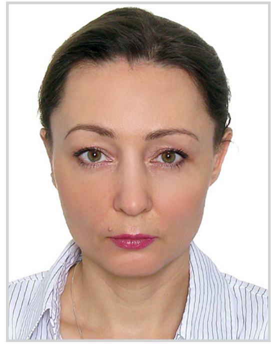
ECONOMIC ANNALS-XXI
ISSN 1728-6239 (Online)
ISSN 1728-6220 (Print)
https://doi.org/10.21003/ea
http://www.soskin.info/ea/

Volume 183 Issue (5-6)'2020

Citation information: Puchkova, S., Brovkin, A., & Potanina, Yu. (2020). Fundamental analysis: the essence and necessity of application in portfolio investment (on the example of the Russian companies). *Economic Annals-XXI, 183*(5-6), 116-124.
doi: https://doi.org/10.21003/ea.V183-11

UDC: 336.58





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Fundamental analysis: the essence and necessity of application in portfolio investment (on the example of the Russian companies)

Abstract
Fundamental analysis is the interpretation, assessment and forecast of analytical indicators at the macro- and micro-levels and expectations of market participants which can directly or indirectly affect the price dynamics of financial assets.
To develop a mathematical apparatus for solving the problem of classifying sets, it is necessary to consider the formal solution of the problem. This statement immediately shows the main issue - the lack of solutions for constructing classifiers for the problem of classifying sets.
The solution to the problem of investment analysis is expressed in the search for the overall best structure for all objects specified as sets available in the database.
The main purpose of using the additional investment Toolkit is to try to reconcile the results of comparative analysis by applying NPV and IRR Methods, more precisely, to link the latter to the former, since this approach gives priority to the net reported income of the project. The economic value of this research method lies in the ability to predict the ratio of NPV and IRR in the future with high accuracy, based on the data entered into the model.
Keywords: Fundamental Analysis; Portfolio Investment; Market Participants; Dynamics; NPV; IRR
JEL Classification: C21; G11
Acknowledgements and Funding: The authors received no direct funding for this research.
Contribution: The authors contributed equally to this work.
DOI: https://doi.org/10.21003/ea.V183-11

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Фундаментальний аналіз: сутність і необхідність використання в портфельному інвестуванні (на прикладі російських компаній)
Анотація
Фундаментальний аналіз – це інтерпретація, оцінка та прогноз аналітичних показників на макро- і мікрорівнях й очікувань учасників ринку, які можуть прямо побічно чи опосередковано впливати на динаміку цін фінансових активів. Дослідники підкреслюють важливість аналітичних показників на макро- та мікрорівнях у визначенні цінової динаміки фінансових активів.
Для розробки математичного апарату розв'язання задачі класифікації множин необхідно розглянути формальне розв'язання задачі. Це твердження відразу показує головну проблему – відсутність рішень для побудови класифікаторів для задачі класифікації множин. Саме тому необхідно розробити рішення для відображення наборів спостережень об'єкта в єдиній багатовимірній множині.
Рішення задачі інвестиційного аналізу виражається в пошуку загальної найкращої структури для всіх об'єктів, зазначених у вигляді множин, наявних у базі даних.
Основна мета використання додаткового інвестиційного інструментарію полягає в тому, щоби спробувати узгодити результати порівняльного аналізу шляхом застосування методів NPV і IRR, точніше, пов'язати останні з першими, оскільки такий підхід віддає пріоритет чистому звітному доходу проекту й мінімізує суб'єктивний фактор.
Ключові слова: фундаментальний аналіз; портфельні інвестиції; учасники ринку; динаміка.

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Фундаментальный анализ: сущность и необходимость использования в портфельном инвестировании (на примере российских компаний)
Аннотация
Фундаментальный анализ – это интерпретация, оценка и прогноз аналитических показателей на макро- и микроуровнях и ожиданий участников рынка, которые могут прямо или косвенно влиять на динамику цен финансовых активов.
Для разработки математического аппарата решения задачи классификации множеств необходимо рассмотреть формальное решение задачи. Это утверждение сразу показывает главную проблему – отсутствие решений для построения классификаторов для задачи классификации множеств.
Решение задачи инвестиционного анализа выражается в поиске общей наилучшей структуры для всех объектов, указанных в виде множеств, имеющихся в базе данных.
Основная цель использования дополнительного инвестиционного инструментария состоит в том, чтобы попытаться согласовать результаты сравнительного анализа путем применения методов NPV и IRR, точнее, связать последние с первыми, поскольку такой подход отдает приоритет чистому отчетному доходу проекта и минимизирует субъективный фактор.
Ключевые слова: фундаментальный анализ; портфельные инвестиции; участники рынка; динамика.

1. Introduction

Improving the efficiency of portfolio investments will create prerequisites for the rapid development of the stock market of Russia and attract investment resources, the need for which is associated with the need to restore and modernize the fixed assets of enterprises.

Given that investors are interested in making only those investment operations on the stock market that guarantee capital security and a satisfactory level of income, they face the need to make the right investment decisions. The process of conducting fundamental analysis makes it possible to assess the risks of investing in a certain financial instrument and determine the potential level of future income.

2. Brief Literature Review

The implementation of portfolio investments implies the need to make investment decisions in relation to financial instruments that should be filled in the investment portfolio (Basu, 1977). In the context of portfolio investment, «investment decisions» should be understood as an investor's conclusion on the feasibility of investing funds in a certain financial instrument on the financial market, at a certain point in time (Bhandari, 1988). It is quite necessary to understand that the investment decision is made at a certain point in time, because the securities market itself is quite dynamic (Beshears & Milkman, 2011). The very word «decision», according to the explanatory dictionary, means the conclusion, completion of something (Binay, 2008). For this purpose, financial analysts and investors use various types of analysis, including fundamental analysis (Damodaran, 2006). The need to analyze securities before making investment decisions occurs in many works devoted to investment (Vardharaj & Fabozzi, 2007). In particular, Raghu (2014) notes that the analysis of securities includes the study of individual types of securities (or groups of securities) within the main categories. One of the purposes of such an assessment is to determine those securities that are incorrectly valued at the moment (Sureshkumar & Elango, 2011).

Stock valuation is usually one of the most important goals of stock analysis (Obamuyi, 2013). When it comes to evaluating shares, it is assumed that the internal value of this stock is determined to compare this value with the current market rate of the stock» (Ali & Rehman, 2013). In both works, the first and second theses on securities analysis, the main emphasis is placed on its purpose (see also Weitao et al., 2016). Thus, the main purpose of the analysis can be considered to determine the correctness of the market's assessment of these securities (Fung et al., 2010). There are many different types (methods) analysis of securities (Wafi et al., 2015). However, fundamental, technical and rating analyses are the most common (Buckley et al., 2014).

Fundamental analysis is a term for a number of methods for predicting the market (exchange) value of a company based on the analysis of financial and production indicators of its activities (Green et al., 2013). This definition focuses on forecasting the value of a company based on its performance (Harris et al., 2015).

3. Materials and Methods

The theoretical basis of the research is based on generally accepted provisions of macroeconomic theory and finance theory, such as: modern portfolio theory, equilibrium models of asset valuation (capital asset valuation model, arbitrage pricing theory, and others). We also use modern developments in the field of investment analysis: generally accepted methods of real estate valuation, models for assessing the return and risk of real estate investments, models for building real estate indices and eliminating measurement errors, and others.

4. Results

A certain amount of fundamental analysis is performed at four main levels or stages, but if necessary, you can reduce the volume or exclude certain stages of this analysis. This variant of the analysis direction is often called «top-down» analysis (Figure 1).

According to this direction, the first stage analyzes the general situation in the country's economy (world economy), or in the securities market as a whole.

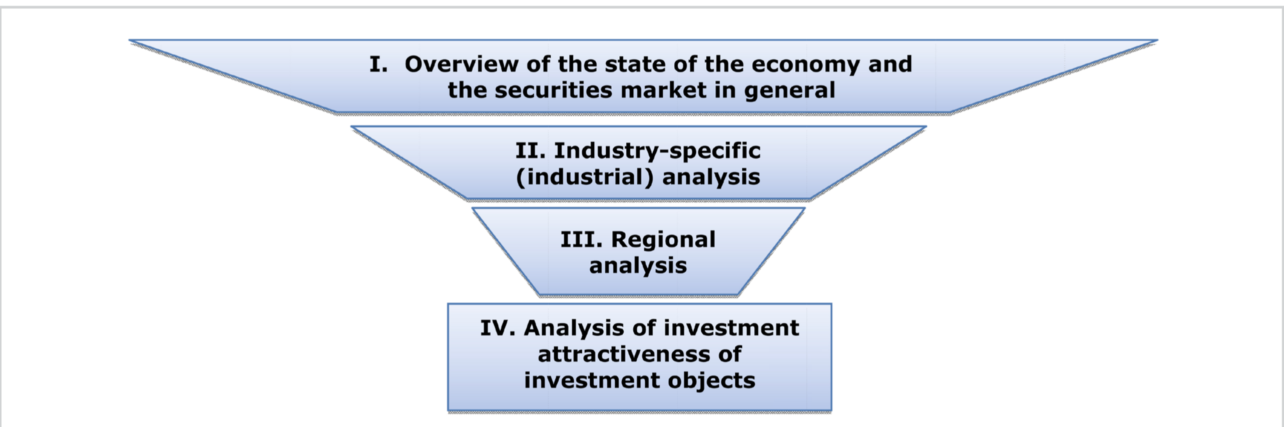

Figure 1:
Conditional stages of fundamental analysis
Source: Author's own development based on McLean & Pontiff (2015) and conventional practice

At the second and third stages, industry and regional analysis is carried out. At these stages, it is necessary to determine the current economic state of a particular industry or region and predict its future state (McLean & Pontiff, 2015).

The last stage is the final one. Most often, investors carry out only this stage, and for the previous stages, they use already prepared research conducted by various agencies. Based on the comparison, conclusions and forecasts are made about future price changes (an over-valued or undervalued asset) and decisions are made about further actions, namely: it is better to buy or sell the asset (Green et al., 2013).

It is advisable to combine the third stage of fundamental analysis proposed with the second stage, so the main stages of fundamental analysis will be as follows (Raghu, 2014):
Stage I. Macroeconomic analysis;
Stage II. Analysis of the Issuer's industry of activity;
Stage III. Analysis of the company-Issuer of securities.

Fundamental analysis should find out what security to buy, sell or hold in the portfolio, and technical analysis determines when it should be implemented (Wafi et al., 2015), its variant is presented in Figure 2.

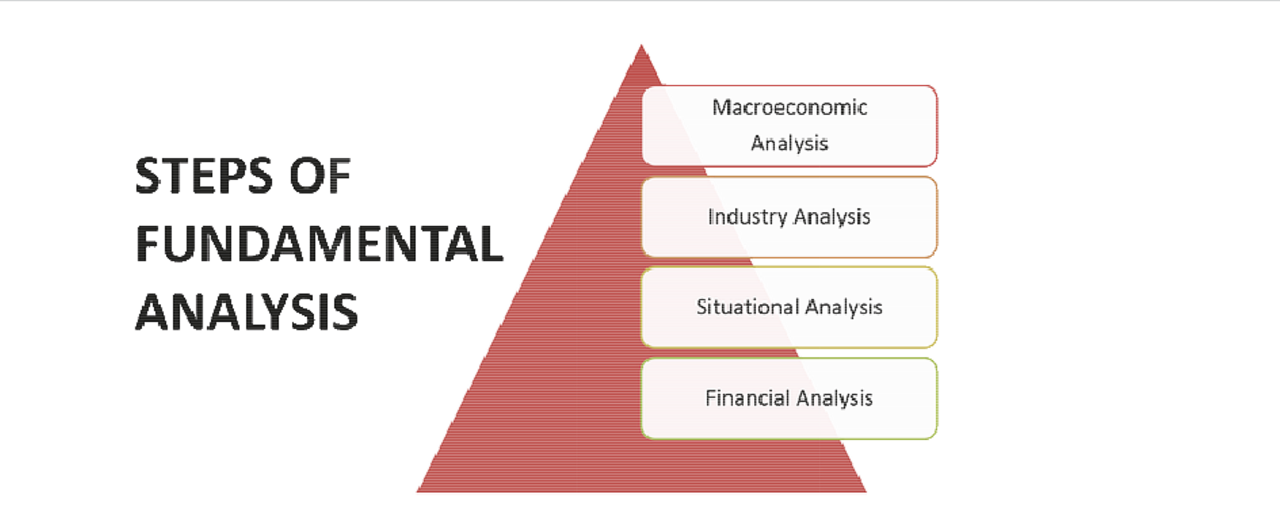

Figure 2:
Steps of fundamental analysis
Source: Buckley et al. (2014)

In Russia, financial analysis uses expert evaluation firms and analytical departments of investment funds with foreign capital in their practical activities. In general, financial market participants use an intuitive approach, which does not always allow them to correctly assess the investment quality of securities or the value of collateral.

Quite common among investors in the global stock markets is the use of the so-called «Buffett Test» - a series of questions, the answers to which allow the investor to make the right investment decision. The Buffett test consists of the following questions (Harris et al., 2015): There is enough information about the business of the company? How has the company performed in recent years? Are there long-term prospects? Do the company's managers act rationally? Who are managers? Do managers put the interests of shareholders above their own? How profitable is the company? Is there enough free cash flow to shareholders? What is the return on invested capital? Or does the company have a clear competitive advantage? What is the company's fair share price? (Figure 3).

Each question is evaluated on a five-point scale, with a value of 5 indicating the maximum positive response to the question, and a value of 1 indicating the maximum negative response.

For each question, the average score is calculated based on expert ratings. In other words, the received score for a particular question will be calculated using the following formula:

$$M_i = \frac{\sum e_{ij}}{n}, \quad (1)$$

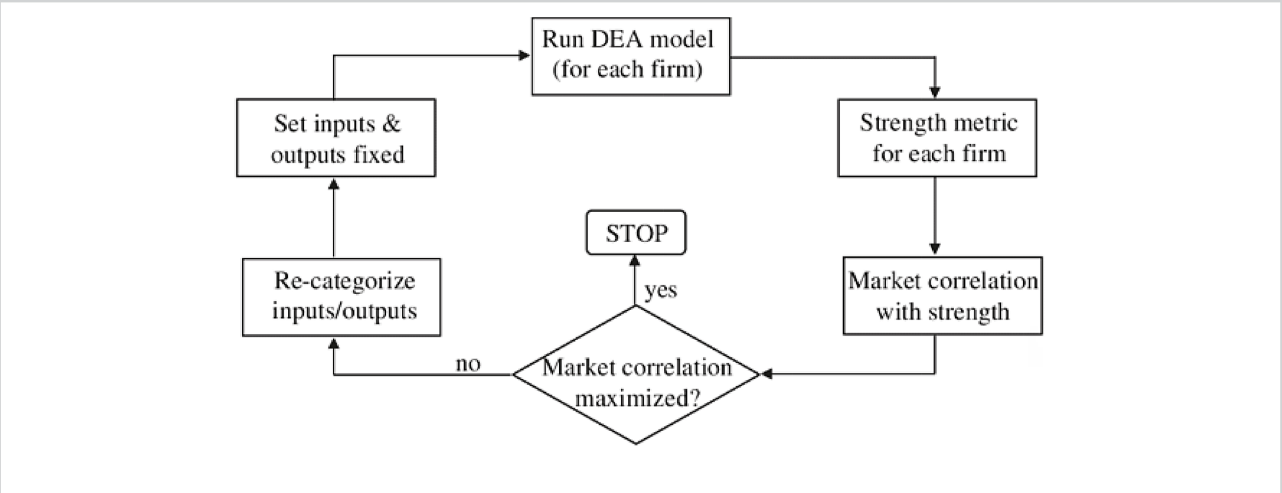

Figure 3:
Schematic view of the generalized DEA approach
Source: Harris et al. (2015)

where:
M_i is the score for the i-th question;
e_{ij} is assessment (score) on i-th questions, j-th expert;
n is the number of experts who evaluated the issue.

Then, the final score for all questions is determined, which acts as a criterion for making an investment decision. The final rating is the average of all ratings (points) multiplied by corrective coefficients. The final evaluation can be determined using the following formula:

$$IK = \frac{\sum M_i \cdot k_i}{11}, \quad (2)$$

where:
IK is the final assessment on all issues, which acts as an investment criterion;
M_i is the rating (point) on the i-th question;
k_i is the correction factor for the i-th question, provided that $\sum k_i = 11$.

If the question is more important, the correction coefficient is set to be more than 1, and if the question is less important, it is set to be less than 1. The sum of the correcting coefficients must be equal to 11. The value of adjusting coefficients should be set according to the consensus opinion of experts. An investment decision regarding the purchase of a security is made if the final score (investment criterion) is more than 4 points. If it is less than 4, then the investment decision to buy securities, according to this test, is not advisable to make.

The procedure for bringing payments to the base date is called discounting. The economic meaning of this procedure is as follows. Then, the discounted value of the payment is $P(t)$ performed at time t is equal to a certain value of $Pd(t)$, which, being issued at the loan interest r, gives at moment t the value $P(t)$:

$$Pd(t)(1+r)^t = P(t), \quad (3)$$

then, the discounted value of the payment $P(t)$ is equal to:

$$Pd(t) = \frac{P(t)}{(1+r)^t}. \quad (4)$$

The amount of loan interest r is called the discount rate (reduction) and, in addition to the above sense, is interpreted in the economic literature as the rate of preference for income received at the moment over income that will be received in the future.

The algorithm for calculating the payback period (PP) depends on the uniformity of the distribution of projected investment income. The General formula for calculating the PP indicator is as follows:

$$PP = n, at\ which\ CF_t > IC >, \quad (5)$$

where:
CF_t is the total net cash flow of income;
IC is the sum of cash flows of expenses (investments).

The investment payback period indicator is very simple to calculate, but it has a number of drawbacks that need to be taken into account in the analysis.

The economic meaning of this indicator is as follows: the enterprise can make any investment decisions, the level of profitability of which is not lower than the current value of the CC indicator (or the price of the source of funds for this project, if it has a target source). The IRR (internal rate of return) indicator calculated for a specific project is compared with it, and the relationship between them is as follows.

If:
$IRR > CC$, then the project should be accepted;
$IRR < CC$, then the project should be rejected;
$IRR = CC$, then the project is neither profitable nor unprofitable.

Regardless of what the IRR is compared to, it is obvious that a project is accepted if its IRR is greater than a certain threshold value; therefore, all other things being equal, as a rule, a higher IRR value is considered preferable.

However, if the analyst does not have a specialized financial calculator available, the practical application of this method is complicated. In this case, the method of consecutive iterations is applied using tabulated multiplier values, which are discounted. To do this, use tables to select two values of the discount coefficient $r_1 < r_2$ so that in the interval (r_1, r_2) the NPV $function = f(r)$ it changed its value from « + » to « - » or from « - » to « + ». Then, apply the formula:

$$IRR = r_1 + \frac{f(r_1)}{f(r_1) - f(r_2)} \times (r_2 - r_1), \quad (6)$$

where:
r_1 is the value of the tabulated discount coefficient, at which $f(r_1) > 0$ ($f(r > 1)$);
r_2 is the value of the tabulated discount coefficient, at which $f(r_2) < 0$ ($f(r_2) > 0$).

The accuracy of calculations is inversely proportional to the length of the interval (r_1, r_2) and the best approximation using the tabulated values is achieved in the case when the length of the interval is minimal (equal to 1%), i.e., r_1 and r_2 are the closest to each other values of the discount factor satisfying conditions (in case of change of sign of the function from « + » to « - »):

r_1 is the value of the tabulated discount coefficient, which minimizes the positive value of the NPV indicator, i.e.:

$$f(r_1) = minr\{f(r) > 0\}, \quad (7)$$

r_2 is the value of the tabulated discount factor, which maximizes the negative value of the NPV indicator, i.e.:

$$f(r_2) = maxr\{f(r) < 0\}. \quad (8)$$

By mutually replacing the coefficients r_1 and r_2, similar conditions are written for a situation when the function changes its sign from «-» to «+».

Let there be a set of classes:

$$C = \left\{\overline{C}^1, \overline{C}^2, \ldots, \overline{C}^K\right\},$$

where:
$\overline{C}^1 = \{\overline{c}^1\}, \overline{C}^2 = \{\overline{c}^2\}, \ldots \overline{C}^K = \{\overline{c}^K\}$.

It is also necessary to note that the object belongs to only one class:
$\overline{C}^i \cap \overline{C}^j = \emptyset$, when $i \neq j$.

In practice, in databases, classes are defined as approximations of natural classes:

$C^K \subset \overline{C}^K$,

where:

$C^K = \{c^K\} \subset \{\overline{c}^K\}$.

C^K is defined as a set of observations $c^K = \{c_1^K, \ldots, c_{n_K}^K\}$ and observations have the form of a feature vector in the source space:

$$z = (z_1, \ldots, z_M)^\top .$$

$$y = a_0 + \sum_{i=1}^{M} a_i \varphi_i(z) = a_0 + \sum_{i=1}^{M} a_i x_i , \quad (9)$$

the structures that are generated for searching are:

$$y_1 = a_0 + a_0 x_{i_1}, \ldots, y_k = a_0 + a_1 x_{i_1} + \ldots + a_k x_{i_k}, \ldots$$

Progressively more complex ones are built up as well, to each of which, at each k -th stage, the best generalized variable x_i ... k is added, from the point of view of external criteria, i_k as a new member of this structure. Generalized variables are formed from combinations of the source space, and the complete structure record has the following form:

$$y = a_0' + \sum_{i=1}^{m} a_i' z_i + \sum_{i=1}^{m} \sum_{j=1}^{m} a_{ij}' z_i z_j + \sum_{i=1}^{m} \sum_{j=1}^{m} \sum_{k=1}^{m} a_{ijk}' z_i z_j z_k + \ldots , \quad (10)$$

where:

z_i are variables of an extended set of input variables, all possible products of which form a set of generalized variables.

To ensure greater accuracy of the models and the ability of the algorithm to understand the properties of classification objects, a mechanism for expanding the set in and initial variables is modeled and applied. In this paper, it includes the extension of the representation of a set of variables Z by additional variables:

$\frac{1}{Z}, \sqrt[3]{Z}, \frac{1}{\sqrt[3]{Z}}$.

For convenience, next, denote the variables with the root extended set again as Z.

The number of members of such a log is determined by the combination (11), where m is the number of arguments (variables) of the root extended set:

$$S = C_{m+p}^{m} - 1 . \quad (11)$$

Since all generalized variables form a complete polynomial together, then it is advisable to form a multiplicative tree of generalized variables next.

A recurrent calculation is that the next value of the parameter vector is calculated based on the previous ones. The first two terms of this vector are transformed by direct calculation (13), then, the calculation proceeds according to the following formulas:

$$X_s a_s = y_s , \quad (12)$$

$$H_s | g_s = X_s^T X_s | X_s^T , \quad (13)$$

$$\hat{a} = H_s^{-1}, g_s , \quad (14)$$

$$[H_{s+1} | g_{s+1}] = \begin{bmatrix} H_s & h_{s+1} \\ h_{s+1} & w_{s+1} \end{bmatrix}^{-1} \begin{bmatrix} g_s \\ \gamma_{s+1} \end{bmatrix}, \quad (15)$$

$$\begin{matrix} \hat{a}_s \\ \hat{a}_{s+1} \end{matrix} = \begin{bmatrix} H_s & h_{s+1} \\ h_{s+1} & w_{s+1} \end{bmatrix}^{-1} \begin{bmatrix} g_s \\ \gamma_{s+1} \end{bmatrix} . \quad (16)$$

The recurrent algorithm is most effective in algorithms that often compare models obtained by adding a single argument sequentially. As a consequence of the formulas given above, it is possible to significantly reduce the number of operations for obtaining $\hat{a}_{s+1}$ than calculating H_{s+1}.

Below is a formula for the criterion, the best structure was selected based on this criterion, and a graph of the object:

$$\frac{1}{K}\sum_{j=1}^{K}\frac{1}{n_j}\sum_{r_i \in R_j}^{n_j}\left\|r_i - \bar{r}_j\right\|^2, \tag{17}$$

$$a_0 + a_1 * DIA + a_2 * SYS * DIA\ . \tag{18}$$

In Figure 4, you can see that the model reproduces quite accurately the trend value of the modeled object, but the values themselves are not accurately transferred, since the model is quite simple. The model object was the ratio of NPV and IRR, and the visualization model shows a correlation between expected and real values. The time period of modeling is 36 months.

In practice, comparative analysis of investment projects is carried out in most cases by simply comparing the values of internal rates of return.

5. Conclusion

Despite certain theoretical inaccuracies, the model allows us to eliminate the influence of the subjective choice of the base interest rate on the results of analysis. Indeed, the main purpose of using the additional investment Toolkit is to try to reconcile the results of comparative analysis by applying NPV and IRR Methods, more precisely, to link the latter to the former, since this approach gives priority to the net reported income of the project. In addition, the use of the additional investment tool is correct only in the case of comparative analysis of alternative or mutually exclusive projects, which further narrows the scope of its application and makes it completely unsuitable for analyzing the investment program. The economic value of this research method lies in the ability to predict the ratio of NPV and IRR in the future with high accuracy, based on the data entered into the model.

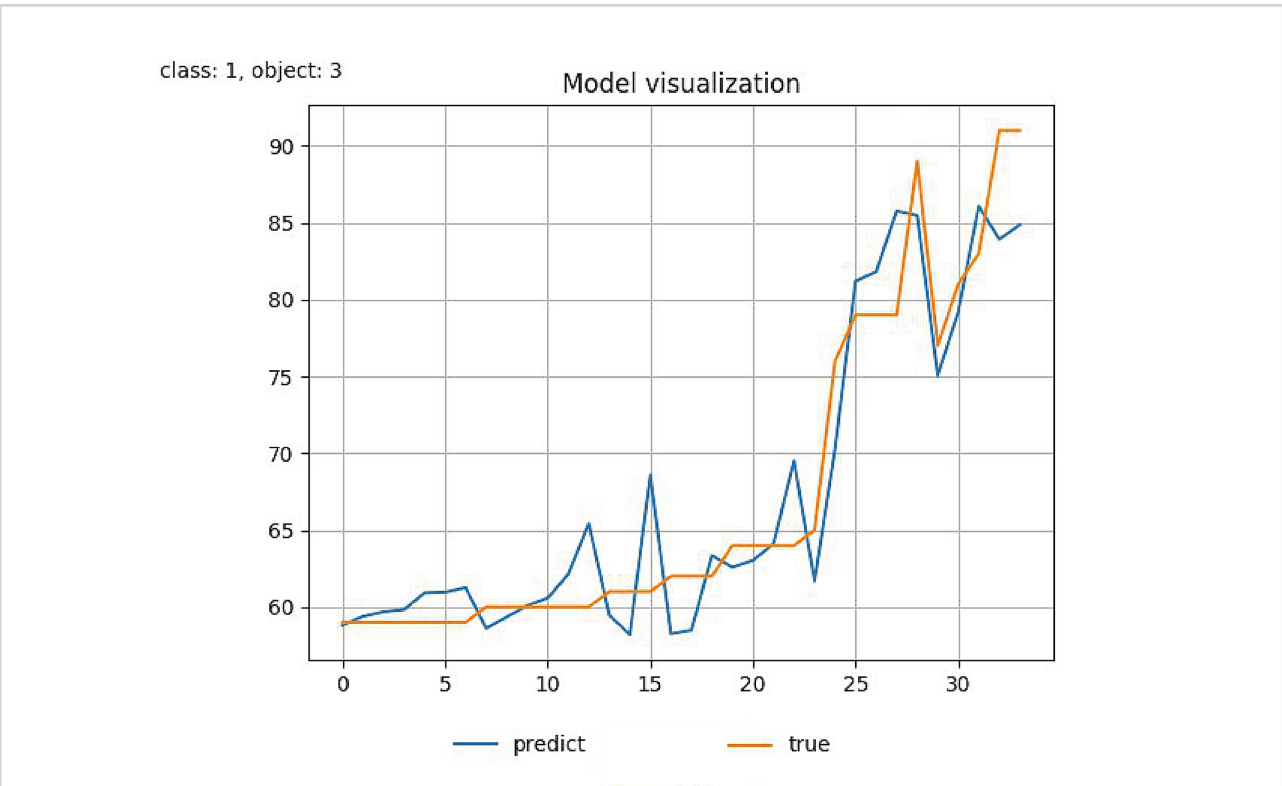

Figure 4:
Displaying the model by internal class variance criteria
Source: Authors' own development

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Received 11.03.2020
Received in revised form 20.03.2020
Accepted 26.03.2020
Available online 4.06.2020