while in Germany the determination of the required return based on investor...
expectations was even more common than the CAPM. Thus, the feasibility of determining the required return solely on the basis of certain objective indicators has to be questioned.

It seems, however, that it is necessary to distinguish risk as a kind of objective entity and subjective perception of risk by a person (including an investor). Obviously, due to differences between people, the same amount of risk will be perceived differently, ranging from completely ignoring this risk (risk-neutral investor) to recognizing such a risk level as unacceptable (investor-absolute risk phobia). Differences in risk perception will entail a different assessment of the required return: if in the first case the investor is ready to invest in a risky asset without any additional risk premium, then in the second case, no return will encourage the investor to risk his money.

In view of the above, it is necessary to propose a subject-oriented approach to determining the required return and supplement the basic algorithm for all considered methods: “assessing the objective level of risk – calculating the required return – choosing an asset to invest according to the ratio of objective risk and profitability” with one more link: assessing the subjective level of risk by specific investor.

3. Methodology and research results

As an objective measure of risk, the author proposes the expected amount of losses, determined as follows:

\[ R = \sum_{i=1}^{n} (k_j - k_i) * p_i * c_i \]  

\( k_i \) – return of risk-free asset;
\( k_j \) – the yield of this asset at the i-th outcome;
\( p_i \) – the probability of the i-th outcome;
\( c_i \) – the selection parameter.

The parameter \( c_i \) is necessary to give this measure of risk a one-sided nature and is determined as follows:

\[ c_i = \begin{cases} 0, & k_j - k_i < 0 \\ 1, & k_j - k_i > 0 \end{cases} \]  

In the framework of this work, a hypothesis is put forward about the similar nature of risk perception and perception of physical stimuli (light, sound, weight, etc.). This will allow the subjective measure of risk to be determine using psychophysical laws of perception, long ago derived and experimentally confirmed. It seems appropriate to use the generalizing law of Zabrodin, which is a solution to the following differential equation:

\[ \frac{ds}{s^2} = K \times \frac{dR}{R} \]  

\( R \) – the stimulus intensity (expected loss size);
\( S \) – a sense of risk;
\( K \) – a constant designed to ensure comparability of stimulus intensity and sensations;
\( z \) – a constant characterizing awareness (0 – complete ignorance, 1 – absolute awareness).

The solution of this equation with respect to \( S \) gives the following expression:

\[ \frac{ds}{s^2} = K \times \frac{dR}{R} \]  

\( C \) is a constant that occurs during integration. The solution of this equation with respect to \( S \) gives the following expression:
Since the perception of risk is determined depending on the expected losses, it can be argued that $S$ shows the expected losses on the asset, taking into account the peculiarities of the perception of the initial data by the investor. In other words, a sense of risk is a kind of “depreciation” of a risky asset in the eyes of the investor. Parameter $S$ shows how much this asset is less valuable compared to a risk-free asset that requires similar investments and provides the same return. Accordingly, the perception of risk should range from 0 to 1.

In this regard, it is necessary to identify three types of risk (risk area) depending on the investor’s perception of risk: zero risk ($S = 0$); acceptable risk ($0 < S < 1$); unacceptable risk ($S = 1$).

At first glance, a zero sense of risk is possible only with a zero value of an objective risk measure, i.e. in the absence of risk as such. However, in practice, sensations arise only when a stimulus overcomes a certain threshold. From the point of view of investments, an example of this is the recognition of certain assets (for example, government bonds) as conditionally risk-free, although any investment is obviously associated with risk, albeit small.

Let us denote the threshold value of the expected losses at which the perception of risk still does not arise, like $R_0$. Then the following expression is true:

$$0 = \frac{1}{(1-z)K \ln (C/R_0)}$$

Transforming this expression, we get:

$$c = \frac{1}{R_0},$$

Accordingly, then the following is also true:

$$S = \frac{1}{(1-z)K \ln (R/R_0)}$$

We denote the threshold value of the expected losses at which a sensation of unacceptable risk arises as $R_1$. Then the following expression is true:

$$1 = \frac{1}{(1-z)K \ln (R_1/R_0)}$$

Transforming this expression, we get:

$$(1-z)K = \frac{1}{\ln (R_1/R_0)}$$

Accordingly, then the following is also true:

$$S = \frac{1}{(1-z)K \ln (R/R_0)} = \frac{1}{\ln (R_1/R_0)} = \frac{\log R}{\log R_0}$$

It should be noted that this expression is applicable only for $R_0 < R < R_1$, i.e. in the area of acceptable risk. In the area of zero risk, $S = 0$, and in the area of unacceptable $S = 1$.

The parameter $z$, denoting investor awareness, significantly affects the perception of risk by the investor. The feeling of risk reaches its maximum value with complete ignorance, while with absolute awareness the feeling of risk tends to zero. Thus, an investor who considers himself completely knowledgeable does not feel the risk – no matter how objectively the asset is risky.

Next, it is necessary to establish the nature of the relationship between the subjective sense of risk and the minimum required return.
A subjective measure of risk shows how much of its value in the eyes of an investor loses an asset, taking into account expected losses refracted through the prism of perception of that investor. However, if a risky asset loses part of its value (as opposed to risk-free), then there should be an incentive that will force an investor to invest in a risky asset if there is a risk-free alternative. Obviously, only high returns can be such an incentive. Accordingly, equality must be respected:

\[
(1 + k)(1 - S) = (1 + k_f)(1 - S_f),
\]

(11)

\(k\) – the required return on the asset;

\(S\) – a subjective measure of the risk of the asset;

\(S_f\) – a subjective measure of the risk of a risk-free asset.

Given that \(S_f\) is zero, we can express the required return:

\[
k = \frac{k_f + S}{1 - S},
\]

(12)

The return on a risk-free asset is the return on Russian government bonds (federal loan bond OFZ) for the period under review (ten years, 2009-2018), which averaged 7.74%. At the same time, it is logical to evaluate the lower perception threshold \(R_0\) as the value of the expected losses on the asset, which the investor considers as risk-free – 0.96%.

The author of the present study conducted a study in which respondents answered the question: “At what level of expected losses is investing in this asset not considered?”. According to its results, the average unacceptable level of losses is 42%, but it must be remembered that in our case, losses are understood not only as a loss of invested funds, but a loss of funds relative to capital that was invested in a risk-free asset. Therefore, to determine the average value of the threshold of perception, the profitability of a risk-free asset should be added to the indicated 42%. Therefore, the upper threshold of perception is 49.74%.

Awareness as well as the upper threshold of perception characterizes a particular investor and should be determined by him. However, it seems appropriate to calculate the average value of this quantity to obtain a certain reference point, which the investor can focus on. Using the averaged parameters obtained earlier and calculating the risk of investing in the MICEX market index by years for the period 2009-2018, it was determined that the average investor awareness in the Russian stock market during this period was 0.591.

We illustrate the proposed methodology by the example of the largest Russian metallurgical companies, whose shares belong to the so-called Blue chips. Table 1 presents the values of the objective risk measure (expected loss, \(R\)), the subjective risk measure (\(S\)), the required and expected (actual) profitability calculated on the basis of a subject-oriented approach and stock price data for these companies for the analyzed period.

As it can be seen from table 1, the MMK company showed the highest profitability, but it also has the highest risk value, which leads to an extremely high required profitability. In general, all the largest metallurgical companies demonstrate returns below the required value, which means insufficient asset management and can lead to difficulties in attracting financial resources. To the least extent, this is characteristic of Severstal and NorNickel companies, which actual profitability is close to the required one, and, taking into account the payment of dividends, may exceed it.

| Table 1. Required and expected returns of the largest Russian metallurgical companies for the period 2009-2018. |
|---|---|---|---|
| Objective measure of risk | Subjective risk measure | Required return | Expected return |
| MMK | 15.2% | 0.417 | 84.9% | 50.4% |
4. Conclusion

The proposed methodology allows taking into account not only the objective risks associated with investing, but also the investor’s attitude to risk, as well as the degree of his awareness (taking into account information asymmetry). This is an important advantage of this approach compared to traditional methods, which involve assessing the required return only on the basis of the characteristics of the asset (investee), without taking into account the characteristics of the investor (investor). It seems that the introduction and development of the proposed approach will make it possible to approach more flexible to determination of the required return and solve the issue of investing funds in full individually for each investor.

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