ORIGINAL PAPER

ECONOMETRIC MODEL NECESSARY FOR ANALYSIS OF EXISTING CORRELATIONS BETWEEN HUMAN RESOURCES AND THE FINANCIAL PERFORMANCE OF THE ENTERPRISES

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Abstract. *This paper aims to determine the link between the human resource-expressed numerically by the number of employees and the financial performance indicators registered at the level of a commercial entity. Financial performance is quantified in this article with three indicators: turnover, total revenue and net profit recorded. In order to analyze the correlations between the dependent variable - the number of employees and the independent variables - turnover, total revenues, net profit, we propose a linear regression model, which is an extremely necessary tool for scientific research of this type.*

Keywords: *human resources, financial performance, econometric correlations.*

1. INTRODUCTION

The main objective of this paper is to identify the correlations between the number of employees and the financial performance indicators by using econometric models. Considering the essential role of human capital for the deployment of economic activity, unfolding the processes of building the basic industrial structure and of the transition to a post-industrial society [1], it has become increasingly important to find models to quantify the relationship between human capital and the performance of the organisation. Every organisation seeks effective management of its human resources to efficiently achieve organisational goals. Consequently, we can state that the major goal of human resource management is to achieve the organization's success through its members [2]. Several definitions have been assigned to the performance term, depending on its users. Thus, managers are interested in the overall performance of companies, investors will perceive performance through return on investment, employees and customers are interested in the stability of the enterprise, and creditors are considering solvency and liquidity [3]. Financial performance is a measure of the company's total business [4].

We believe that regardless of how important financial performance is defined is its appreciation in close relation with the factors that influence it. In this research, we want to determine whether the number of employees at any given time within an organisation influences its financial performance, because the development of human resources, combined with the practical application of simulation, is considered today as a potential source for obtaining a competitive advantage [5].

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2. RESEARCH METHODOLOGY

In order to accomplish the present research, we used as a research method the content analysis of the balance sheet and the profit and loss book published by S.C. ASO CROMSTELL S.A., public information on www.mfinante.ro.

Based on the analysis, we have developed a database with the evolution of the indicators - the number of employees, the turnover, the total revenues and the profit for the time period 2011-2016. The analysis of the correlations between the four (four) variables was carried out using the SPSS program.

In the present research we will try to answer the following research question: To what extent is the performance of the enterprise influenced by the number of employees?

To answer this question we have set the following research assumptions:

I1: Companies with a higher number of employees have registered higher turnover.

I2: Enterprises with a higher number of employees have earned higher total annual revenue.

I3: Enterprises with a higher number of employees have achieved a higher profit.

To test the hypotheses of the study, we used the Pearson correlation coefficient as a measure of the intensity of the relationship between two variables.

2.1. MATERIALS – DATABASE REQUIRED FOR RESEARCH

The data series on turnover, total revenues, profit and number of employees are presented in Table 1.

Table 1. Evolution of financial indicators and number of employees

Crt.	Year	Number of Employees	Turnover	Total Revenues	Net profit
1.	2011	331	251843625	269176809	21560799
2.	2012	379	261673483	271234977	13129163
3.	2013	405	304598093	317516024	17460710
4.	2014	471	336271754	350140714	24547366
5.	2015	530	340228418	353807895	8712816
6.	2016	537	325923822	334492508	13544888

Source: own processing based on published data on www.mfinante.ro

3. RESULTS AND DISCUSSION

3.1. RESULTS

To test the hypotheses of the study, we used the Pearson correlation coefficient (Pearson product-moment correlation coefficient). The Pearson coefficient is widely used in empirical research as an indicator of linear dependence between two variables, determining the extent to which the variables are linearly related to each other. For the significance testing, the correlation coefficient is used, it can take values between -1 and +1. Various interpretations of this coefficient have been asserted over time. We will mention Hopkins (2000), which we have also used in data processing [6].

The calculation formula for the Pearson coefficient is:

$$r = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{[N\sum x^2 - (\sum x)^2][N\sum y^2 - (\sum y)^2]}}$$

where:
N= number of pairs of scores;
x = independent variable;
y = dependent variable.

Table 2. Interpretation of the PEARSON correlation coefficient

The value of the correlation coefficient	Description
<0.1	Very small, non-substantial, irrelevant
0.1 – 0.3	Small, Low
0.3 – 0.5	Moderate, medium
0.5 – 0.7	Big, High
0.7 – 0.9	Very high
>0.9	Describes a perfect relationship between two variables

Source: Hopkins, W. G. (2000). A new view of statistics. Internet Society for Sport Science: http://www.sportsci.org/resource/stats/

3.1.1. The correlation coefficient between number of employees and turnover

The correlation between the dependent variable, "number of employees", and the independent variable, "turnover", is shown in Table 3, using the Pearson coefficient.

Table 3. Correlation coefficient between number of employees and turnover

Indicators		Number_of_employees	Turnover
Number_of_employees	Pearson Correlation	1	0.910*
	Sig. (2-tailed)		0.012
	N	6	6
Turnover	Pearson Correlation	0.910*	1
	Sig. (2-tailed)	0.012	
	N	6	6
* Correlation is significant at the 0.05 level (2-tailed).			

We note that its value is positive and quite large (0.910), which shows that there is a very high dependency relationship between the two variables, and Sig. <0.05, demonstrates a directly proportional relationship of very high intensity between the number of employees and the turnover value.

Table 4. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.910[a]	0.828	0.784	38.998	1.354
a. Predictors: (Constant), Turnover					
b. Dependent Variable: Number of employees					

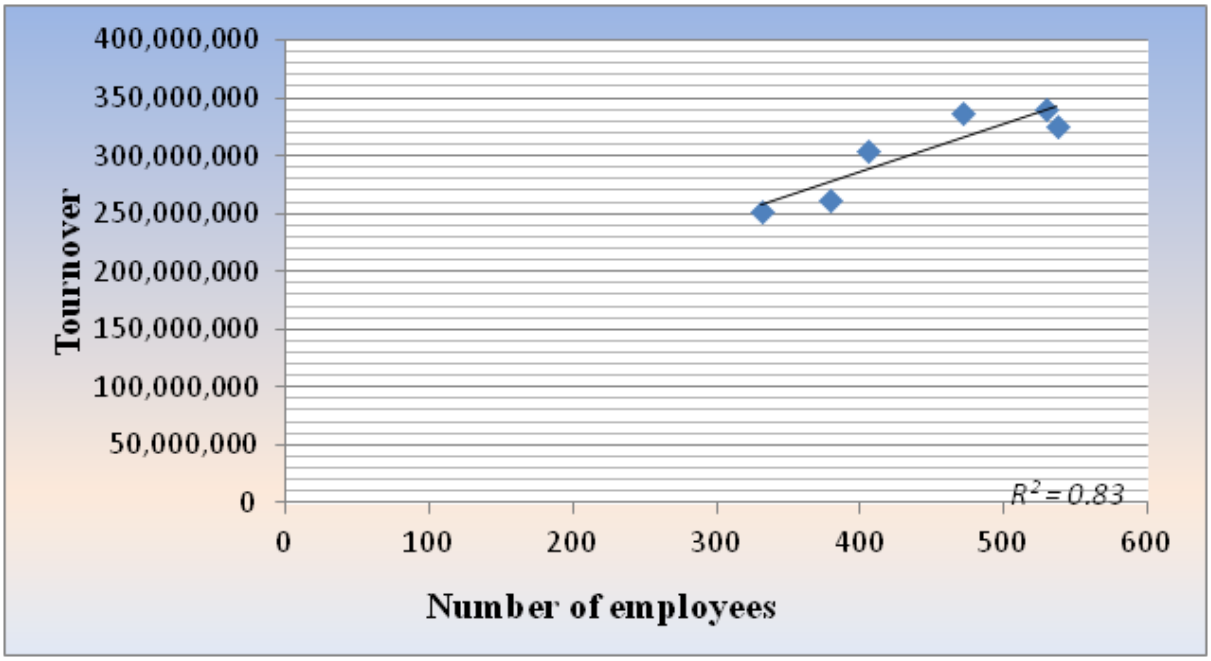

Figure 1. The graphical representation of the correlation between the number of employees and the turnover.

The proportion that the turnover variation is influenced by the number of employees is 83% (R Square = 0.828). In Fig. 1 we plotted the correlation between the two variables and we observe the upward trend due to a positive correlation between the two variables, so we can say that **hypothesis no. 1 is validated**.

3.1.2. The correlation coefficient between the number of employees and the total revenues

The correlation between the dependent variable, "number of employees", and the independent variable, "total revenues", is shown in Table 5, using the Pearson coefficient. We note that its value is positive and quite high (0.885), which shows that there is a very high dependency relationship between the two variables, and Sig. <0.05, demonstrates a directly proportional relationship of very high intensity between the two variables.

Table 5. Correlation coefficient between number of employees and total revenues

Indicators		**Number_of_employees**	**Total_revenues**
Number_of_employees	Pearson Correlation	1	0.885*
	Sig. (2-tailed)		0.019
	N	6	6
Total_revenues	Pearson Correlation	0.885*	1
	Sig. (2-tailed)	0.019	
	N	6	6
*. Correlation is significant at the 0.05 level (2-tailed).			

The proportion that the total income variation is influenced by the number of employees is 78% (R Square coefficient = 0.783), we also validate the **hypothesis no.2**.

Table 6. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.885[a]	0.783	0.728	43.766	1.419
a. Predictors: (Constant), Total revenues					
b. Dependent Variable: Number of employees					

3.1.3. The correlation coefficient between the number of employees and net profit

As we can see in the previous table, the results show that between the number of employees and the net profit is not a direct linear relation, the Pearson coefficient has a negative value of -0.454, thus we **denounce hypothesis number 3**, stating that "Enterprises with a number higher employees have earned more profit".

Table 7. The correlation coefficient between the number of employees and net profit

Indicators		Number_of_employees	Net_Profit
Number_of_employees	Pearson Correlation	1	-0.454
	Sig. (2-tailed)		0.366
	N	6	6
Net_Profit	Pearson Correlation	-0.454	1
	Sig. (2-tailed)	0.366	
	N	6	6

As we can see in the previous table, the results show that between the number of employees and the net profit is not a direct linear relation, the Pearson coefficient has a negative value of -0.454, thus we **denounce hypothesis number 3**, stating that "Enterprises with a number higher employees have earned more profit".

Regarding the time evolution of the independent variables in Fig. 2 we can observe the upward trend of the first two variables - turnover and total revenues and unequal fluctuation in net profit, which can be decisive in explaining the negative connection between the number of employees and the net profit.

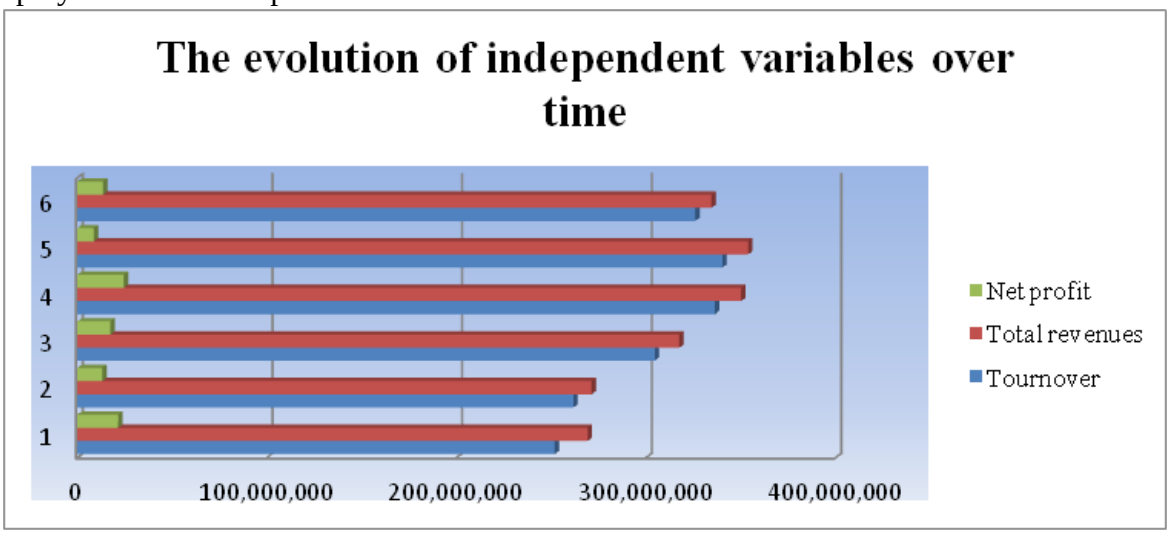

Figure 2. The graphical representation of the evolution of independent variables.

3.2. DISCUSSION - Determining the multiple regression model

Of particular importance is the choice of an analysis model that allows the selection of a set of predictors having the maximum influence power over the variable criterion. Regression is the mathematical expression that allows the estimation of a variable depending on at least one other variable, and the determination of this relationship helps us in future prediction and prediction studies [7].

Because based on the information presented above we could observe a direct linear correlation only between the number of employees and the turnover and total revenues, we will create a multiple regression model using these three variables.

The function of multiple regressions is a method of studying the evolution of a dynamic system starting from successive observations of some characteristics of the system [5].

The mathematical representation of the multiple regression model is in the form:

$$Y_t = b_0 + b_1 x_1 + b_2 x_2 + u$$

In matrix, the multiple regression models can be presented as follows:

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix} = \begin{pmatrix} 1 & x_{11} & x_{12} \\ 1 & x_{21} & x_{22} \\ & \cdot \ \cdot & \cdot \\ 1 & x_{n1} & x_{n2} \end{pmatrix} \begin{pmatrix} b_0 \\ b_1 \\ \vdots \\ b_k \end{pmatrix} + \begin{pmatrix} u_0 \\ u_1 \\ \vdots \\ u_k \end{pmatrix} [8]$$

where:
Y_t = the dependent variable;
b_0, b_1, b_2 = linear regression model parameters;
x_1, x_2 = independent variables;
u = residual variable / model error

Another important aspect of multiple regressions is multicollinearity. This is a concept opposed to orthogonality and expresses the level of correlation between independent variables. Information shared by independent variables reduces their contribution to explaining the variance of the dependent variable. In other words, the more they correlate with each other, the more the correlation with the dependent variable is lower. In addition, the multicoliniarity amplifies the variability of the regression coefficients, which results in a higher imprecision of prediction [9]. For this reason, regression analysis must be preceded by multicollinearity assessment.

Thus, until we begin building the multiple regression models, we will check the degree of correlation of the independent variables, using the Pearson coefficient.

Table 8. The matrix of correlation between model variables

Indicators	Number of employees	Tournover	Total revenues	Net profit
Number of employees	1			
Tournover	0.910	1		
Total revenues	0.885	0.996	1	
Net profit	-0.453	-0.185	-0.143	1

We note that it is an almost perfect correlation between the two independent variables (turnover and total revenues) which causes us to quit the proposed multiple regression model. Thus, the new multi-regression model will have as a dependent variable the turnover and the independent variables will be: the number of employees and the net profit, because between these is not a perfect collinearity relation. Thus the equation will become:

$$T = b_0 + b_1 N_e + b_2 P$$

where:
T/Tournover = the dependent variable;
b_0, b_1, b_2 = linear regression model parameters;
N_e/Number of employees= independent variables;
P/Profit net = independent variables.

We continue to build the model using SPSS, so based on the information obtained, so based on the information obtained, presented in Table 9 we obtain the parameters b_0 = 62708022, b = 474505.50 and b_2 = 1.87, the equation becomes:

$$T = 62708022 + 474505.50N_e + 1.87P$$

Table 9. The regression coefficient between the variables

Regression Statistics					
Multiple R	0.944897089				
R Square	0.892830509				
Adjusted R Square	0.821384182				
Standard Error	16198133.87				
Observations	6				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	6.56E+15	3.28E+15	12.49652	0.035084
Residual	3	7.87E+14	2.62E+14		
Total	5	7.34E+15			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	62708022.1	57316739	1.094061	0.353907	-1.2E+08
X_1=Number of employees	474505.5028	96787.11	4.902569	0.016244	166485.7
X_2= Profit	1.873847437	1.385834	1.352144	0.26923	-2.53649

From the equation of the regression model, we can notice that the variable "turnover" is influenced to a large extent by the number of employees, mathematically we can state that if we increase the number of employees with one unit, the turnover will increase by 474505.50 units. Also, the increase by one unit of the profit will increase the turnover by 1.87 units. We note that the value of the free model term in our case b_0 = 62708022 is very high, which means that the factors that were not taken into account in the construction of the model show an important influence on the tournover.

The model has an 89% confidence level, which together with the results of the F-statistic test, the higher the reference value allows us to use it in the future company forecasting analyzes. The role of statistical and econometric methods and models is considerably amplified in the context of market mechanisms, as the degree of complexity of the enterprise economic and financial activity with profound implications in the management

process, which can not be achieved only on the basis of experience and requires studies and relevant analyzes to underpin operative and strategic decisions [10]. Using simulation techniques, model and the statistical programs (SPSS, Excel, Eviews etc.) the economics specialists can see the future trends of social dysfunctions such work conflicts, work accidents, personnel fluctuation and absenteism [11] and many scenarios which may bring many advantages as: reduced costs, determine future risks, increase performance for both parts, necessary to make decisions in a proper manner and time [12].

4. CONCLUSIONS

The increasingly important role attributed to economic forecasting in the national economy has led us to achieve this article. The empirical results presented in this paper have shown that there is a direct, perhaps even proportional, link between the number of employees and two of the three independent variables: turnover and total income, thus validating the first two hypotheses set at the beginning of the study. Regarding the relationship between the number of employees and the net profit we can see that there is no direct link between these two variables.

Knowing these correlation relationships between the chosen variables allows the use of the econometric model described on the basis of the multiple regression equation in microeconomic forecasting analyzes. We note that the multiple linear regression model provides much more complete and complex statistical information than simple linear regression, which leads to more relevant analyzes.

REFERENCES

[1] Pavelescu, F. M., Ciutacu, C., Chivu, L., Munteanu, A. C., *Capitalul uman şi performanţa economică*, Expert Publishing, Bucuresti, 2007.
[2] Fratila, C., Duica, M.C., *Managementul resurselor umane – Concepte. Practici. Tendinţe,* Bibliotheca Publishing, Targoviste, 2014.
[3] Stefanescu, A., Turlea, E., *Performanţa financiara a intreprinderii intre realitate si creativitate,* Economica Publishing, Bucuresti, 2005.
[4] Danila, A., Horga, M. G., Coman, D. M., Coman, M. D., Stanescu S.G., *Journal of Science and Arts*, **4**(41), 761, 2017.
[5] Florea, N.V., Mihai, D.C., *Journal of Science and Arts*, **3**(32), 229, 2015.
[6] Hopkins, W. G., *A new view of statistics. Internet Society for Sport Science: http://www.sportsci.org/resource/stats/,*2000.
[7] Greene, E., *Econometrie,* Pearson Education Publishing, France, 2011.
[8] Anghelache, C., Dumitrescu, D., Soare, D. V., *Revista Română de Statistică*, **11**, 81, 2015.
[9] Andrei, T., Bourbonais R., *Econometrie,* Economica Publishing, Bucuresti, 2008.
[10] Anghel, M.G., Calota, L.M., *Revista Română de Statistică,* **10**, 25, 2016.
[11] Florea, N.V., Mihai, D.C., Duica, A. *Journal of Science and Arts*, **4**(41), 745, 2017.
[12] Duica, M.C., Florea, N.V., Duica, A., Topliceanu, V., *Journal of Science and Arts*, **3**(40), 503, 2017.