ANALYSIS OF THE ECONOMIC PERFORMANCE OF A ORGANIZATION USING MULTIPLE REGRESSION

PhD Flavia FECHETE*, Prof.univ.dr. Anisor NEDELCU**

*,**Faculty of Technological Engineering and Industrial Management, Transilvania University of Brasov, Brasov, Romania.

Abstract: *Economic performance is one of the major goals of any company. This involes important decisions to optimize the allocation of cash resources, ie labor, raw materials, energy, capital equipment, etc.. The objectives of the organization can be measured as effectiveness (the extent to which objectives have been met) or as efficiency (the extent to which objectives have been achieved in the available resources).*
In this regard, it is particularly important to identify factors that influence getting the desired income and the degree of their influence on the economic performance of the organization. This paper aims is to realize an analysis of these factors and their degree of correlation on economic performance using multiple regression.

Keywords: *economic performance, efficiency, regression analysis, variables, correlation.*

1. INTRODUCTION

Strategic performance, operational, team or at individual level is a major objective of any company. To appreciate the extent to which organizational goals are achieved and business strategies are effective, it is imperative to define an integrated system of indicators that can tell us at any time if our business is going in the right direction or not.

Moreover, any management decision should be based on a good knowledge of the current state of the business, which is not possible without a system of performance indicators to inform management about the results obtained in all key activities and processes of the company.

The economic literature of our country defines organization performance: "an enterprise is performant if it is both productive and effective", productivity representing the ratio between the results and the means employed to obtain the results and effectiveness representing the ratio between the results and the results expected. [3]

The cost and profits are, in fact, the elementary performance for firms and industries from which derive other indicators.

In this respect, in the present paper we intend to identify and analyze sales revenue which is one of the main indicators that reflect economic performance of the organization.

For this purpose, we will use regression analysis to identify factors that contribute to influence economic performance of the

organization, and the degree of correlation with it.

To illustrate the method used will make a case study applied to a company, ie, a sugar factory that produces crystal sugar.

The activity of the Sugar Factory is the processing of sugar beet, in the last quarter of the residue having a current repair activity. The final product obtained is white crystal sugar, which is distributed to different beneficiaries.

The following section of the paper will highlight the exact research methods used in the analysis performed.

2. RESEARCH METHOD

Using statistical analysis – as a statistical part , as a scientific discipline it aims to discover what is permanent in stochastic processes variation and to measure the influence that determines the change in time and space, in the qualitative point of view. [4]

For this purpose there are used the following types of anlaysis : regression analysis, correlation analysis, ANOVA and time series analysis.

In a research based on correlation and regression analysis there must be solved the following problems: identifying the existence of the link consisting of logical analysis of the possibility of existence of a link between the variables considered, determining the intensity of the link , problem solved with parametric or nonparametric indicators of intensity correlation using correlation analysis, establish the meaning and form of connection for using specific methods of regression analysis : basic methods and analytical methods.[1]

The concept of regression expresses a statistic connection, ie average regression on the behavior of variables. Regression analysis is used for:

- estimation of a variable holding values of another / other variables;

-assessment of the measure that the dependent variable can be explained by the independent variable or a set of independent variables;

-identification of a subset of several independent variables to be taken into account to estimate the dependent variable.

The general expression of a regression model can be written as:

$y = f(x_1, x_2,,…, x_n) + ε$, in which:

y – dependent variable (output), randomized;

$x_1, …, x_n$, - independent variables (factorial), non-randomized;

ε– random variable error or residue. Random variable ε summarizes the influences of variables not included in the model that influences the variable y.

Multiple regression method is considered an explanatory one for explaining the change of a complex phenomenon analyzed based on the variation of the variables considered independent or exogenous [2].

Multiple regression analysis is useful in building econometric models. A socio-economic phenomenon is influenced by the combined action of several factors. Considering several explanatory variables for this phenomenon will lead to the identification of a model that reproduces the actual behavior in a measure closer to reality.

The purpose of the econometric analysis is to estimate and predict the average value of the variable y based on known or fixed values of the explanatory variables. Multiple regression analysis allows to estimate the parameters of the econometric model, analyze correlations between variables, testing the significance of the explanatory variables.

For multiple regression, the most common problem that occurs is related to the result of the strong ties of interdependence between the independent variables. They may lead to improper regression coefficients, so the estimating becomes impossible or they can seriously distort it. Therefore, when the independent variables of a regression model are not closely related, the results may have the accuracy needed.

The degree of correlation intensity between phenomena will be obtained by setting specific gravity of dispersion based on recorded factor by total dispersion. [5]

This indicator is called the coefficient of multiple determination (R^2) and measures the proportion of variation in y that is explained by the variables $x_1, x_2,,…, x_n$.

“HENRI COANDA”
AIR FORCE ACADEMY
ROMANIA

“GENERAL M.R. STEFANIK”
ARMED FORCES ACADEMY
SLOVAK REPUBLIC

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A small coefficient of determination (R^2) or very small regression parameters can indicate either a very small causal link, but may also result from wrong or improper mathematical representation of the relationships between variables.

Even if we are using reliable data, a big R^2 does not necessarily means that there is a strong causal relationship. It follows that, on the basis of regression, it is not possible to determine causation.

3. MYLTIVARIATE ANALYSIS USING MULTIPLE REGRESSION - CASE STUDY

In this section of the paper we use as explanatory multivariate method multiple regression analysis to analyze correlations between variables and establishing the validity of the multiple regression model.

In this regard, we consider the following financial ratios derived from the organization studied during years 2007-2013: incomes, number of employees, advertising expenses and product price, as described in Table 1.

***Table 1.Company's financial indicators
Source: mfinante.ro, bvb.ro.***

	Incomes (milioane lei)	Nr. Employees	Adv. expenses (mii lei)	Product price (lei)
2007	66,8	247	23,8	18,3
2008	92,27	233	28,3	20,5
2009	69,8	272	27,6	16,5
2010	73,35	256	26,7	17,6
2011	75,74	234	30	18,4
2012	83,31	212	29	20,02
2013	85,6	201	30,1	21,2

Thus, it was established as a dependent variable the financial indicator total revenue, and as independent variables: number of employees, advertising expenses and product price.

To explain the variation of the dependent variable - total revenue - by its covariance with independent variables: number of employees, advertising and promotion expenses, and price / product (lei), we use a multiple regression statistical model defined by:

$$y = a_0 + a_1 x_1 + a_2 x_2 + ... + a_k x_k + \varepsilon,$$

where :
y = the explained variable;
$x1$ = the explanatory variable *1*;
$x2$ = the explanatory variable *2*;
...
xk = explanatory variable *k.*
$a_0, a_1, ..., a_k$ = model parameters.
ε = specification error, unknown(the difference between the true and the specified model);
n = number of observations.

In Figures 2, 3 and 4 there are presented the correlations between the dependent variable, determined as sales revenue influenced by other variables considered factors.

Figure 2. Inverse relation between the amount of sales and number of employees

Correlation between income and number of employees
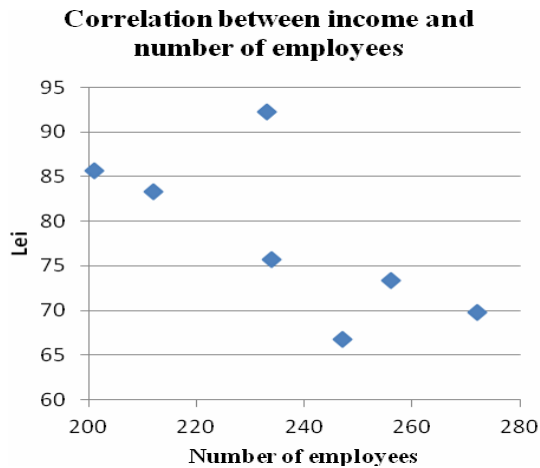
Figure 3. Direct link between the sales and advertising expenses

Correlation between income and expenditure ads
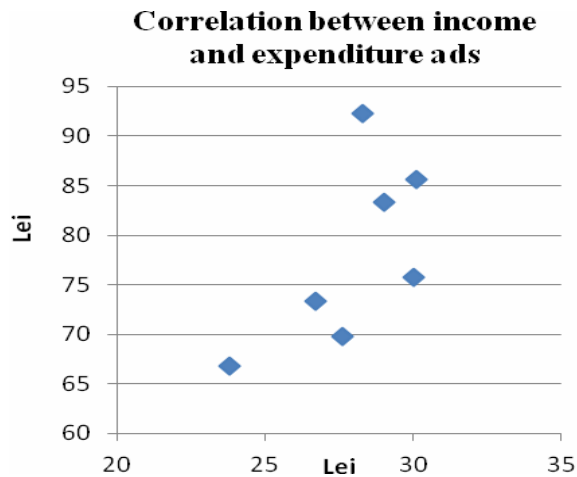
Figure 4. Direct link between the sales and price/product

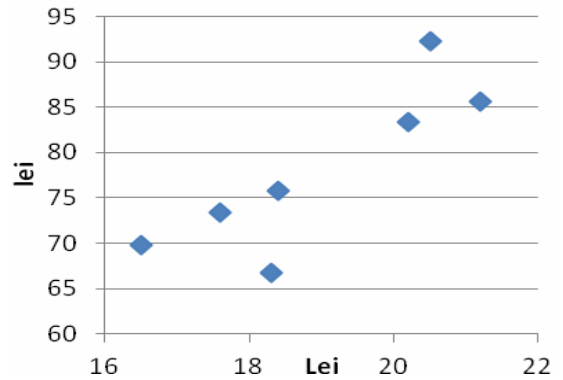**Correlation between income and product price**

Table regression is shown in Table 5. This was performed using the computer program Microsoft Excel using the commands Data Analysis / Regression.

The identified model is:

$$\hat{y}_c = -272,23 + 2,17\, x_1 + 0,46\, x_2 + 9,47\, x_3,$$

adjusted values are presented in Figure 6.

Figure 6. Evolution of sales revenues achieved by the company in the period 2007-2013 and their adjustment.
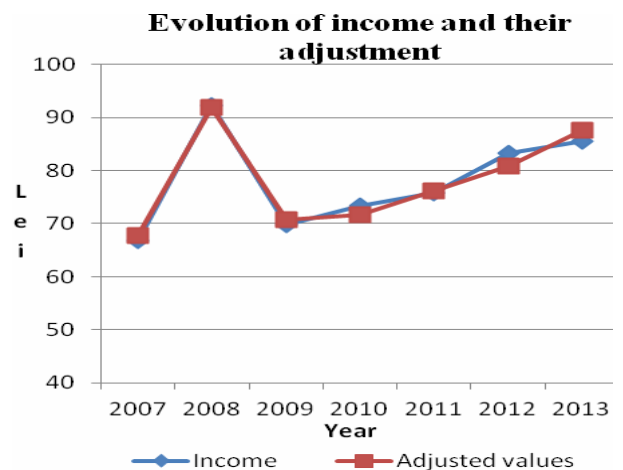
Evolution of income and their adjustment

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Table 5. Table of regression model with three explanatory variables

Summary OUTPUT						
Regression Statistics						
Multiple R	0,98					
R Square	0,97					
Adjusted R Square	0,94					
Standard Error	2,23					
Observ.	7					
ANOVA						
	df	SS	MS	F	Sig F	
Regression	3	493,95	164,65	33,06	0,008	
Residual	3	14,93	4,97			
Total	6	508,8				
	Coeff	Std Error	t Stat	P-value	Low 95%	Upp 95%
Intercept	-272,23	59,05	-4,61	0,01	-460,16	-84,3
X Variable 1	2,17	0,52	4,17	0,02	0,51	3,83
X Variable 2	0,46	0,11	4,21	0,02	0,11	0,81
X Variable 3	9,47	1,47	6,44	0,007	4,79	14,1

It can be seen that the coefficients of the model are significantly different from 0 as indicated by Student calculated ratios, that are higher than the theoretical value of the Student table, the values P-value that is less than 5%.

Besides global significance test, there are analyzed the significance tests of individual coefficients for each explanatory variable in the model.

Student ratio for each regression coefficient is compared with the theoretical Student value for $\alpha = 5\%$ and three degrees of freedom which is 3,18, calculated in Excel using TINV function. Student theoretical ration of 3,18 is less than each value calculated (4.17; 4,21; 6,44), and this shows that each of the variables: number of employees, advertising expense and product price helps in explaining the variation of variable y, ie sales revenue.

We also identify the confidence intervals for the coefficients and we observe that tehy do not change sign in the lower end to the upper, so do not contain the value 0.

Confidence intervals are:

ICa_0 [-460,16; -84,3],

ICa_1 [0,51;3,83],

ICa_2[0,11;0,81],

ICa_3[4,79; 14,1].

Fisher theoretical value for 3 and 3 degrees of freedom for a significance level $\alpha = 5\%$ is 9,27, calculated in Excel using FINV function.

Overall regression is significant because F * (33,6) > Fteoretic (9,27), in order we can say that the regression model is well built. The calculated F * corresponds to a significance level of 0,008%, much lower than 5%, as shown Significance F in Table 5.

Also, the coefficient of determination show a very good linear model that explains the phenomenon of the change in the four analyzed variables according to the explanatory variables in an amount of 98,4%.

The remaining 1,6% is about the influence of unregistered or not considered factors.

4. CONCLUSIONS & ACKNOWLEDGMENT

Performance analysis of a company has a decisive role in setting the strategy followed especially during the financial crisis. Performance should be assessed and measured both with respect to results (outputs of the tasks) and the behaviors (work process entries).The increasingly frequent use of statistical correlation method is justified by the increasing need of reflection in a appropriate numerical form the interdependence of the phenomena analyzed in terms of the nature, direction and the intensity of the links which is manifested in a certain period of time or in dynamic.

Statistical analysis consisted of an investigation of the behavior of known variables and the development of an equation or model to explain the relationship between the environment of variables. In this situation, the income on the product is the result of conjugation many influencing variables, but not all the determined ratios have the same importance, the action of some of them compensating each other.The main objective of regression analysis is to explain and forecast variance of the dependent variable based on its covariance with the independent variables . Showing the revenues and benefits for marketing efforts is a prerequisite for the analysis of efficiency of enterprise system on the market.Thus, this paper has tried to define the notion of performance, to emphasize the importance of economic performance of the enterprise and to achieve a multifactorial regression analysis of factors contributing to performance. In this respect, we conducted a case study on a company that produces crystal sugar, taking into account income from sales as a component of the entity's economic performance. The model built was a well-chosen one, representative and shows that each of the explanatory variables : number of employees, advertisements expenses and product price, contributes to explaining the variation in y, ie sales revenue.

Investing in advertising and promoting the company, the adoption of marketing strategies in the coming year would increase revenue, the identified model shows that there is a direct correlation between these factors.

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