The use of multivariate statistical analysis methods as an effective tool for investment attractiveness

El uso de métodos de análisis estadístico multivariante como una herramienta efectiva para el atractivo de la inversión

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ABSTRACT

In the terms of sanctions and the need to strengthen the import substitution policy, the issues of effective investment attraction in the agrarian-oriented republics of the North Caucasus are especially relevant. Due to the underinvestment of the agro-industrial complex in these depressed republics, diversified enterprises of the agro-industrial complex sectors generated a large amount of physically and morally worn-out equipment, economic entities of the industry are not able to function efficiently and develop properly, which ultimately does not allow them to produce competitive products. Undoubtedly, we need new practical recommendations and directions to improve the management of investment attractiveness to mobilize various sources of investment. There are many methods for assessing the rating attractiveness of enterprises. But all of them have a common drawback - rating evaluations are usually given simultaneously for the entire data set, which, in general, significantly complicates and even excludes the possibility of an objective assessment of the investment attractiveness for an economic entity not previously included in the list of enterprises under study (Dougherty, 1997; Roizman et al, 2001). Another significant drawback is the lack of validity for the selected indicators of the final rating.

Keywords: economic crisis, sanctions, increasing competition, agro-indistrial complex, modeling and forecasting.

RESUMEN

En términos de sanciones y la necesidad de fortalecer la política de sustitución de importaciones, los temas de atracción efectiva de inversiones en las repúblicas orientadas a la agricultura del norte del Cáucaso son especialmente relevantes. Debido a la baja inversión del complejo agroindustrial en estas repúblicas deprimidas, las empresas diversificadas de los sectores del complejo agroindustrial generaron una gran cantidad de equipos desgastados física y moralmente, las entidades económicas de la industria no pueden funcionar de manera eficiente y desarrollarse adecuadamente, lo que finalmente no les permite producir productos competitivos. Sin lugar a dudas, necesitamos nuevas recomendaciones prácticas y direcciones para mejorar la gestión del atractivo de la inversión para movilizar diversas fuentes de inversión. Existen muchos métodos para evaluar la calificación de atractivo de las empresas. Pero todos tienen un inconveniente común: las evaluaciones de calificación generalmente se realizan simultáneamente para todo el conjunto de datos, lo que, en general, complica significativamente e incluso excluye la posibilidad de una evaluación objetiva del atractivo de la inversión para una entidad económica no incluida previamente en el lista de empresas en estudio (Dougherty, 1997; Roizman et al, 2001). Otro inconveniente importante es la falta de validez de los indicadores seleccionados de la calificación final.

Palabras clave: crisis económica, sanciones, aumento de la competencia, complejo agroindustrial, modelización y previsión

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INTRODUCTION

From the presence of many different types of models, we want to dwell on econometric models that are statistical in nature.

Econometrics is the science that involves the empirical derivation of economic laws; it uses the method of observation to establish dependencies for economic relationships (Dougherty, 1997).

In general, it can be noted that the totality of statistical techniques and methods used for this purpose constitute econometrics.

Through the use of econometrics, it is possible to study and explore all kinds of econometric models, during which an analyst (econometrician) not only analyzes and forms econometric models, but also, based on economic theory and (or) empirical data, estimates unknown quantities (parameters) in these models, predicts their accuracy, develops practical recommendations on the current economic policy.

Most modern development models are characterized by a common goal of the next deep structural crisis consequence elimination that the domestic agricultural economy is undergoing, and through the use of a real mechanism of innovative process activation in the agricultural sector, it allows to overcome the situation of low investment attractiveness of agricultural entities. And this is natural, because only effective innovative activity is able to create the necessary basis quickly to build a new technological structure in the industry and thereby increase the potential for economic growth of the national economy (Demchenko, 2015; Misakov et al, 2018; Misakov et al, 2019).

Indeed, it is impossible to achieve the appropriate level of innovativeness of a competitive business in modern realities, without involving third-party innovative resources. On the other hand, the borrower is always exposed to credit risk in the form of the possibility of improper fulfillment of his obligations. In such cases, to assess the investment attractiveness of a particular borrower, the system of assessment indicators is used (the purpose of loan, its amount, the borrower's reputation, the financial situation of his business, etc.). It is clear that subjectivity can appear during assessment, which must be neutralized.

Numerous methods have been developed to evaluate investment projects, including simple accounting rate of return method; payback calculation method; NPV; IRR and others.

The integrated use of these and other similar methods allows a sound analysis of investment projects, to establish specific project characteristics and its inherent features, etc., which, ultimately, allows you to evaluate the final results of business objectively.

The market, acting as an original mechanism, distributes investment resources itself, changes the correlation existing between budgetary and extra-budgetary sources of capital investments, increases the share of banking and other investments provided for use in agricultural enterprises, and also allocated for sustainable development of rural social infrastructure.

STUDY METHODS

The theoretical and methodological basis of the study was the scientific work of foreign and Russian researchers on the problems of the theory and practice development concerning evaluation and management of the investment attractiveness of diversified enterprises, the theory of investment analysis, the economic potential and the risks of agricultural enterprise evaluation and diagnosing.

In the course of the study, they used such scientific methods as comparison, system, statistical and economic analysis, generalization and groupings, etc.

STUDY RESULTS

There are many models in the specialized literature that can be used to study various aspects of economic life, such as the Cobb-Douglas production function, the consumption function (it shows the relationship between food costs and the personal income of the consumer (Engel function); the models of the exponential time trend of spending on food and other models (Dougherty, 1997; Shumetov, 2001; Ugurchiev et al, 2018).

One of the most important factors during a model development is their complexity (due to the large number of features and the complexity of the mathematical form), or their simplicity.

There are many answers and solutions to these questions. So, in (Shumetov, 2001), the problem under consideration is positioned as the function of consumption:

$$I_nC = \beta_0 + \beta_1 I_nY + \beta_2 I_nP, \qquad (1)$$

where C is the consumption of a specific food product per capita during the reporting year;

Y - real income per capita during the reporting year;

P - the price index for this product, adjusted for the general index of the cost of living;

$\beta_0, \beta_1, \beta_2$ – the constants that must be estimated by observation data.

It should be noted that the abovementioned equation (1) describes the general consumer behavior due to the acquisition of a given food product, taking into account the price level of the product and the real product per capita. The law will be established when the coefficients of equation (1) β_0, β_1, β_2 are known. In this case, the analyst needs to make an assessment of these coefficients by conducting a suitable set of observations.

Let us turn to the description of the types of econometric models, with the help of which it will be possible to predict the value of the dependent variable in the future.

Three main classes of models are used in the analysis and forecasting.

Time Series Models.

They consist of simple models:

- Trend: $y(t) = T(t) + E_t$, (2)

where $T(t)$ – the time trend of a given parametric form; E_t is a random component;

- Seasonality: $y(t) = S(t) + E_t$, (3)

where $S(t)$ – the seasonal component;

- Trend and seasonality:

$y(t) = T(t) + S(t) + E_t$ (additive) (4)

$y(t) = T(t) \times S(t) + E_t$ (multiplicative) (5)

Time series models consist of more complex models (such as adaptive forecasting, autoregression, moving average, etc.). Characteristic of these models is the fact that the behavior of the time series is described using the previous values. It is advisable to use such models during ticket sale prediction for various vehicles, the demand study for seasonal goods, short-term forecast of interest rates, etc.

In regressive models with one equation, the dependent variable can be expressed by the following function:

$y = f(x,\beta) = f(x_1, x_2, \ldots x_k, \beta_1, \beta_2, \ldots, \beta_k)$, (6)

where $x_1, x_2, \ldots x_k$ are independent (combining) variables;

$\beta_1, \beta_2, \ldots, \beta_k$ – the parameters determined from observations (empirical data).

The form of the function $f(x, \beta)$ determines linear (by parameters) and nonlinear models. The latest types of models are used more often than linear ones. So, for example, the models of type (6) should be used in the development of initial econometric models of investment attractiveness of economic entities of the regional agro-industrial complex (the so-called spatial models).

The spatial econometric models of type (6) are developed using multiple linear regression analysis. The economic variables are established by establishing the impact of a group of explanatory factors. The influence of the main factors xi can be determined through the following model:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_m x_m + E \quad (7)$$

The parameters of the model (7) β1 can be estimated using the least squares method. At that, the main goal of multiple regression is to build a model with a large number of factors, taking into account the influence of each factor both individually and in combination. The factors themselves, which are in multiple regression, must meet a number of requirements, including quantitative measurability, uncorrelated nature, the lack of functional relationship.

In practice, due to the complexity, the possibilities of the regression model for factor accounting are not fully used.

The selection of factors occurs with the help of qualitative economic analysis. Moreover, based on the fact that the theory of analysis does not allow us to establish a quantitative relationship between the studied features and the inclusion of some factor in a model, this procedure takes place in two stages.

At the first stage, factors are selected, at the second t is determined - the statistics for the regression parameters based on the matrix of correlation indicators.

The use of intercorrelation coefficients allows to get rid of duplicating factors in the model. Two variables are usually clearly collinear if the inter-correlation coefficient is ≥ 0.7. Variables duplicate each other with obvious collinearity of factors. Thus it is necessary to remove one of the factors from the regression equation - the factor that has the least relation with others is left. This is a distinctive feature of regression as a method - it explores the total influence of factors when they are independent of each other.

One should also note the role of factorial and cluster analysis, which are multidimensional statistical analysis, through which you can derive the final results on a wider range of objects (general population).

Multidimensionality is manifested in the fact that a combined analysis of all the factors that form the process under study is carried out simultaneously. The use of factor analysis allows you to "compress" the matrix of features into the matrix with the least number of variables, moreover, with the same information base as in the original matrix. The model of factor analysis itself is based on the hypothesis that takes the studied variables for the indirect manifestation of a small number of hidden factors (the principal component method) (Besedin, 2003; Roizman, et al, 2001).

Cluster analysis allows you to provide the following:

- Formation of typology (classification);

- The study of the necessary conceptual schemes for object grouping;

- Hypothesis development (based on structural data);

- hypothesis testing, etc.

When they choose a specific cluster solution, it is necessary to determine the number of clusters - the groups of elements that have one characteristic trait (common property). But here one rather complicated problem arises - there is still no mathematically reasoned method that would allow us to establish the number of clusters reasonably, which are the fundamental component of the cluster structure. Under these conditions, the analyst has only one thing - to use a priori attitudes and own assumptions. It is also advisable to conduct a visual analysis of the dendrogram; the comparative analysis of the results of clustering, the visual assessment of merger coefficient function dependence graphs on the number of clusters (Zyabliceva, 2015; Serkova-Zhogoleva, 2003; Misakov et al, 2017).

Thus, investment attractiveness should be considered as a multidimensional process. Hence, it is expedient to perform the processes of its modeling and forecasting for diversified agricultural enterprises using multivariate statistical analysis methods consisting of multiple linear regression, discriminant, cluster and factor analyzes.

CONCLUSIONS AND OFFERS

1. The analysis of the problems performed during the study of investment attractiveness management at agricultural enterprises in the depressed republics of the North Caucasus made it possible to establish the absence of a strategic planning system and a strategy for competitiveness provision on the vast majority of business entities of the industry. At that, they observe information closure of agricultural enterprises, increased physical and moral depreciation of equipment, inadequate storage and logistics infrastructure for the movement of food products, etc.

The presence of these and other similar problems makes the agricultural enterprises of the depressed republics of the North Caucasus uncompetitive and unattractive to potential investors.

2. Under these conditions, it is advisable to develop a "proprietary" investment attractiveness management algorithm for each household, based on its capabilities and existing economic potential, on a marketing study of the economic entity competitiveness. Such an approach will allow to develop reasonable measures to find a potential investor and form a real package of proposals taking into account the mutual expectations of both the enterprise and the investor.

3. The complexity of taking into account the characteristics of investment attractiveness development for economic entities of the agro-industrial complex makes us talk about basic models. We justifiably believe that multidimensional statistical analysis methods can be used as an effective tool for modeling and forecasting the investment attractiveness of agricultural enterprises (including such methods as correlation-regression, discriminant, factorial and cluster one).

Conflict of interests

The authors confirm the absence of a conflict of interest.

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