Performance analysis of the plastic industry in Albania

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Abstract—The main goal of this paper is to contribute to the performance enhancement of the manufacturing industry via mathematical modeling. Also, we have focused on the statistical analysis of the economic achievements of the plastic industry.We processed a quantity of data collected in the last 10 years of the production activity of the firm ALB PLAST SHPK-Elbasan, Albania. The analysis of the data collected by this company has been done using the Statistical Package for Social Sciences, version 23. So, we have presented the economic analysis of the activity of this manufacturing enterprise using Multiple Linear Regression (MLR), applied for one dependent variable and several independent variables. We showed via mathematical modeling the impact that variables such as self-financing capacity, return on equity, personnel cost per employee and investment per employee have on the size of profit. Especially we have demonstrated that two of the variables are significant in terms of profit size, but we have also represented some other correlations between the study variables. The results are useful for the plastic industry, because as independent variables are variables which represent economic factors that we think affect the profit size, like self-financing capacity, return on equity, personnel cost per employee and investment per employee. Manufacturing firms are always striving to find and apply innovations to help increase their profits. This study is a novelty for the industry of plastic production in our country, because it gives some important correlations between factors that influence the profit growth of the manufacturing industry directly.

Keywords—Variables, statistical method, mathematical-model, correlation.

1. Introduction

IN Albania, the production industry is one of the main sectors of the economy. Nowadays, with the development of technology and science, companies and manufacturing enterprises, try to find and use different methods to increase their performance, in order to gain and maintain their place in the market. A number of studies on manufacturing industries have already been discussed, focusing on improving efficiency within different production sectors. In 2011, Turóczy Zsuzsannaa and Liviu Mariana proposed "Multiple Regression Analysis of Performance Indicators in the Ceramics Industry" [21], which aims to increase the performance of industrial enterprises through mathematical models. Multiple linear regression provides estimates of both the magnitude and statistical significance of relationships between variables [20]. Their objective is to help increase the competitiveness, flexibility, adaptability and reactivity of enterprises in the ceramics industry in their country.

Inspired by these studies, since the plastics manufacturing sector represents an important part of the manufacturing industry in Albania, we will be focusing on this sector, with the aim of evaluating the development of enterprises that are active in this field. It is known that the development of the economy in Albania and especially the production sector is going through many difficulties. Manufacturing firms are always striving to find and apply innovations to help increase their profits.

In this study, we try to use mathematical methods to identify the impact of four indicators such as: competitiveness, flexibility, adaptability and creative work, on economic performance.

In our case, to analyze these indicators through the MLR we have taken the analysis of the size of profit depending on the capacity of self-financing, return on equity, cost of personnel per employee and investment per person employed.

In terms of self-financing capacity, it is clear that debt or leverage ratios indicate the capital structure and the ways in which the company finances its assets. They represent a kind of measure of the level of investment risk in the company,

determining the degree of utilization of borrowing funds.

Companies with a much higher debt level lose financial flexibility, may have difficulty finding new investors, and face the risk of bankruptcy. However, if the debt is under control and tracked continuously in time and the borrowed funds are used properly, the debt can result in increased return on investment. Debt ratio, leverage ratio shows the extent to which the enterprise uses debt as a form of financing, generally the percentage of assets secured by borrowing. The higher the debt-to-equity ratio, the greater the financial risk.

Return on equity (ROE) is the net income allocated to owners' equity. It measures net income in relation to the amount invested by owners in the company. Return on equity measures the return of shareholders.

Personnel costs mean total cash compensation, training program costs, employment costs, severance pay, payroll taxes, employee compensation, travel expenses, incentive programs (e.g., incentive programs related to employee compensation and risk management) and employee benefits paid to these staff.

The research is not only based in giving statistical data, but also, aimed at the creation of a model that gives the correlation through chosen variables.

The article is organized as follows: First, we present a literature review on this issue, followed by a material and methods sector, that presents the data collection, the research tool and the method used for the analysis. Then, we continue with the explaination and discussion of the results. Our paper ends with conclusions and recommendations for further research in the future..

2. Literature Review

Various papers have been created to study the performance of the economic activity of different manufactories and firms. Thus, most specialists of economy have attempted to identify the correlation between performance analysis and different economic factors that play an important role in the production process.

Performance analysis is mainly used to evaluate the cost efficiency, design, reliability and timeliness of manufacturing management, with its main purpose being to check and identify areas of improvement in companies' activities and help strategic decision making.

This study is mainly focused in operational performance assessed along other factors such as self-financing capacity, return on equity personnel cost per employee and investment per employee [8], [12], [18].

Although, operational performance is related to the organization's internal operations such as productivity, quality of product, and customer satisfaction [7].

Li and Olorunniwo [15] suggested that performance can be evaluated by non-financial performance such as efficiency, growth, and profit.

The plastic industry is defined according to Albanian legislation as an industry that offers services in plastic and manufactures polymer materials. Plastic is used in a range of industries such as building and construction, packagings and transportation etc.

Plastic can be used as a substitute for steel, iron, and many other metals and non-metallic products. Plastic is also used as an intermediate and final product [17].

The manager's responsibility is to enhance the productivity because improving productivity means improving efficiency [9]. Although, Heizer & Render, [10] argue that productivity is the relationship between the outputs or results of the organization with the necessary inputs.

In Albania, a big boost in the plastic industry is the growing demand for plastic materials in building and construction, also in domestic and global market.

According to the British Plastics Federation, around 4 per cent of annual petroleum production is converted directly into plastics from petrochemical feedstock. 50 per cent of plastics are used for single-use disposable applications such as packaging and only 20% and 25 % are for long–term infrastructure [2].

Venkatesh, R. & Vilvijayan, C., [5] found that in India the plastic industry is expected to boost with investments in polymerization and downstream processing capacity.

Lico. E., Vito. S., Boci. I., Marku. J., [16] found that Albania generates small amounts of plastic waste, around 10.5% of urban waste. But nowadays, different effective systems of plastic waste management were found. Plastic waste has found a great use in recycling or in energy.

This study is a novelty, because we haven't read anything similiar for the factors that affect performance of the plastic production industry in our country.

The research demands:

- Is there any linear regression between the indepedent and the dependent variables?
- Which of the independent variables affect the dependent variables the most?

The hypotheses we have constructed are:

- Basic hypothesis: Is every regression coefficient equal to zero?
- Alternative hypothesis: Are any of the regression coefficients different from zero?

3. Materials and Methods

Multiple linear regression is a method of statistical analysis used to analyze and model the behavior of several variables. The multiple regression analysis studies "the simultaneous emotions that some independent variables have over one dependent variable" [21].

Multiple linear regression is an extension of simple linear regression that through the use of multiple independent variables predicts a single criterion variable.

In our case study of the plastics manufacturing industry, MLR was used as a statistical method applied to analyze the relationship between a *dependent variable* (profit size) and several *independent variables* (self-financing capacity, return

on capital, personnel cost per employee and investment per employee).

We processed a quantity of official data collected in the last 10 years of the production activity of the firm ALB PLAST SHPK-Elbasan, Albania [1]. The analysis of the data collected by this company has been done using the Statistical Package for Social Sciences) [3], [13].

The main purpose of the MLR analysis is to demonstrate the profit size limits influenced by the four independent variables.

Table 1. Data of the albanian economic company

Year	Profit size (000 ALL)	Self-financing capacity (000 ALL)	Return on equity (%)	Personnel cost per employee (000 ALL)	Investment per employed person (000 ALL)
2011	2336.745	3203.066	30.205	7760.383	580.867
2012	2754.649	2797.156	1.444	155.706	8.661
2013	2128.739	4705.040	7.819	1248.643	71.691
2014	3754.849	6840.065	10.923	1391.152	82.671
2015	5268.745	7697.637	9.399	941.294	55.809
2016	3685.69	5115.297	6.177	1016.532	42.283
2017	1129.498	1270.573	0.973	124.101	6.926
2018	3129.924	3987.851	4.727	1040.762	52.211
2019	6342.494	7215.994	5.516	896.399	44.385
2020	13480.503	15450.331	12.118	2067.564	107.247

Source: own study

Let's explain the mathematical view of the MLR:

In the MLR analysis, the mathematical equation gives the average relationship between the variables that are used to predict or control the dependent variable.

Supposing that the dependent variable $\boldsymbol{y}$ *depends on the indepedent variables* $\boldsymbol{x_i}$, *for* $i = 1 \ldots n$, *the relationship between the variables is considered to be a linear model in the following form*:

$$\text{(MLRF)} \qquad y = f(x_1, x_2, \ldots, x_n) + \varepsilon, \qquad (1)$$

where $\varepsilon - random\ variable\ error\ or\ residue$ has the normal distribution $N(0, \sigma^2)$ and expresses the deviations of expected observed values of y, calculated through the regression equation [11].

The dependent variable $\boldsymbol{y}$ is also a random unit normally distributed.

In the mathematical-statistical model of the multiple linear regression:

- All the independent variables take part *in the same time* in the statistical model.
- The value of R and R^2 determine *the strength of the correlations* between the independent variables and the dependent variable.

The Statistical Instrument Test (SIT):

- *Fisher test* is used to show if this connection determined by the sample, may or may not generalize for whole the population.
- *t-test* is used to evaluate the individual link between every independent variable and the dependent variable.

The Statistical Package Analysis (SPA):

- Statistical Package for the Social Sciences, version 23 (SPSS) will be used as instrument to analyze and evaluate the statistical results [3], [13].

Determining and testing the correlation ratio:

One of the major problems that appear during the creation of multiple regression model is *the definition and test of the correlation* ratio between variables. For this purpose, a unit, which is called the coefficient of multiple correlation (R) that defines the amount of linear correlation between the dependent variable $\boldsymbol{y}$ and the *n*-independent variables $(x_1, x_2, \ldots, x_n)$, is defined in the multiple regression.

This coefficient takes defined values. If the distribution values are near the medium, the linear dependence is perfect, so, $\boldsymbol{y}$ can be expressed exactly as a linear combination of the independent variables $x_1, x_2, \ldots, x_n$. In this case the statistical model of linear regression is too strong.

This coefficient depends on the degree of measurement of random variables that are part of the model. The bigger the number of variables, the bigger the value of R^2, because the expected margin of error of prediction will be smaller.

Beside the values of $R - squared$, the values of $the\ adjusted\ R^2$ that define the part of variance of $\boldsymbol{y}$ that is "*explained*" from relationship of $x_1, x_2, \ldots, x_n$ should also be taken into consideration.

Even if we are using reliable data, a large adjusted value of R^2 does not necessarily mean that there is a strong random relationship, so, on the basis of regression, it is not possible to determine causation [4], [6], [14].

By calculating the coefficient R^2, we can demonstrate the impact that the independent variables have on the explanation of the total variances.

To prove which of the hypotheses is true or not, we use the $F - test$ and the student test. For each of them there is $n - (k + 1)$ degrees of freedom [7].

Table 2. The Regression's Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	**t**	Sig.
1 (Constant)	65.617	260.050		0.252	0.811
Self-financing capacity (000 ALL)	1.172	0.066	1.314	17.858	0.000
Return onequity (%)	-576.941	83.777	-1.360	-6.887	0.001
Personnel cost per employee (000 ALL)	-0.878	1.102	-0.550	-0.797	0.462
Investment per employed person (000 ALL)	39.103	14.860	1.880	2.631	0.046

a. Dependent Variable: Profit size (000 ALL)
Source: own study based SPSS23.

According to the data processing table 2. and coefficients, the regression equation is:

$$Y = 65{,}617 + 1{,}172x_1 - 576{,}941x_2 - 0{,}878x_3 + 39{,}103x_4 \quad (2)$$

From the equation we can conclude that the variables x_1 (*self-financing capacity*) and x_4 (*investments per employed person*) have a positive impact on the dependent variable y, while x_2 (*return on equity*) and x_3 (*personnel cost per employee*) have a negative impact.

The value of R^2 (0.999) explain that most of the variance is generated by the regression equation.

Table 3. Model Summary

Model	**R**	R-Square	Adjusted R-Square	Std. Error of the Estimate
1	0.997[a]	0.994	0.989	368.374

a. Predictors: (Constant), Investments per employed person (000 ALL), Self-financing capacity (000 ALL), Return on equity (%), Personnel cost per employee (000 ALL)
Source: own study based SPSS23

The test for regression significance in the case of multiple linear regression analysis is performed using analysis of variance. The test is used to check if there is a linear statistical relationship between the response variable and at least one of the predictor variables.

Once the coefficient is determined it can't be claimed that the linear regression coefficients are suitable without performing the hypothesis testing: here hypothesis testing is needed [20].

The regression coefficients are respectively: $\alpha_1, \alpha_2, \alpha_3, \alpha_4$.

The hypotheses we construct are:

- basic hypothesis $\boldsymbol{H_0}: \alpha_i = 0$ where $i = 1, 2, 3, 4$,
- alternative hypothesis $\boldsymbol{H_a}: \alpha_i \neq 0$.

To test the basic hypothesis we use the $F - test$ through an analysis of variance from the ANOVA table. According to the table, the calculated value of $F = 728{,}952$, while the theoretical value of F with a level of significance $\alpha = 0.05$ and 4 degrees of freedom in the numerator and 3 degrees of freedom in the denominator, is 9.117.

Table 4. ANOVA[b]

Model	Sum of Squares	df	Mean Square	F	Sig.
1Regression	1.117E8	4	2.792E7	205.718	0.000[a]
Residual	678498.451	5	135699.690		
Total	1.123E8	9			

a. Predictors: (Constant), Investment per employed person (000 ALL), Self-financing capacity (000 ALL), Return on equity (%), Personnel cost per employee (000 ALL)

b. Dependent Variable: Profit size (000 ALL)
Source: own study based SPSS23

From the comparison of the values of F, we can confirm that it is indisputable to accept the alternative hypothesis, which means that not all coefficients of the regression equation are equal to zero, so the model we have constructed affects the dependent variable. If at least one of these coefficients is not 0, the model is deemed useful [7].

The next step of the MLR analysis method is to determine which of the coefficients is equal to zero and which is non-zero.

The *t-test* is used to check the significance of individual regression coefficients in the multiple linear regression model. Adding a significant variable to a regression model makes the model more effective, while adding an insignificant variable can worsen the model [7].

We use the student *t-test* by calculating the current and theoretical value, respectively with $n - (k + 1)$ degrees of freedom.

Discussing the four variables, from the results of statistical data processing, we obtain the calculated values of the criterion t, which are respectively: *self-financing capacity* $(t = 34{,}468)$, *return on equity* $(t = -6{,}816)$, *investment per person employed* $(t = 0{,}952)$ and *personnel costs per employee* $(t = 0.510)$, compared with the calculated value of theoretical t with confidence level $\alpha = 0.05$, $10 - (4 + 1)$ degrees of freedom, which is $t = \pm 2.57$.

We reach the following conclusions:

- for *the self-financing capacity*, the calculated value of t is higher than the value of theoretical t, $(34{,}468 > 2.57)$ when the level of significance shown by the test is less than the selected level 0.05. In this case *the*

basic hypothesis is rejected and it is accepted that $\alpha_1 \neq 0$.

- the same can be said for the other variables studied: *return on equity* $(-6{,}816 < -2.57)$, again *the null hypothesis is rejected* and thus it is accepted that the regression coefficient $\alpha_2 \neq 0$. In the case of the other two independent variables, the values of the variables are: *Investment per the employed person* $(0.952 < 2.57)$ and *personnel costs per employee* $(0.510 < 2.57)$.

It can be seen that two of the variables: personnel cost per employee and investment per person employed are not significant indicators for the dependent variable-profit size. In this case the regression model does not contain these variables (in these cases *the basic hypothesis is accepted*, regression coefficients $\alpha_3 = \alpha_4 = 0$).

From the MLR analysis we can summarise: two of the independent variables, self-financing capacity and return on equity are significant variables, which affect the regression model built for the dependent variable: profit size. While the other two independent variables: personnel cost per employee and the investment per employed person do not affect the dependent variable: profit size.

If we process the data for the new regression model, with independent variables: self-financing capacity and return on equity, and the dependent variable of profit size, the equation from the data processing tables below.

Table 5. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-497.624	653.374		-0.762	0.471
	Self financing capacity (000 ALL)	0.869	0.085	0.974	10.183	0.000
	Return onequity (%)	-18.490	40.548	-0.044	-0.456	0.662

a. Dependent Variable: Size of the profit (000 ALL)
Source: own study based SPSS23

Table 6. Model Summary

Model	**R**	R-Square	Adjusted R- Square	Std. Error of the Estimate
1	0.968[a]	0.937	0.919	1002.623

Table 5. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-497.624	653.374		-0.762	0.471
	Self financing capacity (000 ALL)	0.869	0.085	0.974	10.183	0.000
	Return onequity (%)	-18.490	40.548	-0.044	-0.456	0.662

a. Predictors: (Constant), Return on equity (%), Self-financing capacity (000 ALL)
Source: own study based SPSS23

$$Y = -497{,}624 + 0{,}869x_1 - 18{,}490x_2 \quad (3)$$

where: x_1: self − financing capacity
x_2: return on equity

Comparison of the calculated value of F given by the ANOVA table below.

Table 7. ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.053E8	2	5.265E7	52.377	0.000[a]
	Residual	7036779.244	7	1005254.178		
	Total	1.123E8	9			

a. Predictors: (Constant), Return on equity (%), Self-financing capacity (000 ALL)

b. Dependent Variable: Profit size (000 ALL)
Source: own study based SPSS23.

The calculated value of F for the variance generated by the regression is $F = 52{,}377$. Comparing it with theoretical F with a confidence level of 0.05 and with 2 degrees of freedom in numerators, and 7 in denominators, respectively: F_{actual} = 4.74.

By comparing the calculated and factual F values, we conclude that we must accept the alternative hypothesis, i.e. regression coefficients are different from zero, the independent variables of the regression equation above are significant for the dependent variable in the constructed multiple linear regression model [7]. What we want to show is: which of the coefficients of the new regression model will be different from zero or not, so we conducted an individual evaluation of every single regression coefficient.

4. Discussion and Results

. After analyzing the data of ALB PLAST SHPK-Elbasan, Albania, we have shown through mathematical modeling the meaning and impact that variables such as self-financing capacity, return on equity, personnel cost per employee and investment per employee have on the size of profit.

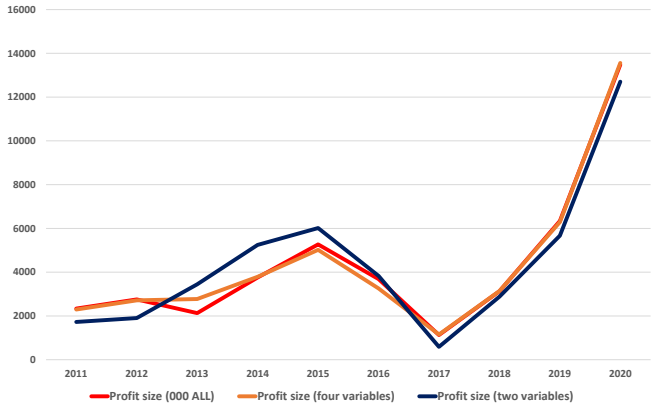

Fig. 8 Gaphs for Linear Multiple Regression Cases
Source: own study based on the research results.

Through the first regression model we showed that two of these variables, personnel cost per employee and investment per employee, were not significant for the dependent variable, profit size.

In the new model built, using the *student test*, with $n - (k + 1)$ degrees of freedom, from the table above, we get the calculated values of t for each of the three variables: $-0.762;\ 10{,}183$ and -4.56.

We compare the found values with the critical values of t, with a confidence level of 0.05 and with $10 - (2 + 1)$ degrees of freedom, i.e. with 7 degrees of freedom. The value of the table is $t = \pm 2.36$.

Analyzing all the values found for the independent variables, with a level of significance from the table less than 0.05, we can state:

- *Self-financing capacity*: the calculated value of $t = 10{,}183 > 2.36$, so the basic hypothesis falls and we accept that the coefficient $\alpha_1 \neq 0$.
- *Return on equity*: the calculated value of $t = -4.56 < -2.36$, the basic hypothesis falls and we accept that the coefficient $\alpha_2 \neq 0$.

The correlation between self-financing capacity and investment per person employed is also important $(R = 0.936)$, as is self-financing capacity and cost per person employed $(R = 0.917)$. there is also a strong correlation between personnel cost per employee and investment per the employed person $(R = 0.584)$. In this way via our analysis we demonstrated the strongest correlation between self-financing capacity and investment per the employed person.

5. Conclusion

Continuing with the data analysis, we can conclude that there are other significant correlations between the other studied variables. Through MLR method we can find different correlation coefficients that demonstrate the relationship between different independent variables and the dependent variable (profit size), thus showing the key indicators that are of great importance in the production of the Albplast enterprise.

In the future, depending on the economic situation, we can conduct many other studies, thus helping the activity of productive enterprises greatly in Albania.

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