

EVALUATING THE EFFECTIVENESS OF COMPANIES' FINANCIAL POLICIES USING LOGISTIC REGRESSION: A CASE STUDY OF ELECTRIC POWER COMPANIES

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Abstract

Subject. This article assesses the effectiveness of companies' financial policies using logistic regression. It considers the financial policy assessment as a comprehensive analysis that helps evaluate the company's financial performance and make a conclusion based on a single criterion.

Objectives. The article aims to develop a single (universal) criterion helping conclude of the company's financial policy effectiveness.

Methods. For the study, I used a comprehensive approach based on the developed logit model, financial analysis, systems approach, and an overview of literature sources on the subject.

Results. The article presents a developed methodology for evaluating the effectiveness of financial policy determined by the effectiveness of financial policy (EFP) equation for Russian electric power companies.

Relevance. The results obtained can be used in practice to evaluate the financial policy by company external and internal users.

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In the context of a volatile external economic environment and financial activity, an urgent task is to evaluate the effectiveness of the financial policy of companies. Evaluating the effectiveness of financial policy implementation is an important factor both for companies, including top managers and shareholders, and external financial market participants. The purpose of evaluating the financial policy of companies is to provide a complete conclusion on the effectiveness of its implementation. At the same time, the task of evaluation is complicated by the lack of a single (universal) criterion that can provide a comprehensive view of the effectiveness of the companies' financial activities implementation.

As world practice shows, companies must closely monitor their financial condition to ensure effective operations. The ability of companies to ensure high economic efficiency in the long term is of fundamental importance.

According to the Global Competitiveness Index¹, the Russian economy has stopped growing in the world competitiveness ranking². The main reason was the deterioration of the investment climate. Among the negative factors in the study the Global Competitiveness Index there are the following: an increase in the regulatory burden on business, a new wave of sanctions, and, as a result, the outflow of foreign direct investment, and a decrease in the competitiveness of companies.

Comprehensive evaluation of the effectiveness of company's financial policies is a necessary prerequisite for the development of the Russian economy. It helps create conditions for high capitalization of companies, capacious financial market, timely management decisions, and predictable dynamics of the key financial indicators of companies³.

Despite the increased scientific interest in the problem of evaluating the effectiveness of the financial policy of companies and a significant number of scientific developments in this area, currently, there is no single criterion to assess the effectiveness of the financial policy of companies.

In financial analysis, an extensive set of financial coefficients is used, on the basis of which a conclusion is made about the effectiveness of the implementation of the company's financial policy. At the same time, the calculated financial ratios do not have clear boundaries. This complicates the task of experts when performing a comparative analysis of companies. The specific weight of the assessment of the effectiveness of the financial policy of companies is based on expert opinions of specialists and their experience.

The article offers a comprehensive approach to assessing the effectiveness of the financial policy of companies based on the developed logit model. The model calculates the value of the criterion of implemented financial policy effectiveness in the range from 0 to 1. The main advantage of this model is the range that helps conclude in the most comparable way on some of the analyzed companies in contrast to the financial ratios used in financial analysis and that have standard values and no clear ranges (for instance, profitability ratio, return on assets, etc.).

The model is based on a logistic function that takes input parameters from minus infinity to plus infinity, while the response (function) is limited to the range [0; 1]. The function is set by the following equation:

¹ It is calculated according to the World Economic Forum methodology, based on a combination of publicly available statistics and the results of the Global Survey of Company Executives – an extensive annual study.

² World Economic Forum. Global Competitiveness Report 2019: How to End a Lost Decade of Productivity Growth, 2019. URL: <https://www.weforum.org/reports/how-to-end-a-decade-of-lost-productivity-growth>

³ Slepov V. Financial Policy as a Factor of Effective Development of Companies. The 32nd International Plekhanov Readings. April 16, 2019: A collection of articles by post-graduate students and young scientists. Moscow, Plekhanov Russian University of Economics Publ., 2019, 444 p.

$$f(x) = \frac{1}{1 + e^{-x}}.$$

The logistic function graph is shown in *Figure 1*.

The input parameter x is indicated on the abscissa axis, and the "response" $f(x)$ is indicated on the ordinate axis. The variable x reflects the exposure to a certain set of factors, while $f(x)$ represents the probability of a particular outcome, given a given set of input parameters. The variable x is a measure of the total contribution of all input variables used in the model, and is known as *logit*, which is set by the following equation:

$$x = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_n x_n,$$

where β_0 is the point of intersection;

β_n shows regression coefficients for specified x_n parameters, each regression coefficient describing the contribution of the specified parameter factor.

Logistic regression is a kind of multiple regression the general purpose of which is to analyze the relationship between several independent variables (also called regressors or predictors) and a dependent variable.

Understanding the effectiveness of financial policy determines the choice of criteria (variables) on the basis of which its effectiveness is evaluated. By the effectiveness of financial policy, we mean a comprehensive conclusion covering various aspects of the effectiveness of economic, organizational, managerial, financial, and economic activities. By choosing criteria, we mean determining the optimal set of financial ratios that meet the main objectives of an effective financial policy of companies. The main objectives of effective financial policy of companies are presented in *Figure 2* [1].

The theoretical basis of the study to develop an approach to assessing the financial policies of companies comprises the works of domestic and foreign scholars [2–4]. In their scientific works, these scholars use a logit model to assess the risk of company bankruptcy.

The model evaluation of the effectiveness of financial policies and diagnosis of the risk of bankruptcy is the range of different financial ratios, defining the main purpose of the model and the introduction of relevant variables to improve its quality, as well as the statistical sample on the basis of which models can be built. In statistical models, a regression model is built on the basis of calculated financial ratios for accounting (financial) statements of companies. For its development, relevant financial ratios are determined that correspond to the tasks set in this study: evaluating the effectiveness of the financial policy of companies. Bankruptcy risk assessment models include financial ratios that assess solvency, financial stability, and the structure of funding sources. The

developed model for evaluating the effectiveness of financial policy includes a group of financial ratios that best meet the objectives of effective financial policy of companies (*Figure 2*).

When forming a group of financial ratios to assess the effectiveness of financial policies, the principles of minimal sufficiency ratios, transparency and measurability, consistency, and focus on the growth of financial and operational performance of companies are to be taken into account. In accordance with the task set, i.e. evaluating the effectiveness of the financial policy of companies, the list contains financial and economic coefficients and industry indicators for the electricity sector.

The financial ratios for evaluating the effectiveness of the financial policy of companies are presented in *Table 1*. Each of them can help assess the main objectives set for an effective financial policy, to some extent. For example, the objectives of financial policy are to maximize profit and capitalization of companies. Indicators C_6 – C_8 allow for selecting companies the financial policy effectiveness of which gets implemented above the industry average, so these companies will be attractive to investors who through investing, increase the company's capitalization, which leads to an increase in quotations on the exchange (taking into account the listing on the exchange). Based on the previous study [1], *Table 1* is formed supplemented with additional coefficients.

Below, there is a description of dummy variables for the logit model from *Table 1*. These variables are binary (take values equal to zero or one) and contribute to improving the quality of the developed model when evaluating the effectiveness of companies' financial policies.

Coefficient C_6 determines the efficiency of the use of equity, i.e. the company's income per one ruble of own funds. The coefficient is usually compared with alternative investments, investments in securities, similar companies, etc. The choice is made in favor of greater profitability. In the proposed methodology for evaluating the effectiveness of the financial policy of companies, the variable takes a value equal to one, with the company's ROE higher than the profitability of 10-year Federal Loan Bonds (FLB), i.e. a risk-free asset.

For example, in 2018, the average annual return of 10-year Federal Loan Bonds was 7,91%⁴, and the return on capital of PAO Kvadra electric power company for 2018 was 2,85%. Under these conditions, it is more effective for an investor to invest free cash in a fixed-income FLBs than in PAO Kvadra, since the investor *ceteris paribus* will choose to invest funds in a less risky and more profitable asset. If ROE is less than the profitability of 10-year FLBs, the value of C_6 variable is equal to zero, since the company implements an inefficient financial policy (the return on the company's capital is less than the profitability of 10-year FLBs).

⁴Investing.com. URL: <https://ru.investing.com>

Coefficient C_7 , *Yield on Capital Investment*, shows how many rubles of revenue is generated by the company per one ruble of fixed assets. The coefficient takes a value equal to one if it exceeds the industry average value. This is an evidence of the company's growing competitiveness. In 2018, the median value for the electric power industry was 3,64⁵ concerning the large companies.

Coefficient C_8 , *Return on Assets*, shows the amount of cash that accounts for a unit of the company's assets. This variable takes a value equal to one when the ROA of the company exceeds the industry ROA, since an effectively implemented financial policy should ensure a return on assets above the industry average. In 2018, the median value for the electric power industry was 2,3%⁶ concerning the large companies.

Developing a logit model for evaluating the company's financial policy effectiveness implies a sequential set of steps including the following ones.

The first step: forming the primary data array of financial statements of companies.

To develop a model for evaluating the effectiveness of companies' financial policies, the electric power industry was chosen. The accounting data array consists of 200 Russian electric power companies. The official accounting (financial) statements of the companies are the source of the data array. They were obtained through the SPARK Interfax system (International Information Group)⁷.

The second step: calculating financial ratios (coefficients) for each company presented in *Table 1*.

To calculate the financial ratios, Microsoft Excel software was used. All the financial ratios from *Table 1* got calculated for 200 Russian electric power companies based on the accounting (financial) statements for 2018 prepared according to the principles of Russian Federal Accounting Standards. A well-known expert in the field of systems analysis, T. Saati states that nine to ten criteria are quite sufficient to describe systems of any complexity [5]. This number is also indicated by some numerical experiments with models for describing complex systems [6]. The model developed by the author includes nine variables presented in *Table 1*.

The third step: evaluating the effectiveness of the companies' financial policies through expert and statistical techniques.

When using an expert technique, an expert specializing in financial analysis independently evaluates and forms an opinion on the effectiveness of the companies' financial policies. The expert uses a set of key coefficients, his or her professional

⁵ Comparison of the financial condition of the firm with industry indicators and competitors.
URL: <https://www.testfirm.ru/>

⁶ Ibid.

⁷ SPARK Interfax. URL: <https://www.spark-interfax.ru/>

experience, financial information from open sources (audit reports, economic reports, relevant research, etc.).

Statistical techniques also use the generalized Harrington's function [7], ratings of specialized Russian and international agencies, compiled by valuation companies based on historical data and analytical base, including Fitch, Analytical Credit Rating Agency (ACRA), Moody's. Based on an analysis, when implementing an effective financial policy, companies are assigned a value equal to one, and when implementing an ineffective financial policy, the variable value is accounted for zero.

All the indicators used in the model to assess the effectiveness of the companies' financial policies meet the following criteria:

- they are to be as informative as possible, consistent, and deliver against the primary objectives of financial policy;
- they are to be same focused;
- for dummy variables, numerical standards of industry-wide (median) values are to be used to select the optimal option and improve the quality of the model for evaluating the effectiveness of the companies' financial policy;
- they are to be calculated on the basis of accounting (financial) statements of companies prepared according to the Russian Federal Accounting Standards.

The fourth step: developing a logit model to assess the effectiveness of the companies' financial policies.

On the basis of the selected financial variables, a model has been developed to assess the effectiveness of the companies' financial policies. The PyCharm integrated development environment is used to calculate a part of the model. The calculations result in a logit model – *Effectiveness of Financial Policy* (EFP). The model is set by the following equation:

$$EFP = \frac{1}{1 + e^{-(0,14 - 0,09K_1 + 0,54K_2 + 0,84K_3 + 0,54K_4 - 0,37K_5 + 0,87K_6 - 0,52K_7 + 0,47K_8 - 0,05K_9)}}.$$

To rank the quantitative values of the results obtained, we will use the scale for evaluating the effectiveness of the companies' financial policies presented in *Table 2* [3]. *Table 3* shows a sample of electric power companies for which the effectiveness of the company's financial policy was evaluated using the developed model.

By the financial policy implementation effectiveness, we mean a comprehensive analysis that allows for evaluating the company's financial performance, making a conclusion about the quality of the company's management based on the analysis of the official accounting (financial) statements using the developed logit model.

The variable in the model is a value that reflects the effectiveness of financial policy within the range from zero to one, where the value of one indicates the most effective financial policy, and the value of zero indicates the most non-effective implementation of the company's financial policy.

The result of the research is a developed and tested methodology for evaluating the effectiveness of financial policy, which is set by the EFP (Effectiveness of Financial Policy) equation for the Russian electric power companies.

Table 1
Financial coefficients of the logit model of financial policy assessment

Coefficient	Calculation Methodology	Standard Value
Current liquidity ratio C_1	Current assets / Current liabilities	> 2
Return on equity (ROE) C_2	Net income / Equity capital	> 0
Return on assets (ROA) C_3	Net income / Assets	> 0
Working capital to current assets ratio C_4	Equity – Non-current assets / Current assets	> 0,5
Equity to total assets ratio C_5	Capital / Assets	> 0,5
ROE exceeds ten-year Federal Loan Bonds yield C_6	A dummy variable for the model	> 0,0791
Yield on capital investment exceeds the industry average C_7	A dummy variable for the model	> 3,64
ROA exceeds the industry average C_8	A dummy variable for the model	> 0,023
Accounts receivable / Accounts payable ratio C_9	Receivables turnover / Payables turnover	0,9–1,1

Source: Authoring

Table 2
Ranking quantitative values to assess the effectiveness of company's financial policies

Company's Financial Policy Evaluation System	Number System
Maximum efficient	1 ... 0,8
Efficient	0,8 ... 0,63
Moderate efficient	0,63 ... 0,37
Inefficient	0,37 ... 0,2
Maximum inefficient	0,2 ... 0

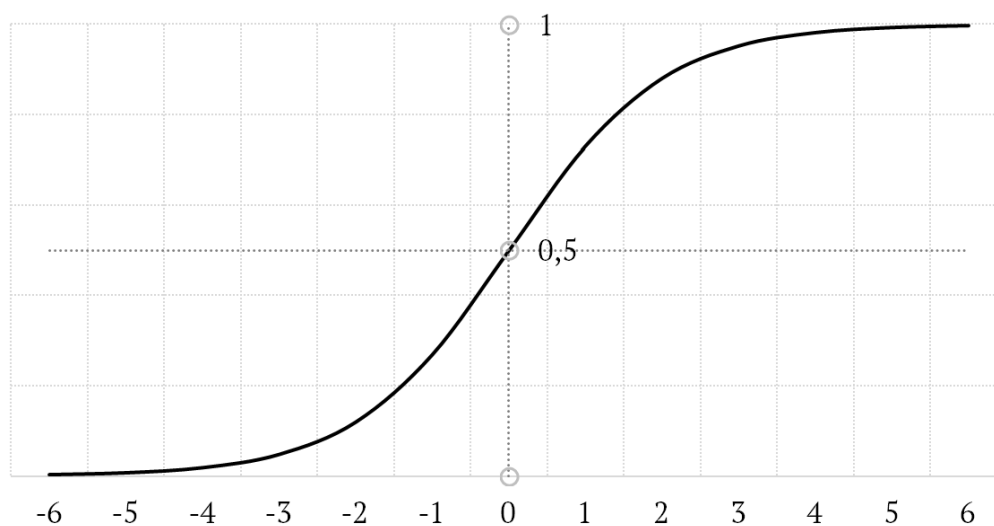
Source: [3]

Table 3
Financial policy performance and series rankings

Company	EFP (Effectiveness of Financial Policy)	Company's Financial Policy Evaluation
PAO Mosenergo	0,69	Efficient
AO Inter RAO – Elektrogeneratsiya	0,68	Efficient
PAO RusGidro	0,39	Moderate efficient
PAO MOEK	0,67	Efficient
PAO TGK-1	0,49	Moderate efficient
PAO Yunipro	0,71	Efficient
PAO Fortum	0,54	Moderate efficient
PAO Enel Rossiya	0,33	Inefficient
PAO Kvadra	0,09	Maximum inefficient
AO Tatenergo	0,41	Moderate efficient

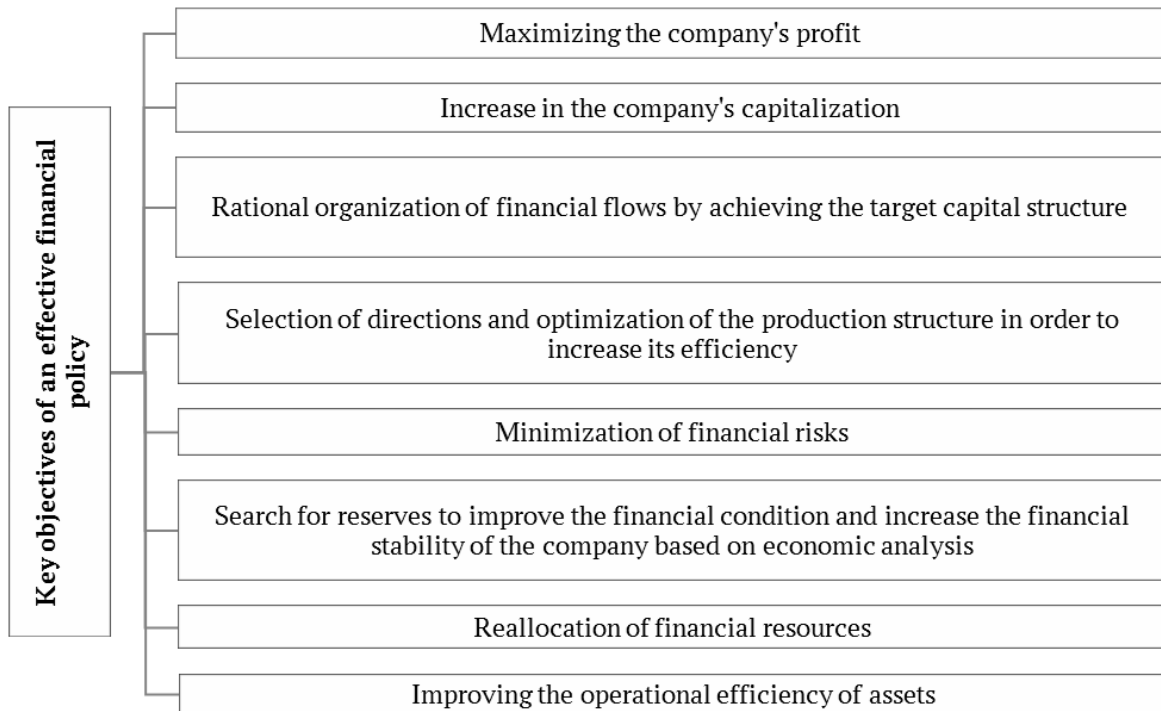
Source: Authoring

Figure 1
Logistic function



Source: Authoring

Figure 2
Main objectives of effective financial policy of companies



Source: [1]

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