Econometric Modeling of Performance Indicators of the Companies

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Abstract: This article is to propose a forecasting method of sales profit of a company of meat-packing industry based on the econometric model designed using the factors identified by the regression analysis. Forecasting methods can be applied for comprehensive assessment and improving of business performance during the certain period affected by the factors directly influencing the final result. This will allow the management stuff of the company to identify the problem areas in the activity of the company and undertake the appropriate and effective measures to improve competitiveness.

Key words: Competitiveness • Performance • Meat-packing industry • Forecasting of competitiveness • Econometric model of profit volume affected by different factors

INTRODUCTION

Forecasting methods are successfully applied for comprehensive assessment and improving of business performance. The aim of the simulation is new information about the studied objects, which are not related with the initial data.

The general method of research of systems, when the efficiency is affected by both external and internal factors (product demand, price fluctuations and other), is the economic-mathematical modeling, which is the theoretical analysis and practical actions directed on development and use of models. In this case, the model is the image of the real object (process) in material or ideal form (i.e. described by the signs in a particular programming language), reflecting the significant properties of the simulated object (process) and the replacing it during research and management. The simulation method is based on the principle of analogy, i.e. the possibility of direct study of a real object through a review of similar and available model.

It is known that the profit is one of the economic indicators of the economic performance of a company. Therefore, the investigation of dynamics of this index to prospective forecasting is an important objective of our study. The forecasts of the volume of profit are one of the tools to increase the validity of decisions, reduction of the possible adoption of sub-optimal decisions during assessment of economic performance of the company.

The study of economic indicators of the meat-packing companies was performed by Keramidou I., Mimis A., Fotinopoulou A. and Tasssi C.D., who investigated the trends of development of the industry [1]. However, the problems of modeling of these processes were omitted in these studies. To study this problem, we have referred to the articles of Ketels C., Ye G., Mukhopadhyay S.K., Chen H.L., Chen C., Liu C., Wei N., Mehrabad M.S., Anvari M. and Saberi M., who investigated the assessment and modeling to identify the effect of various factors on the competitiveness of company [2-5].

General: The accurate forecast requires the taking into account of a number of factors and their dynamics for the certain period. There are complicate relationships between various factors, therefore, their effect is complex and cannot be considered as a simple sum of isolated influences. In this case, the multivariate correlation-regression analysis allows the quantitative assessment of the influence of particular factor to results.
Table 1: The correlation degree of the identified factors and profit received by Kazan meat-packing plant (Kazan, Russia) from sales

<table>
<thead>
<tr>
<th>Factor</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of sales (thousand rubles)</td>
<td>0.82</td>
</tr>
<tr>
<td>Production costs (thous. rubles)</td>
<td>-0.78</td>
</tr>
<tr>
<td>Unit value of imports (thous. rubles)</td>
<td>-0.58</td>
</tr>
<tr>
<td>Production of cattle and poultry for slaughter in the Russian Federation (thous. tons)</td>
<td>0.14</td>
</tr>
<tr>
<td>Total imports of meat (thous. tons)</td>
<td>-0.24</td>
</tr>
</tbody>
</table>

Table 2: Regression analysis for Kazan meat-packing plant

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-value (p&lt;0.05)</th>
<th>R-squared</th>
<th>Dur. Wat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a_1</td>
<td>-71661,36</td>
<td>46768,48</td>
<td>-1.53</td>
<td>0.79</td>
<td>2.3</td>
</tr>
<tr>
<td>a_2</td>
<td>0.45</td>
<td>0.09</td>
<td>4.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a_3</td>
<td>-0.42</td>
<td>0.08</td>
<td>-5.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a_4</td>
<td>-12.04</td>
<td>1.94</td>
<td>-6.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a_5</td>
<td>10.98</td>
<td>2.36</td>
<td>4.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a_6</td>
<td>-8.85</td>
<td>1.81</td>
<td>-4.90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To analyze and study the effects on the performance variable (volume of profit from sales of the investigated objects) of the factorial features $x_i$, the following indicators have been considered: volume of sales of the Kazan meat-packing plant (Russia), production cost, cash income of the population per month and per capita, the average monthly nominal wage of workers, production of cattle and poultry for slaughter, the import volume of meat, population size, average producer’s prices for cattle (in live weight), average producer’s prices for pork (in live weight), average import prices for fresh meat and ice cream and the average price of electricity [6].

The influence level of these factors was determined by the correlation analysis of stepwise multiple regression with the gradual reduction of the independent variables (the method of step-by-step inclusion-exclusion of factors).

The pair correlation coefficients obtained after analysis revealed the five most important factors to be included into the final model (multiple regression equation) (Table 1).

To build the final forecasting model of the volume of sales based on the Multiple Regression program of STATGRAPHICS system, the coefficient of multiple regression (multiple determinants) (R-squared), the coefficients of the regression equation-standard error coefficient (Std. error), the Student’s coefficient ($t$-value) and the autocorrelation coefficient (Dur. Wat.) have been calculated [7]. The estimated values of these indicators for Kazan meat-packing plant are shown in Table 2.

Table 2 suggests that the there is direct relationship between the volume of profits received by Kazan meat-packing plant ($Y$) from sales, volume of sales ($x_1$) and production of cattle in the Russian Federation ($x_2$) and inverse relationship between $\phi$ and $x_2, x_3, x_5$.

Form of correlation was empirically determined, according to which, it was suggested that the there is linear dependence and multiple regression equation for Kazan meat-packing plant is:

$$Y = -71661,36 + 0.45x_1 - 0.42x_2 - 12.04x_3 + 10.98x_4 - 8.85x_5 \quad (1)$$

Each equation coefficient shows the influence level of appropriate factor on the analyzed indicator at a fixed position of other factors. The changing of each factor by unit the $y$ changes to appropriate regression coefficient. Absolute term of an equation shows the average effect on the result feature of unaccounted factors [8]. In particular, the model shows that the increase of sales volume by thousand tons increases the profit by 0.45 thousand rubles in average if the influence of other factors is constant. The increase in the production of cattle and poultry for slaughter by thousand tons increases the profit by 10.98 thousand rubles In the same time it should be noted that the increase in production cost by a thousand rubles reduces the profit by 0.42 thousand rubles in average, increase of average import prices by a thousand rubles that results in a decrease in profit by 12.04 thousand rubles in average and the increase of import of meat by a thousand tons decreases the profit by 8.85 thousand rubles in average at other equal conditions [9].

One of the most important characteristics of the quality of the selected regression equation and the adequacy of the model is the multiple determination coefficient. The determination coefficient for the econometric model developed for Kazan meat-packing plant, is R-SQ = 0.79. This coefficient shows that the variation of the volume of profit of 79% is determined by all above-mentioned factors. Consequently, the selected
Table 3: The predictive economic indicators in different trends for Kazan meat-packing plant

<table>
<thead>
<tr>
<th>Parameter</th>
<th>( x_1 )</th>
<th>( x_2 )</th>
<th>( x_3 )</th>
<th>( x_4 )</th>
<th>( x_5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of trend</td>
<td>Exponential</td>
<td>Exponential</td>
<td>Linear</td>
<td>Linear</td>
<td>Linear</td>
</tr>
<tr>
<td>Equation of trend</td>
<td>( y = 1389475 \exp(-0,165 x) )</td>
<td>( y = 1328408 \exp(-0,172 x) )</td>
<td>( y = 230,9x + 672,4 )</td>
<td>( y = 160,2x + 7099,0 )</td>
<td>( y = 115,7x + 670,3 )</td>
</tr>
<tr>
<td>Coefficient of determination (R²)</td>
<td>( R^2 = 0,975 )</td>
<td>( R^2 = 0,980 )</td>
<td>( R^2 = 0,810 )</td>
<td>( R^2 = 0,676 )</td>
<td>( R^2 = 0,832 )</td>
</tr>
<tr>
<td>Predictive value by year:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013 (8)</td>
<td>369557,9</td>
<td>334219,4</td>
<td>2520,142</td>
<td>8380,802</td>
<td>1595,878</td>
</tr>
<tr>
<td>2014 (9)</td>
<td>313174,5</td>
<td>281267,3</td>
<td>2751,107</td>
<td>8541,007</td>
<td>1711,574</td>
</tr>
<tr>
<td>2015 (10)</td>
<td>265393,6</td>
<td>236704,6</td>
<td>2982,072</td>
<td>8701,212</td>
<td>1827,269</td>
</tr>
</tbody>
</table>

Table 4: Forecast of profit volume of the Kazan meat-packing plant until 2015 received by multiple regression analysis

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2013 (8 period)</th>
<th>2014 (9 period)</th>
<th>2015 (10 period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales profit, thousand rubles</td>
<td>1822,703</td>
<td>-3355,57</td>
<td>-8186,36</td>
</tr>
</tbody>
</table>

Fig. 1: Predicted profit of the Kazan meat-packing plant for 2013-2015

Factors significantly influence the volume of net profit of the studied companies. Average import prices on fresh meat and ice cream are shown in Table 3.

Durbin-Watson autocorrelation coefficient (DW) indicates the presence or absence of autocorrelation and varies from 0 to 4. If DW = 2, then there is no breach of the prerequisites of the least squares method (LSM). For Kazan meat-packing plant, DW = 2.3, i.e. there is no autocorrelation that indicates the sufficient quality of a model.

To forecast using the multiple regression equations obtained above, the trend indicators \( x_1 - x_5 \) have been found. The trends for the indicators \( x_1 - x_2 \) are exponential and \( x_3 - x_5 \) are linear. Types of trends, determination coefficients and the predicted values for these indicators are shown in Table 3.

Substituting the predictive values of indices \( x_1 - x_5 \) shown in Table 3 into the model of sales volume, the forecast of sales volume of Kazan meat-packing plant for 2013-2015 was received (Table 4).

Fig. 1 shows the tendency of decrease in profit of sales since 2008 that require the implementation of specific measures aimed at changing the existing declining trend of the performance indicators of Kazan meat-packing plant.

CONCLUSIONS

According to the performed forecast, the company will reach period of losses by 2015 if the existing situation will keep further (Fig.1). This situation has occurred largely due to decrease of the volume of sales, which is related with the loss of market share during analyzed period. At the same time, the decrease in revenue from sales was higher than decrease of production costs that caused the higher decrease in sales profit of the company. Thus, the measures to improve the financial stability and solvency are required to increase the competitiveness. Competitiveness of the products depends on different factors, criteria and indicators determining the competitive
advantages on the market and the ability to manage it, develop individual behavior model on the market in case of crisis situation [10].

To influence the internal business processes, the implementation of specific management tools that will stimulate the orientation in the environment and increase the economic performance of the company are required.

A specific feature of the proposed model on Fig. 2 is taking into account of the regular and continuous monitoring and analysis of the marketing strategy of the company.

In present conditions, the permanent and continuous monitoring of the competitiveness of the products is one of obligatory conditions. Development of efficiency of methods to achieve and maintain a competitive advantage on the market of meat products requires the assessment of consumer preferences based on monitoring of competitiveness of production of meat-packing industry.

Introduction of the monitoring of the competitiveness of products in to the assessment method of consumer preferences is prospective direction to increase the competitive advantages of meat-packing companies.

The general objectives solved during economic monitoring of competitiveness of meat-packing products, in our opinion should include:

- Development of a group of indicators providing a holistic overview of the products of meat-packing company and the conditions of the external and internal environment of the company based on the methods of mathematical transformation of individual indicators into integral.
- Collection and systematization of information about the condition and development of products of a meat-packing company and its competitors at all stages of the life cycle.
- Elaboration of software for processing of information received after economic monitoring of the competitiveness of the meat-packing company.
- Ensuring a regular and visual presentation of the results of economic monitoring of competitiveness as the reports for managers and technical specialists of the meat-packing company.
Once the objectives are performed, the economic monitoring of competitiveness becomes universal research and practical tool for the monitoring of competitiveness of the products.

Thus, the analysis of the factors stipulating the competitiveness of products and identification of the problems of the meat-packing industry has revealed the following management tools of the competitiveness of meat-packing products as the conditions to increase the efficiency of the integrated management system:

- Analysis and formation of consumer’s preferences in particular products of meat-packing company and promotion of a healthy lifestyle;
- Development of trust to a regional brands and development of image of the product built on the main consumer’s preferences;
- Monitoring of competitiveness of products of the meat-packing industry;
- Implementation of quality control systems;
- The policy of formation of the appearance of the final products (including packaging);
- Price policy;
- Formulated policy and development of new products.

Development of new meat products is one of the directions of formation of competitive advantages of products of the meat-packing company. Expansion of the variety of the products is a basis for increase of the sales volume and allows the exploration of the new market segments. The principle of systematic control of the development of new meat products requires the taking into account of the multistage life cycle of a product beginning from development of the composition, pilot production, experienced sales, introduction to the market and etc.

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**REFERENCES**