THE INFLUENCE OF THE SELECTED ECONOMIC FACTORS ON THE SMALL AND MEDIUM ENTERPRISES VIA USING THE GENERAL LINEAR MODELS

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Abstract: *The company's economic activities are essential for its management. Unfortunately, the acquired information often does not correspond internally and thus it may raise misleading. The information can be gathered from competitors, economical indexes (recent and current circumstances) and the companies from other industrial areas, and exactly this comparison could be useful for SMEs. This work shows the influence of the selected economic factors (turnover, investment) on the small and medium enterprises from two different business areas via using the general linear models.*

Key words*: general linear models, correlation between investments, business area and turnover of small and medium enterprises (SME).*

1. INTRODUCTION

The economic and business activities are essential for any company. The financial and economic knowledge is often based on the information that can be easily obtained from public sources: mainly the information such as gross domestic product (GDP), unemployment, political position of the company and its relationship abroad. The companies often governed the experience from the concurrent other similar sectors in the market. But companies often do not compare the acquired information. Companies can assume that some of the information may affect them more than competitors or companies from another business sector which can rise misleading.

The research should give us the results, if there is dependence between the turnover, investment, and the business area in two sectors. The differences between companies in the area (A,B and C,D) are not considered. For the area the most powerful companies in the market have been selected. The "power" is determined by the highest turnover in the area and via the questionnaire survey from consumers. The data was analysed for 2005 – 2014.

2. RESEACH

General linear model is a statistical linear model [4] which has its roots in the origins of mathematical thinking since the development of a modern algebra theory in 1800. The modern algebra established a general linear model as we know it today.

The development of a linear regression model in the 19th century and the development of the correlation methods lie on the grounds of algebraic invariant theory. Before regression was the method of least squares. It was published by Adrien-Marie Legendre in 1805 and by Carl Friedrich Gauss in 1809 [7].

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General Linear models provide a variety of different statistical models such an analysis of variance (ANOVA), analyse of covariance (ANCOVA), multivariable analysis of variance (MANOVA) and general linear regression [9]. General linear models include a number of different statistical models. They are a generalization of linear regression in case of more than one dependent variable.

The use of linear models brings an effort to describe the connection between the various occurrences as accurately as possible [8].

Assumption of the general linear model (GLM)

For general linear models there is the following assumption in force:

1. $E_{(u)} = 0$, the average value of a random variable in all views is zero
2. $E(_{uu}´) = \sigma^2 I_n$, random mappe are independent and have a constant variance
3. X = non-stochastic matrix
4. X = full rank [4].

In case that the first assumption is disrupt, the nonzero average value of a random quantity show into the estimate level constant. This estimate will be diverted.

The second assumption contents two requirements: the random mappe have the same variance and may not be dependent.

If is the first of the assumption (equal variance) breaks, it is called "heteroscedasticity". If is the second assumption (independent of the random mappe) breaks, it is called "autocorrelation". In this case will be diverted the estimates of standard errors and parameter estimation variance of random mappe and it is not possible to deflect them in a statistical tests. The third assumption breaks in case of the simultaneous equations. The fourth assumption presents that the matrix of explanatory variables must be linearly independent. However, the variables are dependent, it is a perfect collinearity. If the variables are strong dependent, it is "multicollinearity".

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Practical part

For the testing four companies were selected - A,B,C, and D. Two of these companies (A and B) are present in the specialized market in the Czech Republic, hereinafter "area of entrepreneurship 1".Two of the companies (C and D) are present in the drugstore market in the Czech Republic, hereinafter "area of entrepreneurship 2". All these companies are similar (amount of the employees, same customers). This test should give us the results, if there is a dependence between the turnover, investment, and the business area.

	Company A		Company B		Company C		Company D	
	Turnover (in thousend Kč)	Investment (in thousend Kč)	Turnover (in thousend Kč)	Investment (in thousend Kč)	Turnover (in thousend Kč)	Investment (in thousend Kč)	Turnover (in thousend Kč)	Investment (in thousend Kč)
2014	7228	730	6105	201	1212	634	157	54
2013	5836	719	5670	350	854	315	845	254
2012	7870	300	6978	551	985	218	724	364
2011	7401	683	6731	481	623	118	885	544
2009	3832	200	3622	115	823	185	648	384
2008	3486	170	3215	205	451	195	682	301
2007	2350	100	2323	200	108	84	505	121
2006	1210	50	1105	63	284	87	359	105
2005	1101	36	1020	15	257	64	381	56

Table 1: Sourcing data

The first testing shows the dependence of the investment on the area of the entrepreneurship. Analyse of ANOVA was chosen for the testing.

Jednorozměrné testy významnosti, velik. efektů a síly pro Investice (zdroj)
Sigma-omezená parametrizace
Dekompozice efektivní hypotézy

Efekt	SČ	Stupně volnosti	PČ	F	p	Parciál. éta-kvadr.	Výstřednost	Pozor. síla (alfa=0,05)
Abs. člen	4929444	1	4929444	46,73173	0,000004	0,744946	46,73173	0,999995
oblast podnikání	227708	1	227708	2,15870	0,161152	0,118880	2,15870	0,281963
Chyba	1687742	16	105484					

Table2: ANOVA with the program Statistica

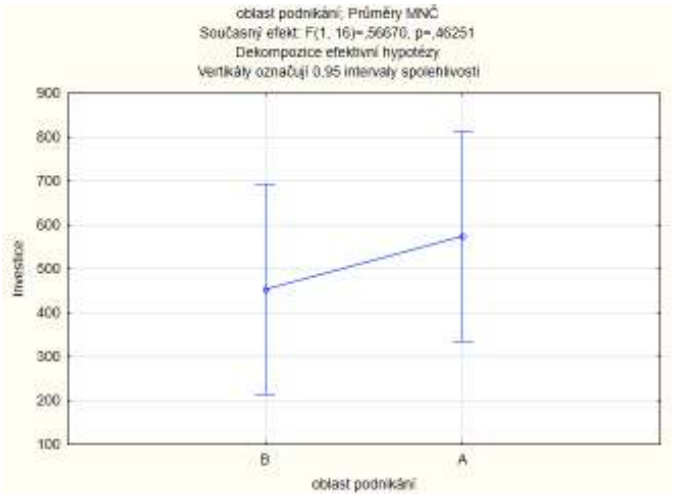

Figure 1: ANOVA with the program Statistica

In this case on the level of significance 5% the null hypothesis about the independent the investment on the area of the entrepreneurship was rejected. Investment is therefore dependent on the area of the entrepreneurship.

The second analyse should show us, if the investments are dependent on the turnover. For analyse the linear regression analyse was chosen.

Jednorozměrné testy významnosti, velik. efektů a síly pro Investice (zdroj)
Sigma-omezená parametrizace
Dekompozice efektivní hypotézy

Efekt	SČ	Stupně volnosti	PČ	F	p	Parciál. éta-kvadr.	Výstřednost	Pozor. síla (alfa=0,05)
Abs. člen	584407	1	584407	10,48334	0,005152	0,395847	10,48334	0,859576
Tržby	1023510	1	1023510	18,36018	0,000568	0,534345	18,36018	0,980105
Chyba	891940	16	55746					

Table 3: Linear regression analyse with the program Statistica

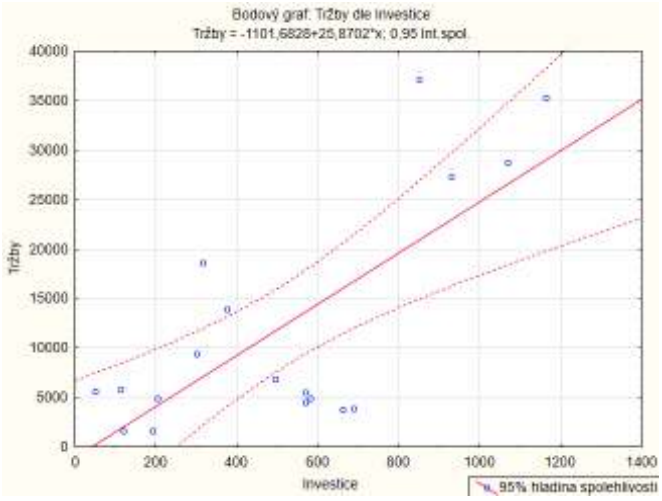

Figure 2: linear regression analyse with the program Statistica

At the 5% significance level the null hypothesis about the independent of the investment on the turnover was confirmed.
Under the same conditions the companies are analysed whether the investment depends on the turnover and the area of the entrepreneurship. Analyse is done with the test ANCOVA.

Jednorozměrné testy významnosti, velik. efektů a síly pro Investice (zdroj)
Sigma-omezená parametrizace
Dekompozice efektivní hypotézy

Efekt	SČ	Stupně volnosti	PČ	F	p	Parciál. éta-kvadr.	Výstřednost	Pozor. síla (alfa=0,05)
Abs. člen	71362	1	71362	2,12471	0,165558	0,124073	2,12471	0,276405
Tržby	1346127	1	1346127	40,07914	0,000013	0,727665	40,07914	0,999957
oblast podnikání	388139	1	388139	11,55631	0,003962	0,435162	11,55631	0,887848
Chyba	503801	15	33587					

Table 4: ANCOVA analyse with the program Statistica.

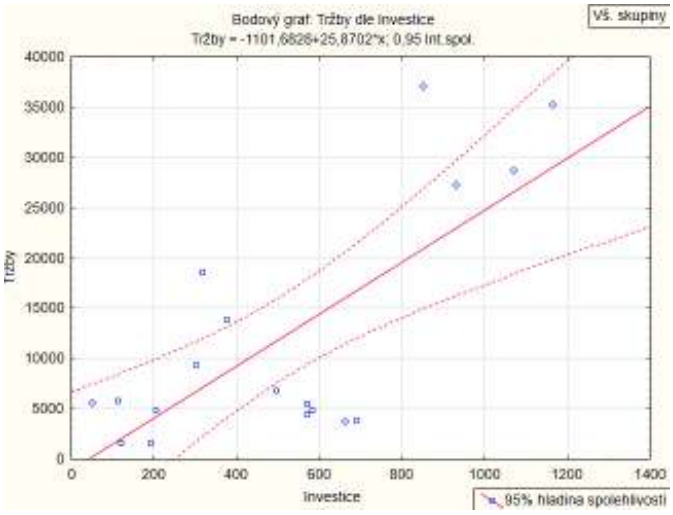

Figure 3: ANCOVA test with program Statistica

The table no. 4 shows the testing independence of the investment on the area of the entrepreneurship. In this care it is not possible to reject the null hypothesis of the independence area of the entrepreneurship.
Independence of investment on the turnover is present on the table no. 4 as well. Even here it is not possible to reject the null hypothesis of the independence the turnover.

The difference between the results is:

- Investment are **dependent** on the area of the entrepreneurship.
- Investment are **independent** on the turnover.

The third test checked both questions in the same time and the results were:

- Investment are **independent** on the area of the entrepreneurship.
- Investment are **independent** on the turnover.

For greater credibility of the results the further analysis with the general linear model was made.

Jednorozměrné testy významnosti pro Investice (zdroj)
Sigma-omezená parametrizace
Dekompozice efektivní hypotézy

Efekt	SČ	Stupně volnosti	PČ	F	p
Abs. člen	71362	1	71362	2,12471	0,165558
Tržby	1346127	1	1346127	40,07914	0,000013
oblast podnikání	388139	1	388139	11,55631	0,003962
Chyba	503801	15	33587		

Table 5: General linear model with the program Statistica

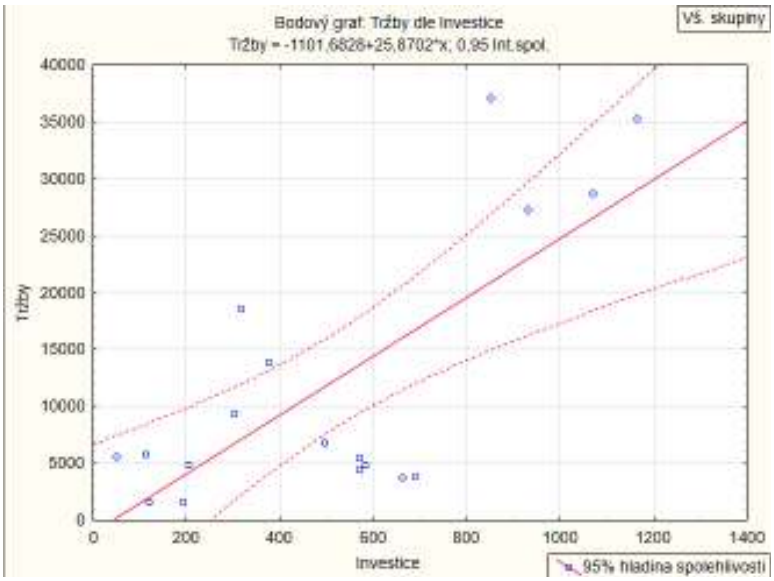

Figure 4: General linear model with program Statistica

The test of the general linear model is shown on the 5% significance level that it is not possible to reject the null hypothesis for the independent of investments on the area of the entrepreneurship. The test cannot reject the null hypothesis about the independent investment on the turnover, too.

The test shows us, that the result from the test ANCOVA were in this case more reliable then the individual testing the independence the area of the entrepreneurship and the turnover.

3. SUMMARY

There are differences between the results with the analysis of variance (ANOVA) and the analysis of covariance (ANCOVA).

The basic differences arise already in the procedure compliance. For ANCOVA analysis it is important to meet five conditions, for ANOVA only first three conditions listed below are important:

1. independent selections
2. normal distribution of the response variable Y
3. equal variance
4. linear dependence X and Y
5. concordance regression coefficients.

For the above mentioned reasons the method of analysis of covariance (ANCOVA) is the result of margin two methods – analysis of variance and general linear regression.
The results show that the more variables are tested for the results on the same significant level, the more predictable and accurate the results are.

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