ORIGINAL PAPER

DOI: 10.26794/2587-5671-2022-26-3-85-109
UDC 336.76:330.4:330.332(045)
JEL E17, G11, G17, G24, G35

Construction of a Dynamic Normative Model of the Stock Valuation Rating

A.S. Tonkikh[a], S.A. Tonkikh[b], E.Yu. Maslova[c]
[a, b] Admiral Ushakov State Maritime University, Novorossiysk, Russia;
[c] Kuban State University Novorossiysk Branch, Novorossiysk, Russia

ABSTRACT

Ratings are widely used in stock analysis, as they increase information transparency, simplify the assessment and investment decision-making in the stock markets, and increase their effectiveness. However, the use of ratings is constrained by subjective factors, which necessitates replacing expert assessments with objective characteristics. The aim of the study is to develop a stock valuation rating model, which allows obtaining additional information about the qualitative characteristics of shares in relation to existing rating methods, ensuring the transparency of the rating methodology and limiting the influence of subjectivity, affiliation and bias of an expert analyst. On the basis of the method of dynamic standard, a rating score is constructed, which expresses the measure of the proximity of the normative and actual order of the growth rates of indicators characterizing the investment attractiveness of stocks. When choosing current indicators for inclusion in the rating, the principle of their dynamic co-subordination (normative ordering by growth rates) proposed by I.M. Syroezhin and successfully used in the analysis of economic situations has been applied. The authors have built a share valuation rating model, which is a system of inequalities for the growth rates of six indicators (reference aggregated indicator — benchmark): the market price of a share, the size of the dividend per share, the company's net profit, revenue, equity and the number of shares in circulation. One of the advantages of the developed model is its universality: it is applicable to any industry, any market, and any accounting system. The model will make it possible to address the problems of expert subjectivism, the use of projected values and the availability of initial information (indicators of official reporting). The authors note the limitation of the model — it is not applicable to the valuation of early-stage companies. The model has been tested by compiling ratings of common stocks from the MICEX index10 for one-year and five-year periods. A comparative analysis of the ratings showed that a higher rating of stocks is observed in the long term. This also determines the applicability of the developed model as a stock analysis tool for long-term fundamental investments.

***Keywords*:** stock ratings; criteria for investment attractiveness of stocks; economic and mathematical modeling; dynamic co-subordination of indicators; market price of stocks

For citation: **Tonkikh A.S., Tonkikh S.A., Maslova E.Yu. Construction of a dynamic normative model of the stock valuation rating. *Finance: Theory and Practice*. 2022;26(3):85-109. DOI: 10.26794/2587-5671-2022-26-3-85-109**

INTRODUCTION

Ratings and rating assessments are widely used by people both in everyday life and in professional activities. Ratings of films, quality of life in the regions, universities, smartphones emitting the most radiation, etc. — this is a small list of those ratings that people turn to in everyday life. Among the ratings used by specialists in their professional activities, there are credit ratings, ratings of companies according to certain indicators, ratings of most reliable banks, etc. It is no coincidence that ratings in the field of economics and finance are presented as examples: the main objective in these areas is to choose the best investment project, increase the efficiency of resources, and ratings solve the object ranking problem, for example, potential investment objects, according to some criterion.

Let us define the initial concepts.

The meaning of the concept of rating, with various approaches to its understanding, comes down to two interpretations:

1. Rating as a rating score is a general indicator (number, rank, interval level) that reflects the quality of an object or the quality of an object's functioning, its results based on certain initial information.

2. Rating in the form of a ranked or classification list — placement of rating objects according to a general indicator that reflects the quality of the object or the quality of the object's functioning, and its results. The ranking is usually carried out from a more significant object according to a certain criterion to a less significant one.

These two approaches should not be opposed, they should be considered as two complementary or, moreover, as two consecutive stages of the rating process: first, a rating score is calculated, and then a ranked list of objects is formed based on the rating score.

The ranked list may not be compiled according to the calculated rating score, but according to some basic indicators that do not require additional processing, such as, sales revenue and profit. In this case, such ranked lists are often referred to as ratings.

Having determined the essence of the rating process, let us consider its application in relation to the stock ratings.

Stock ratings are one of the most used analysis tools in stock market decision-making. Hence, almost every investment company (bank), an investment consultant has its own stock ratings. Moreover, the stock ratings are drivers of the market value of stocks. In particular, this phenomenon is confirmed in [1]. Using the example of Polish stock indices, the author substantiates that rating agencies are one of the most important sources of information, and their rating reports are considered an indicator of confidence in the organization's securities. The rating itself, coupled with information about the projected rating, can have a significant impact on investment decisions and, as a result, on stock indices. This is also true for the markets of other countries. Thus, a comprehensive analysis of the impact of stock ratings on Japanese markets, which confirms the main conclusions of the above study, is considered in [2].

The growing demand for ratings in the United States led to the development of the financial industry regulator FINRA (Financial Industry Regulatory Authority) rule 2212 on the use of ratings by investment companies.[1] A fragment of a similar rating published by the Goldman Sachs Group analysts is shown in *Fig 1*.

As a result of the increasing spread of ratings as a tool for analyzing stocks, special web services have appeared — stock screeners (for example, the finviz[2]), stock screener), which allow investors to create their own ratings (rankings) of stocks according to the parameters they are interested in: dividend yield, P/E and P/S ratios, earnings per share, etc.

The popularity of stock ratings can be explained by the following reasons:

[1] FINRA Rule 2212. URL: https://www.finra.org/rules-guidance/rulebooks/finra-rules/2212 (accessed on 21.04.2021).
[2] Finviz. URL: https://finviz.com/screener.ashx (accessed on 21.04.2021).

Company	Date	Action	Brokerage	Rating	Price Target
RHM Rheinmetall	4/21/2021	Target Set by	The Goldman Sachs Group	Buy	€133.00
HSY The Hershey	4/21/2021	Upgraded by	The Goldman Sachs Group	Neutral -> Buy	$171.00 -> $181.00
PENN Penn National Gaming	4/21/2021	Target Raised by	The Goldman Sachs Group	Buy	$153.00 -> $158.00
RRR Red Rock Resorts	4/21/2021	Downgraded by	The Goldman Sachs Group	Buy -> Neutral	$33.00 -> $36.00
RCL Royal Caribbean Group	4/21/2021	Target Raised by	The Goldman Sachs Group	Neutral	$76.00 -> $95.00
CCL Carnival Co. &	4/21/2021	Target Raised by	The Goldman Sachs Group	Neutral	$21.00 -> $26.00
KER Kering	4/21/2021	Target Set by	The Goldman Sachs Group	Buy	€750.00
AAPL Apple	4/21/2021	Target Set by	The Goldman Sachs Group	Sell	$83.00

Fig. 1. **Fragment of the Goldman Sachs Group analyst stock ratings**

Source: MarketBeat. URL: https://www.marketbeat.com/ratings/by-issuer/goldman-sachs-group-stock-recommendations/ (accessed on 21.04.2021).

1. Reducing labor intensity and saving time for collecting and processing a large amount of information about the issuer of shares.

2. Obtaining information about the quality and characteristics of shares in a concise form.

3. Simplicity of comparison of stocks according to one final, instead of several separate indicators.

4. Ranking of stocks according to the degree of urgency of their acquisition.

5. Additional justification, regardless of the subject of investment, of the expediency of investing in specific shares.

6. Reduction of information uncertainty in relation to investment objects.

7. Search for new investment ideas in the stock market.

8. Ability to choose the object of investment in shares without expertise.

It is for these reasons that the stock ratings, compiled in the form of recommendations — buy, actively buy, hold, sell, actively sell, have become most widespread. Non-fundamental variations of this scale are possible: strong selling, strong buying, numbers from 1 to 5, above the market, below the market, etc. In most cases, this type of rating is compiled by investment companies that are interested in the growth of purchases of shares by their clients, so the rating scale contains an incentive for users of ratings to take specific actions.

Such recommendations may be based on the idea of the target (predicted) stock price, which in this case will be an integral element of such ratings. *Fig. 1* shows an example of such recommendations. Predicted stock prices are expert, often contradictory assessments of various stock analysts. The inconsistency of ratings forces users of ratings to compare, generalize and derive a final rating based on them, which deprives ratings obtained in this way of their main advantages: reducing the complexity and reliability of information when analyzing and investing in company stocks.

These contradictions are caused by a number of factors:

1. *Subjectivity of estimates of target prices.*

First, experts may use different methods of evaluation, the results of which do not match. Second, even if experts use the same methods, they may not have the same understanding of the variables from

which the resulting value is calculated. For example, when applying the discounted cash flow method, the target stock price in the most general form is found by formula (1):

$$PP = \sum_{t=1}^{\infty} \frac{Div_t}{(1+i)^t}, \quad (1)$$

where PP — price prediction, monetary unit;

Div_t — dividend in period t (predicted), monetary unit;

i — acceptable (required) rate of return for an investor, % per annum.

Experts' opinions can differ both in terms of expected dividends and in terms of the required rate of return, and their perceptions of the target price can vary greatly.

2. *Information asymmetry*.

Information about the issuer is unevenly distributed among experts, or some of the necessary information is missing. Consequently, experts, using unequal information, receive different estimates of the same object.

3. *Expert affiliation or bias*.

This issue is well covered in various sources. For example, [3] shows that optimistic analysts have more favorable career prospects. In [4], analysts' bias is considered as a rational property of company financial performance forecasts. Sometimes analyst bias is a reaction to the expectations of the market, which tends to listen to the decisions of analysts with a higher percentage of "buy" ratings even in the face of a downgrade [5]. Equity analysts are also prone to bias: they tie their earnings-per-share forecasts to the industry average without making sufficient adjustments, which encourages hiding negative information about stocks, especially for companies with worse ratings [6]. Affiliated analysts whose securities companies are mortgagees to the firms that have pledged shares issue optimistic rating reports for them due to conflicts of interest [7].

The study [8] is devoted to confirming the hypothesis that the detail and tone of financial analyst reports are much more indicative of an analyst's sentiments than their analysis of quantitative indicators, and can be used to assess the extent to which conflicts of interest of analysts interfere with the display of real estimates of the value of the firm in stock recommendations. In [9], the problem of the herding behavior of analysts is studied. The authors argue that analysts in some cases usually tend to give the same recommendations as their colleagues, thus forming a "prevailing consensus forecast", which is less accurate than "bold" forecasts.

An independent analyst sometimes works with an affiliate analyst to improve the accuracy of their recommendations because, compared to an independent analyst, an affiliate analyst has more information but faces a conflict of interest. Due to the conflict of interest of the affiliated analyst, the value that the independent analyst expects to receive in order to avoid the herding decision may motivate him to get more information [10].

Other aspects of expert bias can also be identified.

4. *The proximity of methods for assigning ratings*.

Evaluators are not inclined to disclose in detail the content of the rating methodology. This is their know-how — a competitive advantage over other raters, which has commercial value due to its obscurity to third parties. The current situation makes it impossible to verify the ratings, which hypothetically creates the preconditions for the dishonesty of the rating subjects in a broad sense: from arbitrary, poorly substantiated assessments to frankly erroneous, unconditional judgments or even fraud.

The foregoing necessitates the weakening of the influence of the subjective opinion of an expert on the rating score by expanding the use of objective characteristics.

For example, many experts see the solution to the problem of the objectivity of a rating compiled on the basis of stock price predictions in improving forecasting

methods using regression methods or machine learning [11–16]. But this does not completely remove the problem of subjectivity: starting from the choice of the type of specific dependence, model variables, their significance, and ending with fitting the model to empirical material. In addition, the non-obvious interpretability of such models reduces confidence in the results obtained by rated consumers: how can an investor be sure that an analyst is right about the target price of a share, if it is not always clear how this price was obtained? It is argued in [17] that the justifications that support the analyst's opinion reduce, and in some models exclude, the importance of profit forecasts and revision of recommendations. The rationale for the target price is the only essential element for an investor to accept an analyst's opinion. There is no correlation between forecasting methodology and analyst accuracy or market reaction to a report. Moreover, although the use of machine learning methods improves the efficiency of forecasts, it significantly complicates the forecasting process. However, the complexity of such models is often a serious obstacle to their practical application. In [18], the myth that complex predictive models outperform simpler ones is questioned.

Developing the idea that the use of predictive models in the formation of stock ratings should be treated with caution, we also note the work [19] with reference to [20, 21]. In particular, research [20] presents the results of a study of 296 published significant factors that are used by financial economists when predicting stock returns. The authors conclude that between 80 and 158 of these are likely to be false discoveries, and this casts doubt on the reliability of such predictive models.

Criticism of approaches to stock price forecasting based on regressions began in 2011 in a message from the president of the AFA (American Finance Association) [21]. J. H. Cochrane suggested that the presence of a large number of noisy and highly correlated predictors does not allow reliable forecasting of returns using cross-data regressions and portfolio sorting, which entails the need to use alternative methods. As a similar approach, [19] proposes machine learning using regularization methods. However, machine learning methods face the usual problem of cross-predictability and opacity of the methods themselves. In any case, predicting stock prices using machine learning methods, the effectiveness and stability of predictive signals, and the lack of transparency in complex machine learning algorithms require additional research.

The problem of applying ratings in the Russian stock market is widely covered in domestic studies. First, we note the work [22], which is a systematic generalization of the rating methodology, the rationale for using ratings to improve the efficiency of management decisions, including investment, practical solutions in various fields of activity: economics, government regulation, sports, etc. As for the rating of valuable securities, the authors focus on the regulation and control of the debt market, while the ratings of shares remain without their attention. In [23], an option of the formation of an investment rating of shares based on the construction of a logistic regression is presented. However, the solution of the problem of independence of variables, which, as was shown earlier, is inherent in some regression functions, was left outside the scope of the presented work by the authors. At the same time, as the authors note, the results do not always correlate with empirical patterns, which in some cases forced them to resort to "manual" tuning of the model.

The study [24] developed a matrix rating model for evaluating the most liquid Russian stocks, taking into account the industry specifics of issuers. This model is based on the dependence of the market stock prices on the dividend policy of companies, primarily on the size of dividends paid. It should be noted that the amount of dividends paid is one of the most important, but not the

only factor in the stock attractiveness, it is advisable to include other indicators in the calculation of the stock rating.

A significantly expanded list of indicators for the formation of stock ratings is presented in [25–27]. They note that one of the most convenient tools for analyzing securities is the rating method, which allows presenting an impressive amount of incoming information in a concise, systematized form [25]. At the same time, the rating of shares should take into account both the indicators of profitability and risk of securities, and the quality of corporate governance.

In [26], the author proposed a rating algorithm based on the adaptation of the Graham-Rea model to the Russian stock market: selection of indicators, normalization and standardization of their values relative to generally accepted standards, calculation of the rating score as the sum of weighted normalized values of indicators. Meanwhile, the conditionality and unconvincingness of generally accepted values of indicators — for some companies, the share of equity less than 50% of total assets is really critical, for others — not (the same applies to other similar standards), as well as the need to determine the significance of indicators based on expert (according to essentially subjective) assessments create prerequisites for the use of alternative rating algorithms. Similar reasoning is appropriate for the score-rating assessment, as well as various combinations of the mentioned rating methods [27], in which the final assessment is impossible without the participation of experts.

The work [28] presents, in our opinion, a rather promising approach to the stock rating process, based on a hierarchical analysis of ranked indicators, taking into account their priority. The priority of indicators is a natural principle of building a stock rating and means that different indicators have different meaning for an investor when assessing the stock attractiveness. In this context, the market stock price is a more significant indicator than the inventory turnover ratio. It is clear that the first indicator makes a more significant contribution to the attractiveness of the stock than the second. Moreover, many analysts generally do not consider the turnover ratio to be a significant factor in the investment quality of a share, then its defining characteristic is the market value of the share or indicators derived from it in the overwhelming majority of cases. Less obvious examples of the hierarchical ordering of indicators can be given. However, when justifying the priority of indicators, in our opinion, one should rely more not on the rules of fuzzy logic (accumulated experience, intuition, etc.), as, for example, in [28], but on a more formal argumentation.

Thus, this study is aimed at creating a model for the rating assessment of stocks, which allows obtaining additional information about the qualitative characteristics of stocks in relation to existing rating methods, ensuring the transparency of the rating assignment methodology and limiting the influence of subjectivity, affiliation and bias of an expert analyst.

METHODOLOGY

Let us formulate the basic principles for the formation of the desired model for the rating evaluation of stocks.

1. *Objectivity.* The assessment should be completely independent of the opinion of the subject of assessment, their experience, intuition, preferences, interests, etc. In other words, when forming a model, it is desirable to exclude expert judgments.

2. *Retrospective*. The rating assessment must be built on the basis of achieved, not predicted results. This principle is a logical continuation of the previous one. As mentioned above, most forecasts are to some extent based on the subjective judgments of the analyst, and this contradicts the principle of objectivity. There will certainly be a lot of objections that a rating without indicating the prospects of the rating

Table 1

Example of assessing the dynamics of indicators excluding the principle of dynamic co-subordination

Indicator, monetary unit	Option 1			
	Previous period	Current period	Growth rate, %	Recommended dynamics
1	2	3	4	5
Dividend per share (*DPS*)	4	5	125	Growth
Earnings per share (*EPS*)	8	12	150	Growth
Conclusion	The dynamics correspond to the recommended, the assessment is positive			
Indicator, monetary unit	**Option 2**			
	Previous period	**Current period**	**Growth rate, %**	**Recommended dynamics**
1	6	7	8	9
Dividend Per Share (*DPS*)	4	3	75	Рост
Earnings per share (*EPS*)	8	4	50	Рост
Conclusion	The dynamics does not correspond to the recommended, the assessment is negative			

Source: compiled by the authors.

subject, forecasting its values in the future will inevitably lose practical significance and applied value, since when making investment decisions, not only the results achieved at the moment are important, but also their subsequent changes. Therefore, we will give a few more arguments in favor of the principle of retrospective rating.

It is noted in [29] that there is no single forecasting method for the profitability of all stock markets; different types of markets require their own methods. Based on this, we cannot reject the assumption that when predicting the quantitative characteristics of some stocks, certain forecasting methods work, others do not. This leads to doubts about the validity of comparisons of such stocks and their ranking relative to each other. And this, as we have determined, is one of the main advantages and purposes of the rating.

Further, statistical forecasting methods, one of the most common in the stock market, are based on extrapolation of historical data. It is logical to assume that if the rating score is based on previously achieved results, then the rating score itself should be formed on their basis, and not on hypothetical future values of indicators. The possibility of extrapolation and the trend towards stability of the current rating values in the future will be determined by the phenomenon of economic inertia. Economic inertia is the desire of an economic object to maintain its current state, the inability to quickly change it. The attractiveness of stocks cannot decrease instantly, this process will stretch over time, in the same way, the attractiveness of stocks cannot increase in a short time. Various aspects of the phenomenon of inertia, confirming its existence in the economy, are considered in [30–32].

In accordance with the above arguments, we consider it expedient to base the developed method of stock ratings on the retrospective principle. We are not against forecasting in the stock market, moreover, we consider it an integral part of the market analysis, but in order to build the required rating, we will adhere to an approach that is not based on forecast estimates.

3. *Methodological simplicity*. The principle of simplicity, sometimes generalized by

the principle of economy, has various interpretations [33–38]. In its most general form, the principle of simplicity is a heuristic principle that generalizes the experience of cognition, according to which, other things being equal, the simplest cognitive construction is preferable.[3] This principle has both supporters and opponents, who argue that in the process of development, science becomes more complicated, not simplified, moreover, the concept of simplicity is relative. We will discuss the validity of certain judgments. At the same time, in striving for a more reliable and convincing interpretation of the ratings obtained, in order to choose a simpler theoretical scheme for explaining the phenomenon of the attractiveness of shares, to meet the criterion of scientific rationality, we will use a modification of this principle — the principle of methodological simplicity [39]. According to this principle, the more complex the calculations and statistical techniques, the more difficult and arbitrary the interpretation of the data obtained. That is why we based the developed rating model on the principle of methodological simplicity.

4. *Generality of the model*. The desired rating model should be valid for the widest possible range of stocks, regardless of country, market, scale of operations, capitalization, industry affiliation, accounting system used, and other similar factors.

5. *Dynamic co-subordination and comparability of indicators*. There are two points to note here. Firstly, the attractiveness of stocks is determined by the growth potential of key market indicators, such as stock price, dividends, price/earnings ratio, book value of shares, etc. In other words, when choosing stocks for an investor, it is important what dynamics this or that indicator has, so the rating of stocks should be based on a dynamic criterion of attractiveness. Secondly, it is not just the positive dynamics of individual indicators that is important, but their orderly growth relative to each other. Let us explain the latter on the example of *Table 1*.

Table 1 presents two hypothetical options for dividends per share *(DPS)* and earnings per share *(EPS)*. At the top of the table, an example of an increase in indicators is considered: *DPS* by 25%, *EPS* by 50% (column 4). If we consider the indicators separately, i.e. without taking into account the principle of dynamic co-subordination, then their dynamics corresponds to the recommended one, and the final assessment will be positive. And vice versa, in the lower part of the table, the decrease in *DPS* and *EPS* was 25 and 50%, respectively (column 8), their dynamics does not correspond to the recommended one, and without taking into account the principle of dynamic co-subordination, the final assessment is negative.

Let us supplement our reasoning with the principle of dynamic co-subordination of indicators. It is obvious that the stocks of a company that has kept the share of profits allocated for payment of dividends (payout ratio) at a level not lower than in the previous period are more attractive to the investor than the stocks of a company that has reduced it. As a confirmation of this thesis, we can cite the situation with the payment of dividends by TATNEFT at the end of 2020.[4] The formulated criterion for the attractiveness of stocks can be written as an inequality ordering the growth rates of *DPS* and *EPS* indicators (2):

$$\text{Growth rate } (DPS) \geqslant \text{Growth rate } (EPS). \quad (2)$$

The growth rate (GR) of indicator A, is calculated by formula (3).

$$GR(A) = \frac{A_2}{A_1}, \quad (3)$$

where $GR(A)$ — growth rate of indicator A;

[3] Website: New Philosophical Encyclopedia. Electronic Library of the Institute of Philosophy RAS. The principle of simplicity. URL: https://iphlib.ru/library/collection/newphilenc/document/HASH2120954aaecac8b1b76221 (accessed on 02.08.2021).

[4] Tatneft will share half of the profits. Kommersant (Kazan) No. 76 of 04/29/2021. URL: https://www.kommersant.ru/doc/4793856 (accessed on 02.08.2021).

A_2 — the value of indicator A in the current period;

A_1 — the value of indicator A in the previous period.

Compliance with inequality (2) indicates at least a non-decrease in the share of the company's profits directed to the payment of dividends. The validity of (2) can be questioned by supporters of low, even zero dividends, which, in their opinion, lead to a much greater increase in the value of stocks by increasing the amount of profits reinvested in the company's assets. We will return to this thesis later, in the course of substantiating the desired rating model. Now we use inequality (2) as an illustration of the principle of dynamic co-subordination of indicators.

The co-subordination (mutual ordering) of indicators in dynamics, similar to inequality (1), allows us to make significant adjustments to our reasoning about the attractiveness of the stocks presented in *Table 1*. Thus, the authors, without hesitation, gave a positive assessment of the attractiveness of the stock for the first option: the actual dynamics of market indicators corresponds to the recommended one. However, taking into account inequality (2) does not allow such an unambiguous assessment, since for a given stock *GR* (*EPS*) > *GR (DPS)*, and according to (2) it should be vice versa.

The same picture with the second option. We negatively assessed the attractiveness of stocks, whose market characteristics have worsened in dynamics. At the same time, the normative relation (2) is observed for this action. In practice, the following interpretation of this situation is possible: an unfavorable market situation has developed, which has led to an objective decrease in the company's net profit and, as a result, to the inability, primarily at the legislative level, not only to increase dividend payments, but even to keep them in the amount of previous year. However, the organization has found a way to pay its shareholders a larger share of net income compared to the previous period, as evidenced by the smaller decline in *DPS* compared to *EPS*. In this sense, the stocks of the second option look quite attractive: despite the objective decrease in the amount of dividends paid, the company seeks to minimize the loss of current income of shareholders.

As a result, we have: the implementation of the principle of dynamic co-subordination of indicators significantly affects the result of assessing the attractiveness of stocks, which must be taken into account when constructing a rating model.

The principle of dynamic comparability of indicators means that indicators that are not comparable in statics become comparable in dynamics. Thus, for example, the indicator of the company's equity and the indicator of the number of outstanding stocks cannot be compared with each other if they are considered as static, including because of their different dimensions: the first indicator is measured in monetary units, the second is a dimensionless indicator. However, the growth rates of these indicators, used as a quantitative characteristic of their dynamics, are quite comparable values. We consider the book value per share. One of the ways to calculate it is presented in the form of formula (4).

$$\text{Book value per share (BV)} = \frac{\text{Equity (Eq)}}{\text{Number of shares outstanding (NSO)}}. \quad (4)$$

The book value per share characterizes, among other things, the amount that the shareholders of the enterprise will receive in the event of its liquidation. The higher this amount, the better for shareholders. Therefore, this indicator in dynamics is attributed to growth. For the growth of *BV*, a faster growth of the numerator relative to the denominator is required, which can be written as a dynamic relation (5).

$$\text{Growth rate } (Eq) > \text{Growth rate } (NSO). \quad (5)$$

Here, the principle of dynamic comparability of indicators is manifested:

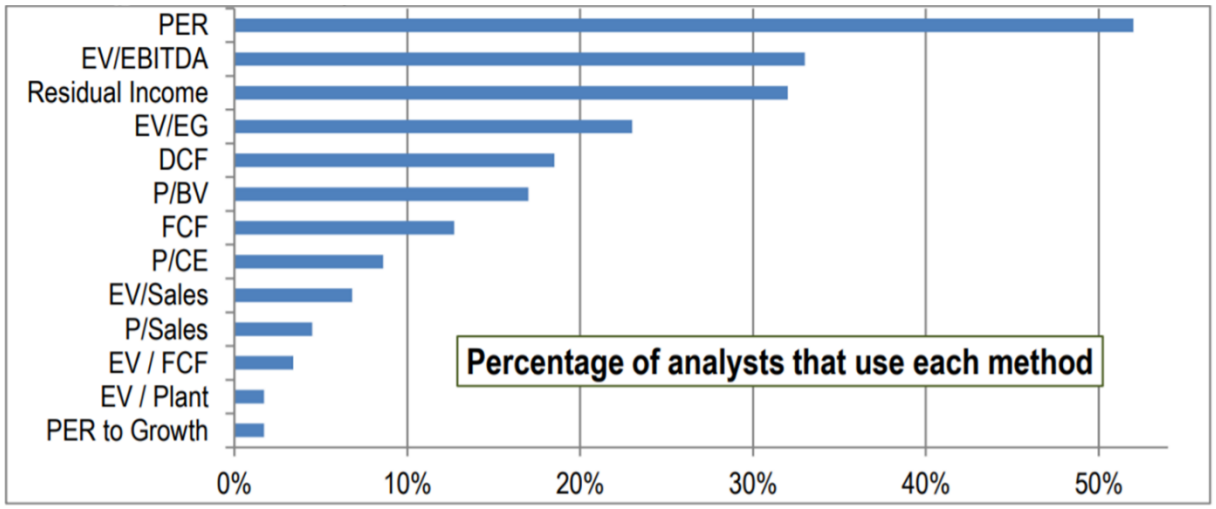

Fig. 2. **Most widely used stock valuation methods**

Source: P. Fernandez [46].

two indicators that are not comparable in statics become comparable in dynamics, which is an important methodological technique when building composite ratings when it is necessary to reduce several heterogeneous characteristics into one.

Dynamic co-subordination and comparability of indicators are the fundamental concepts of the theory of a dynamic standard, and expressions (2) and (5) can be considered as an example of the simplest dynamic standards or, in other words, the reference dynamics of indicators. Dynamic standards are called a system of indicators, normatively ordered by growth rates relative to each other. The idea of ordering indicators of the dynamics of economic systems belongs to I.M. Syroezhin [40]. In the future, this approach was repeatedly tested in the analysis of various economic situations, for example, in assessing sustainable development and the balance of economic systems [41, 42], modeling the development of production and economic structures [43], measuring and monitoring the parameters of various economic processes and phenomena [44, 45] and others. The situations considered in one form or another are based on the calculation of integral (rating) estimates, so the choice of a dynamic standard as a methodological method for building an exchange rating seems natural, logical and justified.

Let us move on to the content of the stock rating model.

RESULTS AND DISCUSSION

To select the indicators of the constructed rating model, we will use the results of the study [46]. In this article, with reference to Morgan Stanley Dean Witter Research, we present the most popular methods for assessing the attractiveness of stocks among stock analysts (*Fig. 2*).

The authors note that the preference for one method or another, i.e. the percentage of analysts using one method or another, depends on the industry and the country of the companies. At the same time, the composition of the calculated indicators basically remains the same — similar to the composition in *Fig. 2*. Description and formulas for calculating these indicators are presented in *Table 2*.

We do not consider in this paper which of these methods better or worse. We are primarily interested in the list of indicators that determine the attractiveness of stocks, according to stock analysts. Moreover, in the context of the principle of dynamic co-subordination of indicators, we are interested not so much in the indicators,

Table 2

The most commonly used indicators in stock valuation

Designation	Indicator	Calculation formula
PER, P/E	Earnings Multiplier	Market capitalization / Net profit = Market price per share / earnings per share
EV/EBITDA	Enterprise Value-to-EBITDA ratio	Enterprise Value / EBITDA (earnings before interest, taxes and depreciation)
Residual Income, RI	Residual Income	Operating Profit – Minimum Required Rate of Return × Operating Assets
EV/EG	Enterprise Value-to-Projected EBITDA ratio	Enterprise value / EBITDA (actual) / projected EBITDA growth
DCF	Discounted cash flow	$\sum_{i=1}^{n} \frac{\text{projected annual cash flow}_i}{(1+\text{discount rate})^i}$
P/BV	Price-to-Book Value ratio	Market capitalization / Book value of equity
FCF	Free Cash Flow	Earnings before interest and taxes + depreciation – change in working capital requirement – capital expenditures
P/CE	Price-to-Cash Earnings ratio	Market capitalization / Net profit before depreciation
EV/Sales, EV/S	Enterprise Value-to-Sales ratio	Enterprise Value / Sales
P/Sales, P/S	Sales Multiplier	Market capitalization / Sales = Market price per share / Sales per share
EV/FCF	Enterprise Value-to-Free Cash Flow ratio	Enterprise Value / Free Cash Flow
PER to Growth, P/EG, PEG	Earnings Multiplier-to-Earnings Growth	PER / Projected EPS Growth

Source: compiled by the authors based on [46].

but in what indicators are compared with each other in their calculation process. This will allow the formation of a set of dynamic standards that will be taken as the basis for the desired model for stock ratings.

To begin with, in accordance with the principle of objectivity, we will exclude from the list of the most used indicators those of them that are calculated on the basis of predictive and subjective assessments. These include EV/EG, DCF, PEG, RI.

The following important point is which of the indicators characterizes the investment attractiveness of shares to a greater extent — *P* (market capitalization or market value per share) or *EV* (fair enterprise value / share)? The fair enterprise value is calculated using the formula (6).

Table 3

PER and P for Apple Inc stocks in 2019–2021

Indicator	2019	2020	September 2021
P/E Ratio (PER)	18,41	34,28	29,74
Market value (P), USD.	55	113	154

Source: compiled by the authors based on finanz.ru and finviz.com. URL: https://www.finanz.ru/balans/apple; URL: https://finviz.com/quote.ashx?t=AAPL&ty=c&ta=0&p=m (accessed on 31.08.2021).

$$EV = \text{Market Capitalization} + \\ + \text{Net Debt} + \text{Minority Interest}. \quad (6)$$

Net debt is the difference between the sum of a company's long-term and short-term liabilities and cash.

Some stock analysts believe that to assess the attractiveness of shares, it is necessary to use the *EV* indicator, and not *P*. This is motivated by the fact that the investor when buying stocks, i.e. stocks in the company's business, acquires from this the obligations and free cash of the company, which increase or decrease the value of the company. An example is often given with the purchase of an apartment with a mortgage on it, the value of which increases due to the fact that, along with the apartment, the obligation to pay the balance of the debt to the bank passes to the new owner. At the same time, if a cache of money is found, the new owner can appropriate it, thereby compensating for part of the cost of buying an apartment. However, there is a significant difference between buying an apartment and buying company stocks: in the case of buying stocks, their new owner is not liable for the company's obligations and cannot directly claim the funds at its disposal. The investor, regardless of the method of the stock valuation, is interested in the amount of actual income per share, which is the sum of the difference between the sale and purchase price of a share, as well as dividends received during the period of ownership. At the same time, the owner of the share does not pay anything additional for the debts of the company and also does not receive anything, except dividends, from the funds at his disposal. The purchase and sale of shares take place at a real market price, and not at a hypothetical fair value, i.e. the investor's profit is formed as a result of transactions at market value.

We also add that the increase in *EV* due to debt may not affect the market value of the shares owned by the investor. In this case, the increase in fair value will be of little interest to the investor, since it is not accompanied by an increase in his income. This type of stock will not be attractive to an investor, despite the *EV* growth. Therefore, the investment attractiveness of stocks should be assessed not by the *EV* indicator, but by the market capitalization indicator *P*. That is why, when forming the stock rating model, we will not consider the indicators obtained on the basis of a comparison with the fair value of the company presented in *Table 2* — EV/EBITDA, EV/S, EV/FCF. We note that when comparing *P* and *EV*, we are not talking in the context of identifying undervalued stocks, but in the context of generating income per share.

From the indicators remaining in the list (Table 2), we will form dynamic standards that will characterize the investment attractiveness of stocks.

The most popular indicator among analysts and investors is the PER or P/E ratio. Its goal is to identify undervalued stocks with upside potential. The formula for calculating the P/E ratio is P/E = Market share price / Earnings per share.

To answer the question of which price/earnings ratio is good or bad, standard P/E values are introduced, which can be set:

1. Absolute values, for example, if P/E > 20, then the company's shares are overvalued.

2. P/E values of a peer company, for example, if the P/E of a company (1) is less than the P/E of a similar company (2), then the company (1) is undervalued compared to the company (2).

3. Average P/E values for the industry, for example, if the P/E of the company (1) is less than the average P/E for the industry, then the company (1) is undervalued compared to the industry as a whole.

The validity of the presented standards is not obvious. For example, if we focus on the first version of the standard, then Apple stocks have been overvalued for several years since P/E starting from 2018 has been either at the border of the standard or above it (*Table 3*).

Given the above standards, Apple stocks were not attractive enough for investors in 2018 — there were many other interesting stocks in the market in terms of P/E. However, Table 3 shows that the market value of stocks has risen by almost 100% in 2020 and by almost 40% in 2021. The situation is exactly the same with the other two benchmarks: there are examples of "undervalued" stocks with low and even declining P/E during a long period of time, as well as "overvalued" stocks with high and rising P/E for a long time. Such "overvalued" stocks have greater investment attractiveness than similar "undervalued" ones. Therefore, a clarification or a different presentation of this criterion is required.

Regardless of which of the three criteria the investors are guided by, they buy stocks that they consider undervalued, hoping for future growth in their value, believing that their P/E will "catch up" with the industry average or similar companies. In other words, after buying stocks, investors expect P/E growth, which, given the popularity of this indicator, should be taken as one of the main criteria for their attractiveness. The growth of P/E implies a faster growth of *P* (market value, capitalization) over *E* (net profit), which can be written as a dynamic standard (7):

$$GR\,(P) > GR\,(E), \qquad (7)$$

where $GR\,(A)$ — the growth rate of indicator *A*;

P — market price per share;

E — company's net profit.

Presentation of the P/E indicator in the form (7) makes it possible not to use its insufficiently substantiated normative values, expressed either in absolute or industry average or in indicators of peer-competitors.

A distinctive feature of the dynamic standard (7) is its focus not on comparison with the stocks of peers, but on assessing the dynamics of the company's own indicators. This means that it is more important to improve one's own results compared to the previous period than to try to meet or beat the industry average or a competitor's performance. There are no absolute analogs, each company is unique in terms of a combination of strengths and weaknesses, the ability to seize opportunities and withstand threats from the external environment, risk appetite, shareholder structure, goals, interests, etc. What is acceptable for one company may not fit for another. For example, one competitor achieved a significant increase in market value through leveraged buybacks. These actions are accompanied by a significant increase in risk, which can lead to a significant deterioration in financial and market results in the future, and even bankruptcy. However, by doing so, the competitor establishes a high level of PER, which is accepted by the market as a benchmark. As a result, market information is distorted, and on the basis of distorted information, conclusions are drawn about the investment attractiveness of certain shares. Also, a regular, albeit relatively small, increase in P/E can result in a much larger net increase in the long term than a significant increase in the short term followed by a decline. In this sense, the dynamic standard (7) makes it possible to assess the attractiveness of stocks with

Fig. 3. **Stock price dynamics of Gazprom, Sberbank, Apple Inc and Johnson & Johnson**
Source: Investing.com. URL: https://ru.investing.com/equities/ (accessed on 31.08.2021).

greater certainty than the traditional interpretation of the P/E ratio.

Similar reasoning can be given for P/S and P/BV. P/S = Market price per share / earnings per share. Corresponding dynamic standard:

$$GR\,(P) > GR\,(S), \qquad (8)$$

where P — market price per share;

S — sales revenue.

P/BV = Market capitalization / book value of equity. The requirement for the growth of this coefficient leads to a dynamic standard (9).

$$GR\,(P) > GR\,(Eq), \qquad (9)$$

where Eq — is equity.

Earlier we substantiated the dynamic standard (10).

$$GR\,(Eq) > GR\,(NSO), \qquad (10)$$

where NSO — the number of shares outstanding.

According to the theory of business valuation, one of the methods for assessing the market value of a company can be a cost method. In accordance with it, the market value of the company is equated to the book value of its equity. Therefore, an increase in equity means an increase in market value and, consequently, an increase in the investment attractiveness of stocks. The requirement for equity growth can be written as a normative ratio (11)

$$GR\,(Eq) > 1. \qquad (11)$$

The growth of equity can occur not only due to its quantitative increase but also due to the acceleration of its turnover. In this case, there is a faster release and, accordingly, the involvement of funds in circulation, which leads to an increase in the company's profit, and therefore, as we noted earlier, to an increase in the market value and investment attractiveness of stocks. The equity turnover rate (ET) is expressed as the equity turnover ratio (12).

$$ET = \frac{S}{Eq}. \qquad (12)$$

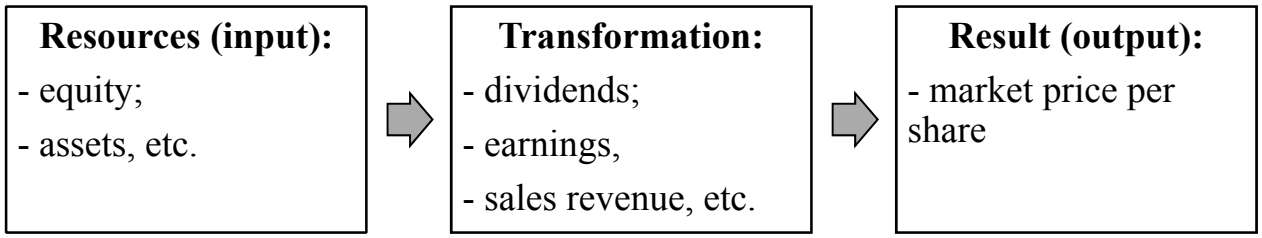

Fig. 4. **Formation of the stock market price**
Source: compiled by the authors.

The acceleration of the turnover of equity means faster growth in sales (*S*) in relation to the growth of equity (*Eq*), which can be written as a dynamic standard (13).

$$GR\,(S) > GR\,(Eq). \qquad (13)$$

Next, we will consider the normative ratio of earnings (*E*) and sales revenue (*S*), which is sometimes called the "golden" rule of the enterprise economy. But we will consider it not in the context of the enterprise economy, but through its impact on the market value and investment attractiveness of stocks. Under the income approach, the market value of a business is defined as the present value of future cash flows, which in turn are calculated based on the company's earnings. The greater the profit, the greater, ceteris paribus, the cash flows, and the higher the valuation of the company, which entails an increase in the investment attractiveness of stocks. Earnings growth means that sales revenue (income) is growing faster than expenses, and this is tantamount to faster growth of earnings in relation to sales revenue (14).

$$GR\,(E) > GR\,(S). \qquad (14)$$

It remains to determine the place of the indicator of paid dividends in the stock rating model in accordance with the principles of dynamic co-subordination and dynamic comparability of indicators.

The question of the impact of dividends on market value is one of the most contentious issues in corporate finance. Thus, in [47], an extensive review of the literature on this issue was carried out, which allowed the authors to identify three different approaches. The first approach states that an increase in dividend payments increases the company's value (price per share). Proponents of the second approach believe that increasing the payment of dividends reduces the value of the firm. The third approach supports the Modigliani-Miller theory that dividend policy does not affect the market value of a company or price per share. To date, no consensus has been reached on this issue and the results are inconclusive.

However, our task in constructing a rating model is not to assess the impact of dividends on the market value of a share, but to assess its attractiveness for an investor, i.e. those properties of the stock that arouse interest, the desire to buy it and allow getting additional benefits.

In this sense, the payment of dividends has the properties necessary in the context of attractiveness, namely, it determines the desire, depending on the amount of declared dividends, to buy or sell shares and provides an opportunity to receive additional income. There is a lot of empirical evidence for this. As an example, let's take the stocks of Gazprom, Sberbank, Apple Inc, and Johnson & Johnson, the price dynamics of which are shown in *Fig. 3*.

The letter "D" in the charts indicates the date of closing the register for receiving dividends (the date of compiling the list of persons entitled to receive dividends).

The stocks of the selected companies belong to different industries, circulate on the markets of different countries, and are

listed on different exchanges (MOEX, Nasdaq, and NYSE). Nevertheless, in each case, the influence of dividends on the interest of investors in the stock can be traced. In the case of Gazprom, Sberbank, and Johnson & Johnson, the amount of declared dividends attracted investors, which was reflected in the increase in the volume of purchases and the corresponding increase in share prices before the register was closed. In the case of Apple, investors' expectations for dividends were initially optimistic — the market price of the stocks was growing, but then the announced dividends disappointed investors to some extent and there is a slight decrease in the stock price before the registration closing date. Earlier we gave a similar example of the negative impact of dividends on the demand for stocks in relation to Tatneft. We have other examples. Consequently, there are numerous confirmations that the dividends paid on a share are a factor in its attractiveness for an investor.

Another argument in favor of including dividends in the calculation of stock ratings. The model we are developing is based on a normative (reference) idea of a stock. In practice, it is customary to distinguish between growth stocks, which provide their owners with a high income from the growth of their market value (capital income), and dividend stocks, which provide their owners with a regularly increasing income in the form of dividends from the company's profit (current income). But a reference, a perfect share should bring to its owner all possible types of income — both capital and current income at the same time i.e. should combine the benefits of both growth stocks and dividend stocks. In the example of the stocks shown in *Fig. 3*, we see that this is achievable and is not an isolated case. Therefore, the indicator of dividend payments will be taken into account by us when forming the model for the rating assessment of stocks.

Illustrating the principle of dynamic co-subordination, we substantiated the normative ratio of the growth rates of dividend and profit indicators (2). Let us write this relation in the accepted notation (15).

$$GR\,(D) \geqslant GR\,(E), \qquad (15)$$

where D — dividends per share;

E — the company's net profit.

We present arguments in favor of the validity of inequality (15).

1. On the one hand, it is necessary to leave a part of the company's profit for development ("get into the pocket of shareholders").

2. On the other hand, the owners of stocks would not like to see more money in their pocket in the current period than in the previous one, i.e. to reduce their current income.

3. However, during a period of declining profits, shareholders must accept that the dividends paid will also decrease.

We write the ratio of the growth rates of the market price per share and dividends in the form of inequality (16).

$$GR\,(P) > GR\,(D), \qquad (16)$$

where P — market price per share.

To justify the validity of inequality (16), let us imagine the formation of the market price per share in the form of a processor (*Fig. 4*).

According to the concept of a dynamic standard, the growth rates of indicators characterizing the result should outpace the growth rates of indicators characterizing the transformation, and those, in turn, the growth rates of indicators characterizing resources. This is the principle of increasing processor performance. This principle formally substantiates inequality (16).

This concludes the list of indicators characterizing the investment attractiveness of stocks, which should form the basis of the rating model.

It is necessary to explain why we did not include the FCF indicator in the stock rating indicators, although more than 10%

of analysts use it to assess the attractiveness of stocks (*Fig. 2*). They consider it a more informative indicator than net income, since the company's shareholders have access (including for the payment of dividends) only to cash, and not to profit reflected in the financial statements. FCF characterizes the amount of cash for the reporting period remaining at the disposal of the enterprise after the implementation of current cash payments and capital expenditures (CAPEX). The formula for calculating the indicator is presented in *Table 2*.

We agree that this is an important indicator for assessing the financial condition of a company, but, in our opinion, it is not suitable for assessing the investment attractiveness of stocks. Dividends are based on net profit, not FCF, although sometimes the shareholders may limit their amount to FCF. This means that a company can have positive free cash flow but no net profit, in which case it will not be able to pay dividends. In addition, hypothetically, and in some cases practically, a company can borrow to pay dividends and thereby pay dividends even in the absence of free cash flow. It should also be taken into account that the payment of dividends for the reporting period occurs much later than its end, and by this time the situation with free cash in the company may change significantly — the company will be able to pay dividends, although at the end of the reporting period it did not have FCF. In view of the foregoing, when forming the rating model for shares, we will take into account the net profit indicator, and not free cash flow.

As a result, generalizing inequalities (7)–(11), (13)–(15) and (16), and also taking into account the transitivity of «>» and «⩾», operators, we will form the desired model for the stock rating (17).

$$\begin{cases} GR(P) > GR(D) \geq GR(E) > GR(S) > GR(Eq) > GR(NSO) \\ GR(Eq) > 1 \end{cases}, \quad (17)$$

where $GR\ (A)$ — (A) is the growth rate of indicator A;

P — market price per share;

D — dividends per share;

E — the company's net profit;

S — sales revenue;

Eq — equity;

NSO — the number of shares outstanding.

The second inequality in the system (17) for all indicators, with the exception of *NSO*, is imputed to growth in dynamics.

The constructed stock rating model (17) has the following features:

1. Forecast and expert estimates are not used, a high level of formalization of the model, due to which the required level of objectivity is achieved.

2. Only achieved and confirmed indicators of official reporting are used. This ensures, firstly, the availability of initial information, and secondly, an increase in the reliability of the rating.

3. The attractiveness of stocks is assessed for compliance with the normative (reference) dynamics of indicators. In essence, model (17) is a benchmark, a reference aggregated indicator, which, when compared, allows assessing the real attractiveness of a particular stock for an investor.

4. The presented stock valuation model makes it possible to compare companies in different industries, different markets, different accounting systems, etc. For example, despite the serious differences between Russian (RAS) and international (IFRS) accounting standards both in accounting rules and in the formation of financial results, the main inequalities (17) are valid for both one and the other standard. In particular, the requirement for faster earnings growth compared to sales revenue growth will be in place for both RAS and IFRS. The same can be said about the other relations used in (17). These ratios are also valid for companies in any industry and any market.

5. It is not required to determine the significance of indicators. The formation of a hierarchy of indicators is a mandatory component of most rating methods. The

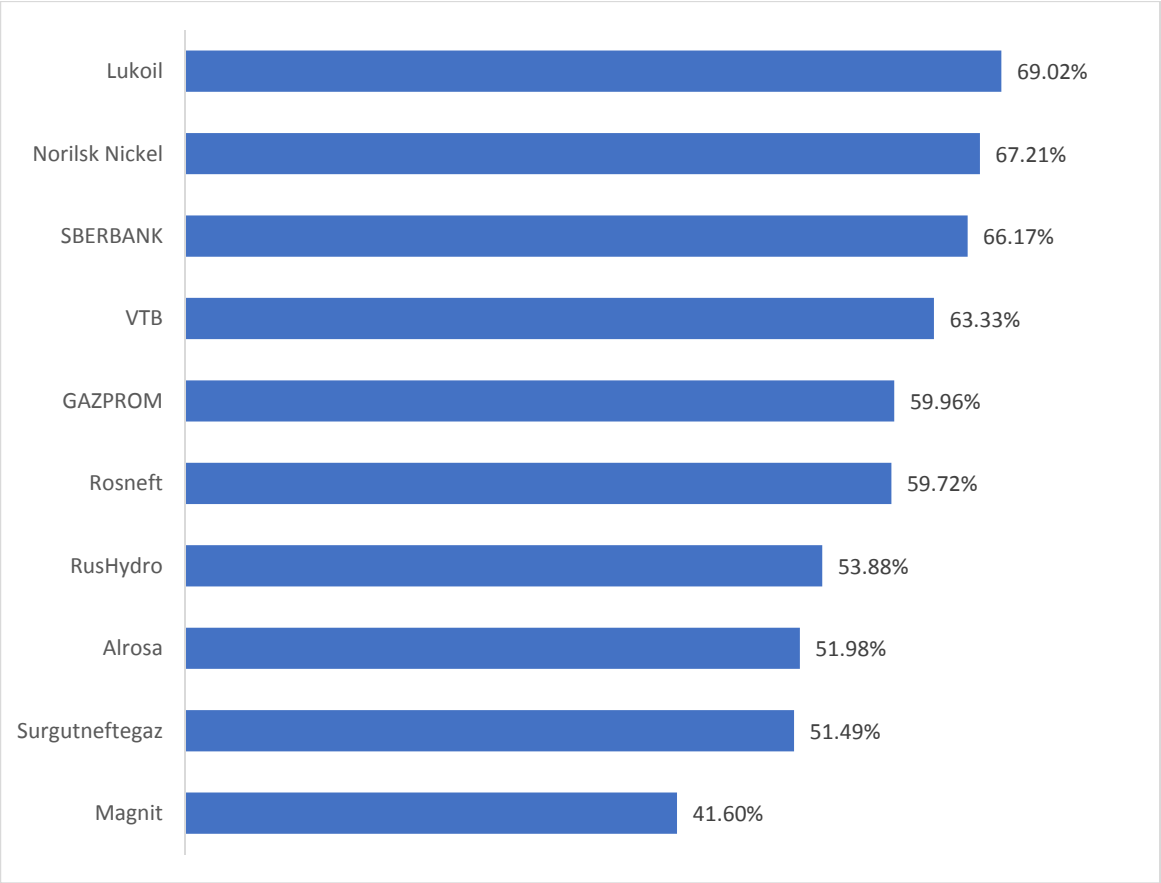

Fig. 5. **Rating of common stocks from the MICEX10 index for a one-year period**

Source: compiled by the authors.

significance of indicators is quantitatively determined on the basis of expert methods. This introduces subjectivity into the assessment process, reduces the transparency of the methodology and the interpretability of the results, and leads to the emergence of various options for constructing a rating score, the advantages of which are not obvious. In addition, the significance of indicators may change over time along with market conditions, business practices, and the external environment of the company, which will lead to a revision of the model and hence to the problem of comparability of ratings over time. Therefore, the absence of the need to determine the significance of the indicators included in the model for evaluating the attractiveness of stocks should be considered a significant advantage of the proposed approach.

6. The criterion for a stock's attractiveness is positive performance relative to its own performance in the previous period, not relative to competitors or industry averages, and, in addition, insufficiently justified absolute standards (for example, that the P/E ratio should be less than 10). The justification for the importance of this thesis is given above. Comparison with stocks of other companies is carried out only by how much the performance of each stock has improved in relation to their own values in the past.

7. A more rigid criterion for the attractiveness of stocks is compliance with the benchmark dynamics and not simple growth or achievement of generally accepted normative values of individual indicators. Presenting the criterion in the form (17) makes it much more difficult to manipulate the market and "embellish" reporting, which makes possible to exclude stocks that grow

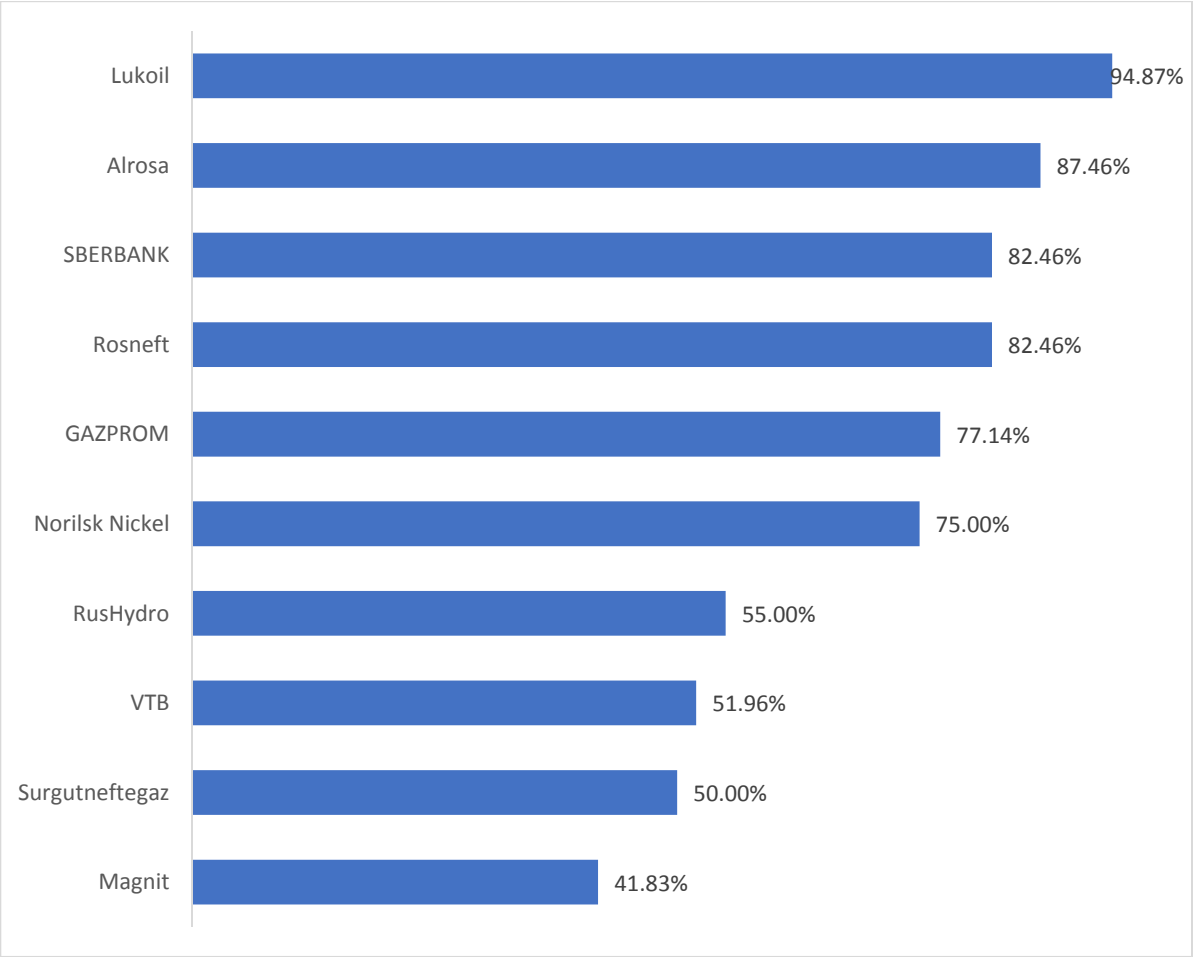

Fig. 6. **Rating of common stocks from the MICEX10 index for a five-year period**

Source: compiled by the authors.

in the short term, the price of which is artificially "accelerated" in order to sell at an overpriced price or increase the size of the bonus.

8. The developed model makes it possible to operate with negative indicators (losses, equity, etc.), although traditionally the growth rate, as well as some indicators of *Table 2* for negative values are not calculated. To do this, it suffices to change the order of indicators in the system of inequalities (17). For example, if in the base period the net profit of a company is negative (in this case, the traditional growth rates cannot be calculated), then either the profit will be positive, or a decrease in the amount of loss in the current period, which is equivalent to the inequality (18):

$$1 > GR'(E), \qquad (18)$$

where $GR'(E)$ — an indicator that replaces the traditional growth rate, but which can be calculated for negative values of the indicators. For convenience, we call it the quasi-tempo. $GR'(E) = E_2/E_1$, where E_2 is net profit in the current period; E_1 is the net profit in the previous period.

Compliance with inequality (18) in the case of $E_1 < 0$ can mean:

1. $E_2 > 0$ and the whole fraction $GR'(E) < 0$, i.e. during the period under review, losses were replaced by profit, which is considered a significant factor in the growth of the attractiveness of stocks of a company.

2. $E_1 < E_2 < 0$ and the whole fraction $0 < GR'(E) < 1$, i.e. in the period under review, there was a decrease in losses, which is also considered a positive factor in the attractiveness of stocks.

Taking into account (18), the benchmark (17) will take the form (19).

$$\begin{cases} GR(Eq) > GR(NSO) \\ GR(P) > GR(D) > GR(S) > GR(Eq) > 1 > GR'(E). \end{cases} (19)$$

By changing the order of the exponents in (17), it is possible to operate with other negative exponents.

Similarly, division by zero can be bypassed if dividends in the base period are zero. The growth of dividends by any amount in the next period is considered a very positive factor in the growth of the attractiveness of stocks, and it can be assigned an arbitrary quasi-rate, the numerical value of which will be the maximum in relation to the growth rates of the indicators that make up model (17). As a result, benchmark (17) will take the form (20).

$$\begin{cases} GR'(D) > GR(P) > GR(E) > GR(S) > GR(Eq) > GR(NSO). \\ GR(Eq) > 1 \end{cases} (20)$$

9. Model (17) is not suitable for evaluating new companies (established less than 2 years ago), since the assessment of the attractiveness of shares is based on the analysis of their dynamics, i.e. by comparing the indicators of the reporting and previous period. In the case of valuation of the shares of a new enterprise of the previous period, there may not be a history of a relatively newly created company. This feature of the model characterizes the limitation of its use.

Thus, we have developed and substantiated a model for rating the company stocks, and also highlighted its features. The next step is the calculation of the rating score.

PRACTICAL APPLICATION

The quantitative calculation of the rating score is carried out on the basis of a measure of the coincidence of the actual order of the growth rates of the calculated indicators with the normative order (standard) (17), (19), or (20), depending on the values of the indicators in the base period. This measure can be calculated in different ways. Since the orders (17), (19), and (20) are non-linear, it is advisable to use the normalized Hamming distance between the matrices corresponding to the normative and actual order of the values of the indicators to calculate the rating score. The procedure for calculating such a measure is given by us in [48]. The calculation of the similarity measure of the normative and actual order based on the Hamming distance makes it possible to set the dimension of the final indicator that is convenient for interpretation. The indicator varies from 0 to 100% and characterizes the percentage of the actual dynamics that coincide with the benchmark. This is the desired rating of a stock that meets our requirements, including the ability to compare stocks of companies in different industries, markets, or with a certain specificity. At the same time, instead of many different indicators of the stock attractiveness— P/E, P/S, P/BV, return on equity, dividend yield ratio, dividend yield — we got one, expressed as a percentage, which will be a generalized assessment of the attractiveness of stocks.

It should also be noted that at time intervals of different lengths, the dynamics of the indicators of the same stock can differ significantly. Since investors purchase stocks for different periods, we consider it expedient to form separate rating estimates for time intervals of various lengths. In addition, to obtain a generalized assessment for a number of consecutive periods, the geometric average of private rating indicators is calculated.

Let us test the developed model on the shares of Russian companies from the MICEX 10 Index based on the results of 2019. The stock rating for a one-year period is shown in *Fig. 5*.

A one-year period means that the previous year is taken as the reference period when determining the actual order of growth rates of indicators; biennium — the year before last; three-year — the previous year before last, etc.

The rating of the Lukoil stocks of 69.02% implies that, on average, the actual dynamics of the stocks' attractiveness indicators annually coincide with the normative (benchmark) by 69%. This is the largest value for stocks shown in *Fig. 5*, so they are the most attractive in terms of compliance with the regulatory dynamics. This statement is true for an investment period of 1 year. If the investment period is more than one year, for example, 5 years, then the rating list will be different from the previous one (*Fig. 6*).

We see that the ratings of stocks at different time intervals can differ significantly, both in terms of rating scores and in terms of the distribution of places in the ranked list. Thus, the Lukoil stocks annually have an average rating of 69.02%, while over a five-year interval the rating reaches a very high level of 94.87%. This means that the attractiveness of the Lukoil stocks with investments for a period of 5 years is much higher than with investments for 1 year. We also notice that some stocks that are the least attractive for investment in the short term become attractive in the long term. For example, the Alrosa stocks are in 7th place out of 10 in the rating for a one-year period with a result of 51.98%, but the situation changes when considering them for a 5-year period — they are already in 2nd place with a fairly high rating of 87.46%.

We also note that 8 stocks out of 10 in the list improve their ratings in the long term relative to the short term. At the same time, their relative attractiveness may decrease. For example, the rating of the Norilsk Nickel stocks in the transition from a one-year interval to a five-year interval increases from 67.21 to 75.00%, while their relative attractiveness decreases — the stocks take 2nd place in the ranked list for a one-year period and only 6th for a five-year period.

The higher rating of stocks in the long term is explained by the smoothing of the volatility of the Russian stock market, which in some short-term periods can lead to a significant deterioration in the rating, as in 2017 against the backdrop of an annual market decline of more than 5%. This is another confirmation that company stocks are a long-term investment tool.

It is possible to significantly expand the list of rated stocks both at the expense of stocks remaining on the Russian market and foreign stocks. The presented approach makes it possible to do this.

CONCLUSIONS

Ratings occupy an important informational niche in the analysis of the investment attractiveness of stocks. The ratings, by increasing information transparency, simplify the assessment and adoption of investment decisions in the stock markets and increase their efficiency. However, the use of ratings is constrained by the subjective component in determining the significance of the indicators formed by the rating, as well as in predicting their target values, which necessitates the replacement of expert assessments with objective characteristics. A large number of studies have been carried out in this area, which in their own way solve this problem.

In this study, the increase in the objectivity and informativeness of the stock ratings is decided on the basis of the principles of dynamic co-subordination and dynamic comparability of estimated indicators. The application of these principles made it possible to present traditional indicators of attractiveness of stocks in a new way, to propose specific criteria for their evaluation and an original method of processing.

The developed model was tested on the example of the Russian stocks from the MICEX 10 index. As a result, a list of 10 stocks was compiled, ranked according to the integral characteristic of the investment attractiveness of the selected securities, depending on the expected investment period. The estimates obtained have a high level of objectivity, solidity, dynamism, interpretability, and comparability. Comparability means that the presented algorithm makes it possible to compare

the investment attractiveness of stocks of companies in different industries, scales of activity, markets, and countries without modification.

We believe that our model will be useful both as a primary and as an additional stock analysis tool for long-term fundamental investments. Its application is not focused on obtaining immediate benefits, but on a long-term and sustainable improvement in investment results. The present study was carried out in this context.

An increase in the level of algorithmization of evaluation process in the stock market determines the constant development of this area, so the search for the most relevant ratings will continue. In the future, the results of this study will be tested in other markets. In particular, ratings are currently being formed for a wider range of Russian stocks, as well as US stocks from the S&P500 index. The results will be posted on the Alternative Stock Rating website (URL: http://alteratingstock.biz/currently under construction).

Thus, we have presented a working methodology for the process of investment decision-making in the stock market, which is quite easy to interpret and put into practice, consolidating various investor ideas about the investment attractiveness of stocks. Approbation of the methodology showed that this approach has the potential for widespread use both together with existing assessment systems and independent use.

REFERENCES

1. Adamczyk M. The impact of ratings and other information on the fluctuation of Polish stock indexes. *Bank i Kredyt*. 2020;51(3):239–262. URL: https://bankikredyt.nbp.pl/content/2020/03/BIK_03_2020_02.pdf
2. Ishigami S., Takeda F. Market reactions to stock rating and target price changes in analyst reports: Evidence from Japan. *Journal of International Financial Markets, Institutions and Money*. 2018;52:134–151. DOI: 10.1016/j.intfin.2017.09.014
3. Hong H., Kubik J.D. Analyzing the analysts: Career concerns and biased earnings forecasts. *The Journal of Finance*. 2003;58(1):313–351. DOI: 10.1111/1540–6261.00526
4. Lim T. Rationality and analysts' forecast bias. *The Journal of Finance*. 2001;56(1):369–385. DOI: 10.1111/0022–1082.00329
5. Chan C.-Y., Lo H.-C., Su Y.-R. Distribution of stock ratings and analyst recommendation revision. *The North American Journal of Economics and Finance*. 2014;28:273–286. DOI: 10.1016/j.najef.2014.03.004
6. Ashour S., Hao G.Q. Do analysts really anchor? Evidence from credit risk and suppressed negative information. *Journal of Banking & Finance*. 2019;98:183–197. DOI: 10.1016/j.jbankfin.2018.11.006
7. Zhang C., Qian A., Shi X. The effect of affiliated analysts on stock recommendations: Evidence from share pledges in China. *China Journal of Accounting Research*. 2020;13(1):79–107. DOI: 10.1016/j.cjar.2020.02.001
8. Twedt B., Rees L. Reading between the lines: An empirical examination of qualitative attributes of financial analysts' reports. *Journal of Accounting and Public Policy*. 2012;31(1):1–21. DOI: 10.1016/j.jaccpubpol.2011.10.010
9. Clement M.B., Tse S.Y. Financial analyst characteristics and herding behavior in forecasting. *The Journal of Finance*. 2005;60(1):307–341. DOI: 10.1111/j.1540–6261.2005.00731.x
10. Xue H. Independent and affiliated analysts: Disciplining and herding. *The Accounting Review*. 2017;92(4):243–267. DOI: 10.2308/accr-51631
11. Asghar M.Z., Rahman F., Kundi F.M., Ahmad S. Development of stock market trend prediction system using multiple regression. *Computational and Mathematical Organization Theory*. 2019;25(5):271–301. DOI: 10.1007/s10588–019–09292–7
12. Bilev N.A. Modelling of stock market security price dynamics using market microstructure data. *Finansy: teoriya i praktika = Finance: Theory and Practice*. 2018;22(5):141–153. (In Russ.). DOI: 10.26794/2587–5671–2018–22–5–141–153

13. Meher B.K., Hawaldar I.T., Spulbar C., Birau R. Forecasting stock market prices using mixed ARIMA model: A case study of Indian pharmaceutical companies. *Investment Management and Financial Innovations*. 2021;18(1):42–54. DOI: 10.21511/imfi.18(1).2021.04
14. Sharma S., Kaushik B. Quantitative analysis of stock market prediction for accurate investment decisions in future. *Journal of Artificial Intelligence*. 2018;11(1):48–54. DOI: 10.3923/jai.2018.48.54
15. Alzheev A.V., Kochkarov R.A. Comparative analysis of ARIMA and lSTM predictive models: Evidence from Russian stocks. *Finance: Theory and Practice*. 2020;24(1):14–23. DOI: 10.26794/2587–5671–2020–24–1–14–23
16. Singh J., Khushi M. Feature learning for stock price prediction shows a significant role of analyst rating. *Applied System Innovation*. 2021;4(1):17. DOI: 10.3390/asi4010017
17. Asquith P., Mikhail M.B., Au A.S. Information content of equity analyst reports. *Journal of Financial Economics*. 2005;75(2):245–282. DOI: 10.1016/j.jfineco.2004.01.002
18. Gosiewska A., Kozak A., Biecek P. Simpler is better: Lifting interpretability-performance trade-off via automated feature engineering. *Decision Support Systems*. 2021;150:113556. DOI: 10.1016/j.dss.2021.113556
19. Avramov D., Cheng S., Lior M. Machine learning versus economic restrictions: Evidence from stock return predictability. *SSRN Electronic Journal*. 2019. DOI: 10.2139/ssrn.3450322
20. Harvey C.R., Liu Y., Zhu H. ...and the cross-section of expected returns. *The Review of Financial Studies*. 2016;29(1):5–68. DOI: 10.1093/rfs/hhv059
21. Cochrane J.H. Discount rates. *The Journal of Finance*. 2011;66(4):1047–1108. DOI: 10.1111/j.1540–6261.2011.01671.x
22. Karminsky A., Polozov A. Handbook of ratings: Approaches to ratings in the economy, sports, and society. Cham: Springer-Verlag; 2016. 356 p. DOI: 10.1007/978–3–319–39261–5
23. Digo S.N., Sokolova A.M. Shaping the stock portfolio by the investment rating method. *Vestnik Rossiiskogo ekonomicheskogo universiteta imeni G.V. Plekhanova = Vestnik of the Plekhanov Russian University of Economics*. 2018;(1):75–89. (In Russ.). DOI: 10.21686/2413–2829–2018–1–75–89
24. Badokina E.A., Maksimenko O.I. The rating approach to assessing the dividend policy effectiveness of Russian public companies. *Korporativnoe upravlenie i innovatsionnoe razvitie ekonomiki Severa: Vestnik Nauchno-issledovatel'skogo tsentra korporativnogo prava, upravleniya i venchurnogo investirovaniya Syktyvkarskogo gosudarstvennogo universiteta = Corporate Governance and Innovative Economic Development of the North: Bulletin of Research Center of Corporate Law, Management and Venture Investment of Syktyvkar State University*. 2018;(4):36–46. (In Russ.).
25. Gorbunova N.A. Using the methodology of rating evaluation of risk and return of securities public company. *Kazanskii sotsial'no-gumanitarnyi vestnik = The Kazan Socially-Humanitarian Bulletin*. 2016;(5):13–16. (In Russ.).
26. Pyatnitsky D.V. Rating and valuation of investment attractiveness of companies. *Izvestiya vysshikh uchebnykh zavedenii. Seriya: Ekonomika, finansy i upravlenie proizvodstvom = News of Higher Educational Institutions. Series: Economy, Finance and Production Management*. 2018;(1):52–60. (In Russ.).
27. Samsonov A.V., Vasiliev I.V. Comparative analysis of investment attractiveness of oil and gas industry enterprises in Russia. *Moskovskii ekonomicheskii zhurnal = Moscow Economic Journal*. 2020;(2):50. (In Russ.). DOI: 10.24411/2413–046X-2020–10088
28. Vygodchikova I. Toolkit of decisions making about investment of large Russian companies using hierarchical procedure of ranking and minimax approach. *Prikladnaya informatika = Journal of Applied Informatics*. 2019;14(6):123–137. (In Russ.). DOI: 10.24411/1993–8314–2019–10054
29. Mallikarjuna M., Rao R.P. Evaluation of forecasting methods from selected stock market returns. *Financial Innovation*. 2019;5:40. DOI: 10.1186/s40854–019–0157-x
30. Różycki M. Inertia in assessing the possibilities of economic development: Limits in modelling economies. In: Sarfraz M., Adbullah M.I., Rauf A., Shah S.G.M., eds. Sustainable management practices. London: IntechOpen; 2019:65–76. DOI: 10.5772/intechopen.86351

31. Seth H., Talwar S., Bhatia A., Saxena A., Dhir A. Consumer resistance and inertia of retail investors: Development of the resistance adoption inertia continuance (RAIC) framework. *Journal of Retailing and Consumer Services*. 2020;55:102071. DOI: 10.1016/j.jretconser.2020.102071
32. Zhuravsky Yu.A. Economic inertia and acceleration in the methodology of economic dynamics. *Ekonomika i upravlenie innovatsiyami = Economics and Innovation Management*. 2019;(4):20–34. (In Russ.). DOI: 10.26730/2587–5574–2019–4–20–34
33. Gunitsky S. Rival visions of parsimony. *International Studies Quarterly*. 2019;63(3):707–716. DOI: 10.1093/isq/sqz009
34. Becchio G. The two blades of Occam's razor in economics: Logical and heuristic. *Economic Thought*. 2020;9(1):1–17. URL: https://core.ac.uk/download/pdf/326909303.pdf
35. Cohen M.R., Nagel E. An introduction to logic and scientific method. Germantown, MD: Hughes Press; 2013. 480 p.
36. Mamchur E.A., Ovchinnikov N.F., Uemov A.I. The principle of simplicity and measures of complexity. Moscow: Nauka; 1989. 304 p. (In Russ.).
37. Opolev P.V. The logical principle of simplicity in sciences about complexity. *Vestnik Omskogo universiteta = Herald of Omsk University*. 2014;(4):87–90. (In Russ.).
38. Anikin A.V., Yashina N.I., Kashina O.I., Pronchatova-Rubtsova N.N. The methodical aspects of analysis of the dependence of the gross regional product of high-tech branches from financial factors in the conditions of knowledge economy. *Fundamental'nye issledovaniya = Fundamental Research*. 2019;(7):7–12. (In Russ.).
39. Allakhverdov V.M., Karmin A.S., Shilkov Yu.M. Introduction to the heading "History and philosophy of science". *Metodologiya i istoriya psikhologii = Methodology and History of Psychology*. 2007;2(1):227–230. (In Russ.).
40. Syroezhin I.M. Improving the system of indicators of efficiency and quality. Moscow: Ekonomika; 1980. 192 p. (In Russ.).
41. Tret'yakova E.A., Osipova M. Yu. Evaluation of sustainable development indicators for regions of Russia. *Studies on Russian Economic Development*. 2018;29(2):124–134. DOI: 10.1134/S 1075700718020144 (In Russ.: *Problemy prognozirovaniya.* 2018;(2):24–35.).
42. Polyanskaya I.G., Yurak V.V. Balanced natural resource management of a region: Estimation by dynamic normal technique. *Ekonomika regiona = Economy of Regions*. 2018;14(3):851–869. (In Russ.). DOI: 10.17059/2018–3–12
43. Biryukova V.V. Production system management based on a balanced development model. *IOP Conference Series: Materials Science and Engineering*. 2020;753:062014. DOI: 10.1088/1757–899X/753/6/062014
44. Pogostinskaya N.N., Pogostinskiy Yu.A., Vlasova M.S. Measuring the strategy for socio-economic development of the Russian Arctic zone. *Arktika: ekologiya i ekonomika = Arctic: Ecology and Economy*. 2019;(1):21–33. (In Russ.). DOI: 10.25283/2223–4594–2019–1–21–33
45. Kazakova N.A., Kogdenko V.G. Monitoring of the main parameters of environmental safety industrial production. *Ekologiya i promyshlennost' Rossii = Ecology and Industry of Russia*. 2021;25(3):60–65. (In Russ.). DOI: 10.18412/1816–0395–2021–3–60–65
46. Fernandez P. Valuation using multiples: Dispersion. Useful to compare and to negotiate. *SSRN Electronic Journal*. 2019. DOI: 10.2139/ssrn.274972
47. Raza H., Ramakrishnan S., Gillani S., Ahmad H. The effect of dividend policy on share price: A conceptual review. *International Journal of Engineering and Technology*. 2018;7(4):34–39. DOI: 10.14419/ijet.v7i4.28.22386
48. Tonkikh A.S., Ionov A.V., Ionov S.A. Methodological tools of increase of firm market value and the compliance of the balance of interests. *Audit i finansovyi analiz = Audit and Financial Analysis*. 2013;(2):280–319. (In Russ.).

ABOUT THE AUTHORS

Andrei S. Tonkikh — Dr. Sci. (Econ.), Assoc. Prof.; Prof., Admiral Ushakov State Maritime University, Novorossiysk, Russia
https://orcid.org/0000-0001-9085-5691
Corresponding author
andrew.tonkih@gmail.com

Svetlana A. Tonkikh — Cand. Sci. (Econ.), Lecturer, Admiral Ushakov State Maritime University, Novorossiysk, Russia svetlana.tonkih@gmail.com
https://orcid.org/0000-0001-6358-8364
svetlana.tonkih@gmail.com

Elena Yu. Maslova — Lecturer, Kuban State University Novorossiysk Branch, Novorossiysk, Russia maslovaey@mail.ru
https://orcid.org/0000-0003-1559-3251
maslovaey@mail.ru

Authors' declared contribution:
A. S. Tonkikh — statement of the problem, development of the conceptual framework of the article, critical analysis of the literature, substantiation of the research methodology.
S. A. Tonkikh — model development and validation.
E. Yu. Maslova — collection and analysis of data, description of the results, formation of research conclusions.

Conflicts of Interest Statement: The authors have no conflicts of interest to declare.

The article was submitted on 17.09.2021; revised on 07.10.2021 and accepted for publication on 25.02.2022.
The authors read and approved the final version of the manuscript.