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FACTORS THAT INFLUENCE THE NUMBER OF STUDENTS ENROLLED IN THE HIGHER EDUCATION SYSTEM IN ROMANIA

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Abstract: *The present article begins with a short analysis of the scientific literature, represented by theoretical and methodological aspects regarding the regression analysis. Then, it continues with the description of the data used for analysis and econometric model construction. The present paper also presents the adjusting and forecasting curve for the data analysed, as well as the final conclusions. The general conclusion is that in the following period the number of students will increase constantly.*

Key words: *regression analysis, higher education system, econometric model, forecasting.*

1. Introduction

The education system in Romania has gone through major changes recently. Whether we talk about adopting the Bologna system, which means structuring the higher education system on three levels (undergraduate, master's and doctoral studies), the emergence of private universities or classifying educational facilities in Romania, the increasing number of students, at the end, all of them have had an impact on the quality of the Romanian education.

The economic development of any country is closely related to the quality of human resources. Therefore, the development of higher education is essential for the Romanian economy. Barro's studies, carried out in more than 100 countries, from 1965 to 1995, show that education (especially higher education) has a direct impact on the rate of economic growth [2].

Therefore, in this article some theoretical aspects regarding the multiple regression analysis will be reviewed. The paper will continue with the construction of the econometric model, followed by the forecast for the next two academic years, respectively 2012/2013 and 2013/2014.

The analysed data are the following: students enrolled in the national system of higher education (in thousands), higher education institutions, the faculties in Romania, the number of teachers (in thousands), university graduates (in thousands) and the real wage indices. The

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period analysed is from 1990/1991 and 2011/2012 academic year, and the analysis was performed at the level of the Romanian education system.

2. Theoretical and methodological aspects regarding the regression analysis

Multiple regression analysis is useful for the construction of econometric models. Therefore, a socio-economic phenomenon is influenced by the action of several factors.

The multiple regression analysis allows estimating the parameters of the econometric model, analysing correlations between variables, testing the significance of the explanatory variables, establishing the validity of the multiple regression model, and can be used for forecasting [4].

Manifestations of interdependent relationships are extremely varied and most of the time pretty difficult to observe.

In order to highlight the law which is manifested in each relation and for statistical measure of the tendency, the estimating equations shall be used. This function is known as the ***regression function [5].***

The purpose of multiple regression (a term used by Pearson in 1908), is to highlight the relationship between a dependent variable (explained, endogenous, outcome) and several independent variables (explanatory, factors, exogenous, predictors). The best model is the one that has the most explanatory variables.

3. Econometric model construction and forecasting

As mentioned before, the analysed data are the following: students enrolled in the national system of higher education (in thousands), higher education institutions, the faculties in Romania, the number of teachers (in thousands), university graduates (in thousands) and real wage indices.

The period analysed is from the year 1990 and until 2012, and the analysis was performed at the level of the Romanian education system.

The notations further used for constructing the econometric model are:

explained variable:

(y) - students enrolled

explanatory variables:

(x1) - higher education institutions
(x2) - faculties in Romania
(x3) - teachers
(x4) - university graduates
(x5) - real wage indices.

The following table presents the data used for the multiple regressions. It can be observed that the analysed period is between 1990 and 2012.

Data used for multiple regression Table 1

Academic year	Students enrolled (in thousands)	Higher education institutions	The faculties	Teachers (in thousands	University graduates (in thousands)	Real wage indices
	Y	**X1**	**X2**	**X3**	**X4**	**X5**
1990/1991	193	48	186	271	25	100
1991/1992	215	56	257	274	29	81,5
1992/1993	236	62	261	283	33	70,8
1993/1994	250	63	262	283	34	58,9
1994/1995	255	63	262	288	47	59,1
1995/1996	336	95	437	296	57	66,5
1996/1997	354	102	485	306	80	72,7
1997/1998	360	106	516	313	67	56,2
1998/1999	407	111	556	309	63	58,4
1999/2000	452	121	632	311	67	57
2000/2001	533	126	696	301	76	59,4
2001/2002	582	126	729	294	93	62,4
2002/2003	596	125	742	300	103	63,9
2003/2004	611	122	754	286	110	70,8
2004/2005	641	117	742	281	108	78,3
2005/2006	716	107	770	285	112	89,5
2006/2007	785	104	755	281	125	97,4
2007/2008	896	106	631	277	232	111,8
2008/2009	891	106	630	272	214	130,3
2009/2010	775	107	629	268	191	128,3
2010/2011	673	107	621	252	186	123,6
2011/2012	539	108	614	260	103	121,3

Source: Statistical Yearbook of Romania, National Institute of Statistics, Breviary Statistically, Romania in figures 2012, Bucharest, Quality Barometer - 2010 The State of Quality in higher education in Romania, the Romanian Agency for Quality Assurance in Higher Education, The Romanian Statistical Yearbook, Chapter 8, Education,
http://www.insse.ro/cms/files/pdf/ro/cap8.pdf
http://www.insse.ro/cms/files/Anuar%20statistic/08/08%20Educatie_ro.pdf
http://statistici.insse.ro/shop/

The table of the regression for the data presented can be found below.

Table of the regression model with five explanatory variables Table 2

$$\hat{y}_1 = a_0 + a_1 * x_1 + a_2 * x_2 + a_3 * x_3 + a_4 * x_4 + a_5 * x_5$$

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,99224
R Square	0,98454
Adjusted R Square	0,97970
Standard Error	31,64867
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	1020335,239	204067,0479	203,7332407	6,77207E-14
Residual	16	16026,21524	1001,638452		
Total	21	1036361,455			

	Coefficients	*Standard Error*	*T Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-254,22707	295,16016	-0,86132	0,40179	-879,93865	371,48452	-879,93865	371,48452
X Variable 1	-4,99428	1,01501	-4,92045	0,00015	-7,14599	-2,84256	-7,14599	-2,84256
X Variable 2	1,05440	0,12028	8,76585	0,00000	0,79941	1,30939	0,79941	1,30939
X Variable 3	1,43615	0,94648	1,51735	0,14869	-0,57030	3,44260	-0,57030	3,44260
X Variable 4	2,43471	0,25523	9,53916	0,00000	1,89364	2,97578	1,89364	2,97578
X Variable 5	0,38832	0,73498	0,52834	0,60452	-1,16977	1,94640	-1,16977	1,94640

The result model is

$$\hat{y}_1 = -254.22 - 4.99 * x_1 + 1.05 * x_2 + 1.43 * x_3 + 2.43 * x_4 + 0.38 * x_5$$

Determination coefficient of 0.98 indicates that the model explains the variance of students enrolled annually in a proportion of 98%, and the correlation coefficient of 0.99 shows a very powerful correlation between the indicators.

It has to be noted that the variables X_3 and X_5 should be eliminated from the model. Based on this, it can be concluded that the number of teachers and real wage indices does not significantly influence the number of students enrolled in Romania. At the beginning, the variable $_{X3}$ will be eliminated, which represents the number of teachers. The regression will be performed again with the remaining variables.

Table of the regression model with four explanatory variables Table 3

$$\hat{y}_1 = a_0 + a_1 * x_1 + a_2 * x_2 + a_4 * x_4 + a_5 * x_5$$

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,99112
R Square	0,98231
Adjusted R Square	0,97815
Standard Error	32,83860
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1018029,105	254507,276	236,010	1,19207E-14
Residual	17	18332,349	1078,373		
Total	21	1036361,455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	183,35953	65,22739	2,81108	0,01202	45,74176	320,97730	45,74176	320,97730
X Variable 1	-4,33258	0,95101	-4,55576	0,00028	-6,33904	-2,32612	-6,33904	-2,32612
X Variable 2	0,99400	0,11777	8,43981	0,00000	0,74552	1,24248	0,74552	1,24248
X Variable 3	2,49335	0,26178	9,52470	0,00000	1,94105	3,04565	1,94105	3,04565
X Variable 4	-0,39897	0,54014	-0,73864	0,47020	-1,53855	0,74062	-1,53855	0,74062

The resulting model is

$$\hat{y}_i = 183{,}35 - 4{,}33 * x_1 + 0{,}99 * x_2 + 2{,}49 * x_4 - 0{,}39 * x_5$$

The determination coefficient has remained 0.98 and indicates that the model explains the variance of students enrolled annually in a proportion of 98%. The correlation coefficient of 0.99 indicates a very powerful correlation between indicators. However, it is noted that variable X_5, which represents real wage indices, needs to be removed from the model as well. The regression is performed again for the remaining variables.

Table of the regression model with three explanatory variables Table 4

$$\hat{y}_1 = a_0 + a_1 * x_1 + a_2 * x_2 + a_5 * x_5$$

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,99083
Research Square	0,98174
Adjusted R Square	0,97870
Standard Error	32,42144
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	1017440,756	339146,919	322,644	7,87524E-16
Residual	18	18920,698	1051,150		
Total	21	1036361,455			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	143,0428	35,2589	4,0569	0,00074	68,966	217,119	68,966	217,119
X Variable 1	-3,9963	0,8243	-4,8477	0,00013	-5,728	-2,264	-5,728	-2,264
X Variable 2	0,9745	0,1133	8,5986	0,00000	0,736	1,212	0,736	1,212
X Variable 3	2,3367	0,1515	15,4225	0,00000	2,018	2,655	2,018	2,655

After obtaining the regression table, the model is:

$$\hat{y}_1 = 143{,}04 - 3{,}99 * x_1 + 0{,}97 * x_2 + 2{,}33 * x_5$$

It is observed that the determination coefficient of 0.9817 is close to 1, showing that the linear model is valid and the explanatory variables explain the dependent variable in a proportion of 98.17%. The multiple correlation coefficient of 0.9908 indicates a very strong correlation between the explanatory variables and the explained variable. The Fisher test value indicates a significant overall regression, Significance F, being very small.

By applying Fisher's test, it may be observed, from the previous regression table, that $F^* = 322{,}6$. This value compared with the theoretical Fisher value with 3 and 18 degrees of freedom, which for significance threshold α=5% is $F_{k,n-k-1}^{\alpha=5\%} = 3{,}15$.

Because F^* > $F_{theoretical}$ the alternative hypothesis H1 is accepted, the overall regression is significant, and therefore the model is well constructed.

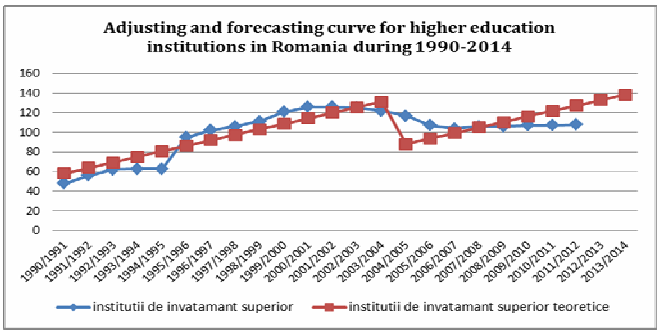

Fig. 1. *Adjusting and forecasting curve for higher education institutions in Romania*

The previously presented graph shows the forecasting for the next two years.

A slight increase in the number of higher education institutions can be observed.

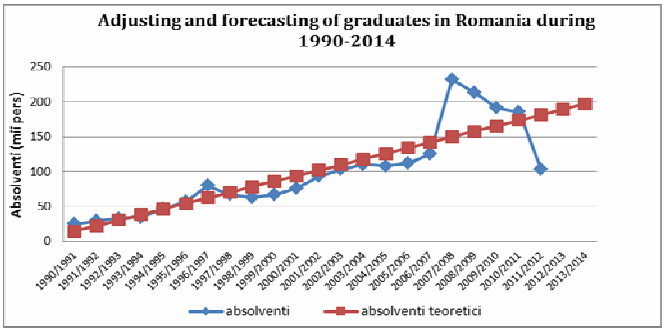

Fig. 2. *Adjusting and forecasting of graduates in Romania during 1990-2014*

As shown above, in the academic year 2007/2008 the number of university graduates has doubled as compared to the previous year.

It is noted that for the period 2012-2014 the number of graduates is on the increase.

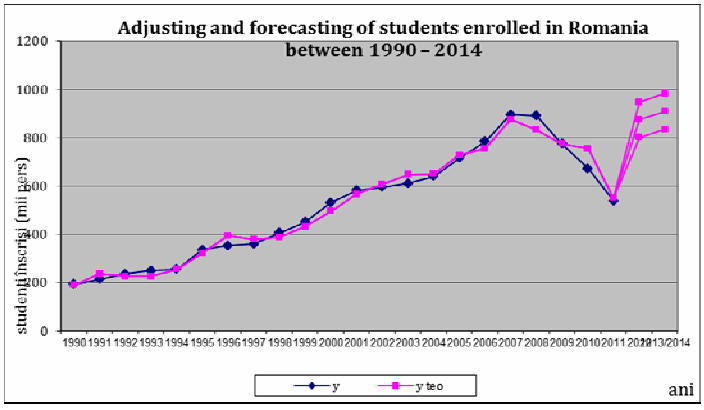

Fig. 3. *Adjusting and forecasting of students enrolled in Romania between 1990 – 2014*

The graph above also shows, the adjusted values, which, starting from the year 2012, are separated into three directions which mark the lower and respectively the upper limit. Between them there is a punctual forecast for students, for the next two years. As expected, in the period 2012-2014 the number of students will increase from year to year.

4. Conclusions

The analysed phenomenon appeared and was developed as a result of various causes, which may act in the same direction or in the opposite direction, usually with varying degrees of intensity.

In the studied situation, the evolution of the number of students enrolled in the national higher education system is the result of many influencing variables. Not all dependency ratios have the same significance, and for this reason two variables have been removed from the model (number of teachers and real wage indices).

Regarding the evolution of the number of students, it can be observed that, after a period of constant growth, a normal period of adjustment followed.

The Recorded significant increases can be explained mainly through the very fast development of the private segment, while the decrease that followed is due to demographic trends and the decrease in the number of high school graduates. However, the reduction of the places at "distance" learning at private universities may also have an important role.

The main objective of this analysis was to explain and forecast the evolution of the dependent variable (in this case, the number of students), depending on the independent variables (it refers to the number of higher education institutions, faculties and graduates). As it was expected, the general conclusion is that in the next period, 2012-2014, the number of students will increase constantly.

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