ANALYSIS OF THE FINANCIAL PERFORMANCES OF THE FIRM, BY USING THE MULTIPLE REGRESSION MODEL

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Abstract

The information achieved through the use of simple linear regression are not always enough to characterize the evolution of an economic phenomenon and, furthermore, to identify its possible future evolution. To remedy these drawbacks, the special literature includes multiple regression models, in which the evolution of the dependant variable is defined depending on two or more factorial variables.

Key words: *company, phenomenon, analysis, indicator, influence, regression*

The multiple regression model can be used too for the company, completing the previously performed analysis with a simple linear model. In this respect, we will consider that the two previously analyzed variables (the turnover and the personnel expenses) to which we will add the value of investments made during the period 2000 – 2009 by the company. These data are synthesized in table 1:

Turnover, personnel expenses, investments

Table 1

Year	Turnover (thousand lei)	Personnel expenses (thousand lei)	Investments (thousand lei)
2000	71.190,2	18.890,0	673,5
2001	74.778,5	19.101,6	688,0
2002	79.989,7	19.434,0	701,2
2003	84.209,1	20.105,7	727,4
2004	87.763,3	20.989,8	786,5
2005	90.055,2	22.417,6	814,1
2006	240.693,0	28.707,6	932,1
2007	182.727,5	31.796,6	379,4
2008	203.728,2	33.090,9	900,8
2009	197.230,1	32.995,2	740,7

Based on these information, we will analyze the existence of an eventual dependency relation between the turnover (the resulting variable y) and the level of personnel expenses (causal variable x_1), respectively of the investments (exogenous variable x_2).

The econometrical description of the connection between the three variables can be made with the help of three models:

an uni-factorial model to explain the variation of the turnover based on the personnel expenses level (presented in the first section of this article).

$y_i = f(x_{1i}) + u_{1i}$

an uni-factorial model to explain the variation of the turnover based on the modification of the investment level .

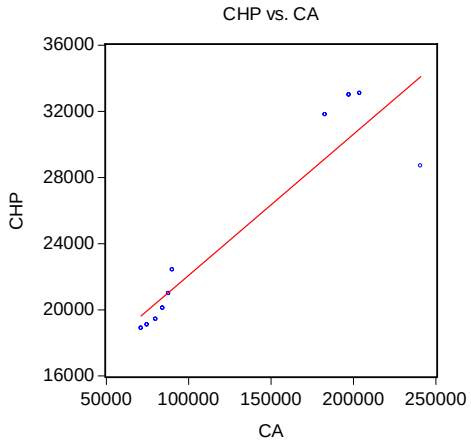
$y_i = f(x_{2i}) + u_{1i}$

a multi-factorial model to explain the variation of the turnover based on both factors.

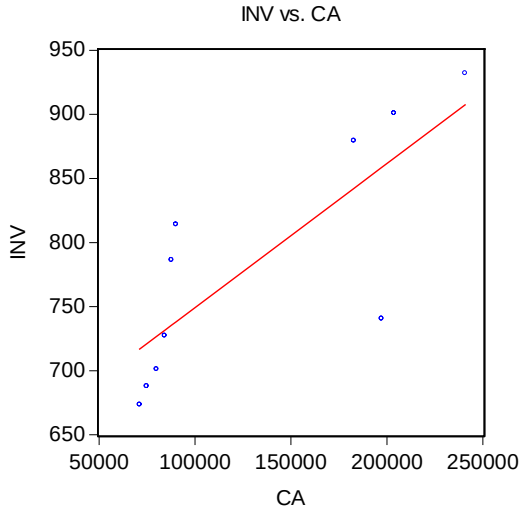
$y_i = f(x_{1i}, x_{2i}) + u_i$

to determine the shape of the regression function of the multi-factorial model, we will determine first the shapes of the regression functions for the two uni-factorial models, through the graphical method (with the help of corelograms).

Correlogram CHP vs CA



Corelogram INV vs CA



Based on the graphics in fig. 5 and fig. 6, it can be observed that the connections between x_1 and y and, respectively, x_2 and y can be approximated with a straight line, so we can consider that the analyzed multi-factorial model will be a linear one, such as:

$y_i = b_0 + b_1*x_{1i} + b_2*x_{2i} + u_i$

Estimation of parameters

We define:

$$Y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}$$

Y → the column vector of the endogenous variable, of size n = 12

$$X = \begin{pmatrix} 1 & X_{11} \cdots & X_{1k} \\ 1 & X_{21} \cdots & X_{2k} \\ \vdots & \vdots & \vdots \\ 1 & X_{n1} \cdots & X_{nk} \end{pmatrix}$$

X → matrix of exogenous variables, of size n*k+1

$$B = \begin{pmatrix} b_0 \\ b_1 \\ \vdots \\ b_k \end{pmatrix}$$

B →the column vector of parameters, size k + 1 = 3

$$U = \begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{pmatrix}$$

U → the column vector of the random variable, size n = 12
The multi-factorial linear model identified above can be written as a matrix:
Y = X * B + U

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix} = \begin{pmatrix} 1 & X_{11} \cdots & X_{1k} \\ 1 & X_{21} \cdots & X_{2k} \\ \vdots & \vdots & \vdots \\ 1 & X_{n1} \cdots & X_{nk} \end{pmatrix} * \begin{pmatrix} b_0 \\ b_1 \\ \vdots \\ b_k \end{pmatrix} + \begin{pmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{pmatrix}$$

Where:
n = 12 → number of available observations;
k = 2 → number of exogenous variables.

The regression function corresponding to the considered regression model, written as a matrix equation, is:

$Y = X * B$.

To estimate the parameters we will use the least squares method. For the multi-factorial linear model, the application of this method assumes the minimization of the function:

$$F(\hat{B}) = \min \sum_{t=1}^{n} u_t^2 = \min (Y - X\hat{B})^2$$

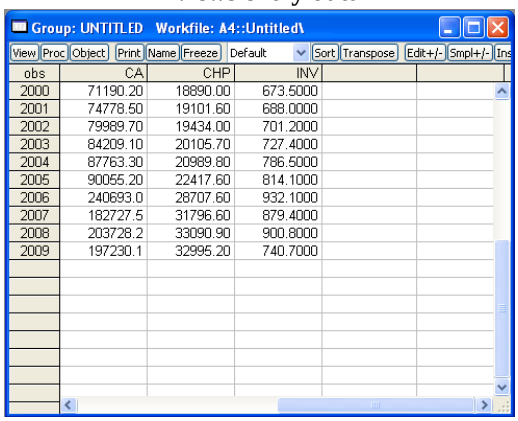
$$= \min (Y^T Y - 2\hat{B}^T (X^T Y) + \hat{B}^T (X^T X)\hat{B})$$

That implies the computation of the function's derivative depending on the $\hat{B}$ estimator and its annulations:

$(X^T X)B = X^T Y$.

To facilitate the determination of the multiple regression model, we have used the Eviews 5.1 software. The three variables considered were opened as a group:

Eviews entry data



Group: UNTITLED Workfile: A4::Untitled\

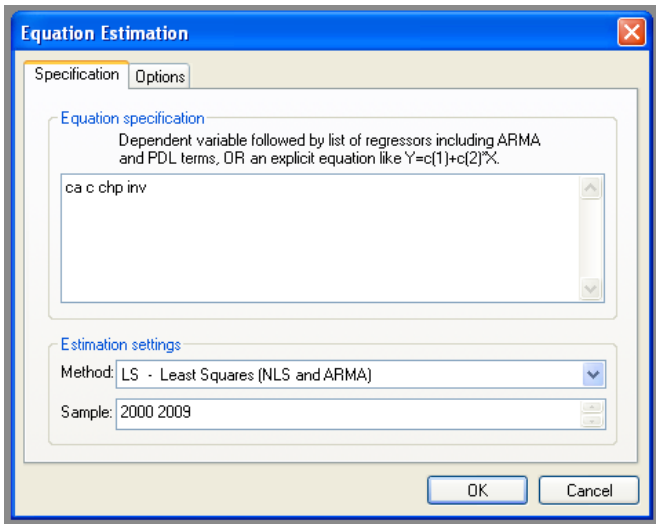
View | Proc | Object | Print | Name | Freeze | Default | Sort | Transpose | Edit+/- | Smpl+/- | Ins

obs	CA	CHP	INV		
2000	71190.20	18890.00	673.5000		
2001	74778.50	19101.60	688.0000		
2002	79989.70	19434.00	701.2000		
2003	84209.10	20105.70	727.4000		
2004	87763.30	20989.80	786.5000		
2005	90055.20	22417.60	814.1000		
2006	240693.0	28707.60	932.1000		
2007	182727.5	31796.60	879.4000		
2008	203728.2	33090.90	900.8000		
2009	197230.1	32995.20	740.7000		

In this group, by using the Quick – Estimate Equation command, an equation was defined, having the turnover as resulting variable, and the personnel expenses and the level of investments as factorial variables. Also, un the regression model, the free term c was inserted, to reflect the influence of the terms not taken in consideration at the construction of the model.

Similar to the simple linear regression, we shall use, for the estimation of parameters, the least squares method:

Equation Estimation window - 1



The results achieved with the help of the considered model and determined through Eviews 5.1. software are:

Dependent Variable: CA
Method: Least Squares
Date: 07/07/10 Time: 02:31
Sample: 2000 2009
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-216697.6	74767.04	-2.898304	0.0230
CHP	7.787177	1.961396	3.970221	0.0054
INV	197.8389	128.4364	1.540365	0.1674

R-squared	0.886593	Mean dependent var	131236.5
Adjusted R-squared	0.854191	S.D. dependent var	66214.25
S.E. of regression	25283.87	Akaike info criterion	23.35705
Sum squared resid	4.47E+09	Schwarz criterion	23.44782
Log likelihood	-113.7852	F-statistic	27.36231
Durbin-Watson stat	2.780845	Prob(F-statistic)	0.000491

The multiple regression model determined can be written as an equation:

CA = -216697,6 + 7,787177 CHP + 197,8389 INV

As it can be observed, the use of the multiple regression model confirms the conclusion formulated after the analysis with the simple linear model, that the value of personnel expenses influences significantly the evolution of the turnover. It can be observed, however, that in this case, the increase of the turnover based on the increase by one lei of the personnel expenses is slightly lower, that is eight lei for each modification with one unit of the factorial variable.

Also, it can be observed that the investments bring an increase more than significant for the value of the company's turnover. According to the previous mode, for each unit invested, an increase by 197,84 lei of the company's turnover will be recorded. It must be mentioned that, in the considered model, the influence of the free term, as an expression of the factors that have not been included in the model, is significant. So, we can state that the factors not taken into consideration at the construction of the econometric model determine a significant decrease of the turnover's value.

From the point of view of statistical tests, it can be seen that the values of the R and R^2 tests are close to 90% (R^2 = 88,66%, and R^2 adjusted = 85,5%), allowing

us to state that the model subjected to analysis is a correct one and has a degree of risk that can be considered acceptable for an economic analysis. Also, we can observe that, by including an additional factorial variable in the model, we have achieved an increase of its degree of probability, compared to the simple regression model.

Also, we can ascertain that the value of the F-statistic test (27,36) is superior to the table reference value, inducing the idea that the considered econometric model is a correct one and can be used in economic analysis and to forecast the level of the turnover.

Not last, the value of the Prob (F-statistic) test, 0,000491 is significantly close to zero, confirming the previously formulated affirmations.

Conclusions

An econometric regression model that uses as resultant variable the turnover, and the personnel expenses and the value of investments as factorial variables, is a correct one, an can be used to forecast the result of the company.

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