18. A COMPARATIVE STUDY OF SOME FEATURES OF HIGHER EDUCATION IN ROMANIA, BULGARIA AND HUNGARY

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Abstract

The transition from the centralized economy to the market economy has determined important changes in higher education in the countries of the former socialist bloc. In a relatively short period an impressive growth in the number of students has been recorded without taking into account the evolution of the number of pupils in high school and demographic phenomena, such as increased migration, reduced birth rate, and so on. In a medium and long time horizon the current increases in the number of students cannot be sustained. For the analysis of the data series we used a number of econometric techniques.

Keywords: regression models, cointegration, higher education statistics, education expenditures, ADF, unit roots

JEL Classification: I21, C01, C51

1. Introduction

Economic development of a country is directly linked to the quality of human capital in the economy. In McMahon (1999) a series of models of economic growth that emphasize the role of education in ensuring economic growth of countries over medium and long time horizon is presented. In the countries of Eastern Europe, with the collapse of the communist system there have been major changes in education in general and in the higher education in particular. At the beginning of the transition period the first private universities appeared, and the number of students has increased in most cases, from one year to another.

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The paper aims to identify some characteristics of some important developments in higher education in Romania comparing the results with those obtained in Bulgaria and Hungary. In the economic literature one can find a series of works that aim to verify the extent to which Wagner's law is valid at the level of some countries. According to this law, a trend of faster growth of the public expenditures in relation to increase in the activity of economy for the industrialized countries is emphasized. We can mention a series of classical papers that approach this problem: Gupta (1967), Peacock (1967), Pryor (1968), Goffman (1968), Tarschys (1975), Mann (1980), etc. The development of cointegration econometric techniques by Granger and Engle, Granger causality, etc., has resulted in the emergence of new studies in this field: Demirbas (1999), Murthi (1993), Ahsan (1996), Halicioglu (2003), Sari (2006), Akitoby (2006), etc.

The strategies used for analyzing the characteristics of evolution of higher education and for testing the validity of the Wagner law are based on the estimate of parameters of regression models or ECM models using data series for a single country or several countries (cross-sectional data sets).

For Wagner's law, contradictory results have been obtained for a number of countries in various papers. Ahsan (1996) shows that the potential factors that determine an inconsistency of results and the differences between different authors are: the data series, seen through the covered period and their contents; the econometric procedures used, including the specification of the model, the tests and the influence of variables omitted from the model.

In a simple version, Wagner's Law assumes positively correlated total activity in the economy and government involvement. In the economic literature there are numerous empirical studies which confirm or not for certain countries and for certain periods the validity of this law. Initial application of econometric methods for validation of this law was originally designed using total government spending. Yet there are many cases where verifying the validity of this law is also conducted on disaggregated government expenditures. We mention the case study of Chletsos (1997) made for Greece for the period 1958-93. In this case, using disaggregated government expenditures the author confirmed the validity of this law only for military spending, but not for other expenditure, for example on education or health. For Romania, Andrei (2010) confirms the same result for the Romanian military spending and for other developed countries.

In this work, the authors try to verify to what extent the Wagner's law can be applied for the educational expenditures of Romania - a country that registered an unprecedented expansion of higher education.

There is a number of studies for the analysis of relevant issues related to higher education in Romania. We can mention the study by Korka (2010) that highlights some characteristics of the higher education in Romania during transition. There are a number of works for characterization of some aspects of the nonacademic behavior in higher education institutions or in other public institutions. Several interesting results are presented in Teodorescu (2009) and Andrei (2009). The paper is organized in four sections. Section 2 presents the methodology and data series used to identify characteristics of higher education in Romania, as compared to some countries in Eastern Europe (Bulgaria and Hungary). In section 3, by exploiting the series of data,

we identify some characteristics of higher education in three countries in Eastern Europe: Romania, Hungary and Bulgaria. Also, in this part of the paper we test the validity of Wagner's law for Romania in the case of education expenditures. In the last part of the paper the authors formulate some conclusions and final comments.

2. The Methodology

This paper tries to identify the characteristics of the evolution of some data series regarding important variables that characterize the higher education in three countries in Eastern Europe, namely Romania, Bulgaria and Hungary. The evolution of the number of students (STUD), number of students per ten thousand inhabitants (STUD_L), number of pupils per ten thousand inhabitants (ELV_L), professors in higher education (CDD), the ratio of the number of pupils to the number of students (ELV_S) and the number of students to a professor in higher education (STD_P) are taken into account. For Romania, we check the validity of Wagner's law for educational expenditures and we also try to identify causal relationships between different variables considered above.

In order to analyze the causal relationship between variables we used Granger tests and for the identification of the characteristics of evolution of the data series given above we used the ADF unit root tests.

The basic idea for defining the analysis model of the validity of Wagner's law starts with the following postulates:

(i) there are two variables that are first order integrated (X_t and $Y_t \to I(1)$);

(ii) the two series are cointegrated if they define a regression model of the form:

$$Y_t = aX_t + u_t, \tag{1}$$

where: u_t is a stationary series. It is vital that residues series to be zero order integrated; otherwise the regression model is a false regression.

In this approach, we test the stationarity of the data series included in the regression model, using one or more Dickey-Fuller and Augmented Dickey-Fuller (Dickey and Fuller, 1979) and Phillips-Peronne tests (Phillips and Peronne, 1988). In this respect, we consider the nonstationary series X_t that is $I(1)$. For testing the unit root we consider the model:

$$\Delta X_t = \alpha_0 + \alpha_1 X_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \beta_i \Delta X_{t-i} + \varepsilon_t \tag{2}$$

By ΔX_t we denoted the first order difference of the data set. Depending on the values of α_0 and α_2 parameters we defined particular models used to test the presence of the unit root in the $(x_t)_{t=1,\dots T}$ data set. If $\alpha_0 = 0$ and $\alpha_2 = 0$ then the model M_1 without constant and trend is obtained. M_2 model with constant is obtained from the general model if $\alpha_0 \neq 0$ and $\alpha_2 = 0$. In equation (2), the model M_3 with constant and trend is defined. Testing the presence of the unit root at the level of the

data set is achived by a cascade algorithm of the form $M_3 \to M_2 \to M_1$. The value of the natural parameter p is established by Akaike criteria. The null hypothesis is defined: $H_0 : \alpha_1 = \alpha_2 = 0$ in order to test the presence of the unit root – case when the data set is nonstationary. Rejection of the null hypothesis recommends that a data set has a determinist trend rather than a stochastic one. This procedure is applied for the data sets for the following variables: $\ln GDP, \ln ED$ and $\ln(ED/GDP)$, where GDP is Gross Domestic Product, ED – educational expenditures and ED/GDP – the share of the educational expenditures in GDP.

For example, to analize the ED function on GDP we use an ECM model. This model describes the ED variation (Δc_t) as a result of the GDP variation (Δy_t) of a country but also of some trends in the education area in the long term $(c_{t-1} - \alpha \cdot y_{t-1})$. For the last model, b_0 is the short term elasticity of the ED related to GDP, α is the long term elasticity and $\delta = 1 + a_1$ is the ratio with which the educational expenditures are adjusted at the equilibrium.

The model can be written with the general form:

$$\Delta c_t = a - \delta(c_{t-1} - \alpha \cdot y_{t-1}) + A(L)\Delta c_{t-1} + B(L)\Delta y_t + \varepsilon_t \quad (3)$$

We used the following notations: $c_t = \ln(ED_t)$ şi $y_t = \ln(GDP_t)$.

3. Empirical Results

Romania, Bulgaria and Hungary are countries in Eastern Europe that joined the European Union in the last two accession waves. The transition has brought a number of important changes in higher education in these countries. The reform of higher education was accelerated after signing the Treaty of Bologna. In the following, we present some characteristics of higher education in the three countries.

3.1. The characteristics of higher education in Romania as compared to Bulgaria and Hungary

Higher education in Romania has undergone a series of fundamental transformations in the 19 years of transition. During the past 19 years a spectacular increase in the number of students was recorded. In the academic year 1990/1991 there were 192,810 students enrolled, all in public education and in the academic year 2005/2006 there were 716,464 students enrolled, of which 202,786 at private universities. During this period, the ratio of the number of college graduates to those of higher education has decreased, from 7.3 for high school graduates / alumni of the university in the academic year 1990/1991 to only 1.6 in the academic year 2005/2006.

Figure 1 shows the evolution of some important features that characterize higher education in Romania: STUD - number of students in one academic year, STD_L - number of students per ten thousand inhabitants, ELV_S - ratio of the number of pupils to students, ELV_L - number of pupils to ten thousand inhabitants, CDID -

number of professors in higher education and STD_P - number of students per one professor. The statistical data show an extensive development of higher education in Romania. In this regard, we present the following arguments:

- in the academic year 1990-1991 there were 56 universities with 257 faculties, and in the academic year 2005-2006 their number increased to 107, with 770 of faculties;
- in the 1991-1992 academic year the education institutes were located in 21 cities, while in the academic year 2005-2006 they were found in 60 cities;
- the ratio of the number of pupils to students decreased significantly, from 21.4 at the beginning of the transition period to 4.2 (Figure 1 ELV_S);
- the number of students increased over the entire period 1991-2006 by 3.7 times, with an average annual rate of more than 9%, while the number of professors increased 2.3 times, with an average annual rate of 5.6% (Figure 1, variables STUD and CDID). Under these conditions, the number of students per professor rose from 13.8 to 22.7 (Figure 1 variable STD_P);
- in a relatively short period of 18 years, 52 private educational institutions have been established, with 202,786 students and a total of only 4662 professors;
- the share of foreign students studying in Romania in the total number of students decreased from 4.5% in the academic year 1990-1991 to only 1.4% in the academic year 2005-2006.

The results presented above emphasize the extensive development of the higher education that cannot be sustained at the same level in a medium time perspective. Moreover, two important variables, namely ELV_L and STD_L, have totally different characteristics to the evolution of the analyzed period. Using the ADF test we determine the order of integration for the two variables.

The same results are also obtained for the two other countries considered in this study: Bulgaria and Hungary. In the case of Bulgaria, during the 19 years of transition a 45.5% increase in the number of students was recorded. Thus, if in the academic year 1990-1991 the number of enrolled students was 188,479 this number increased during the period by over 85,000 students, reaching 274,247 students at the beginning of 2008-2009 academic year. During this period, the ratio of the number of pupils to the number of students decreased, from 2.1 at the beginning of the period to 1.2 at the end of the analyzed period.

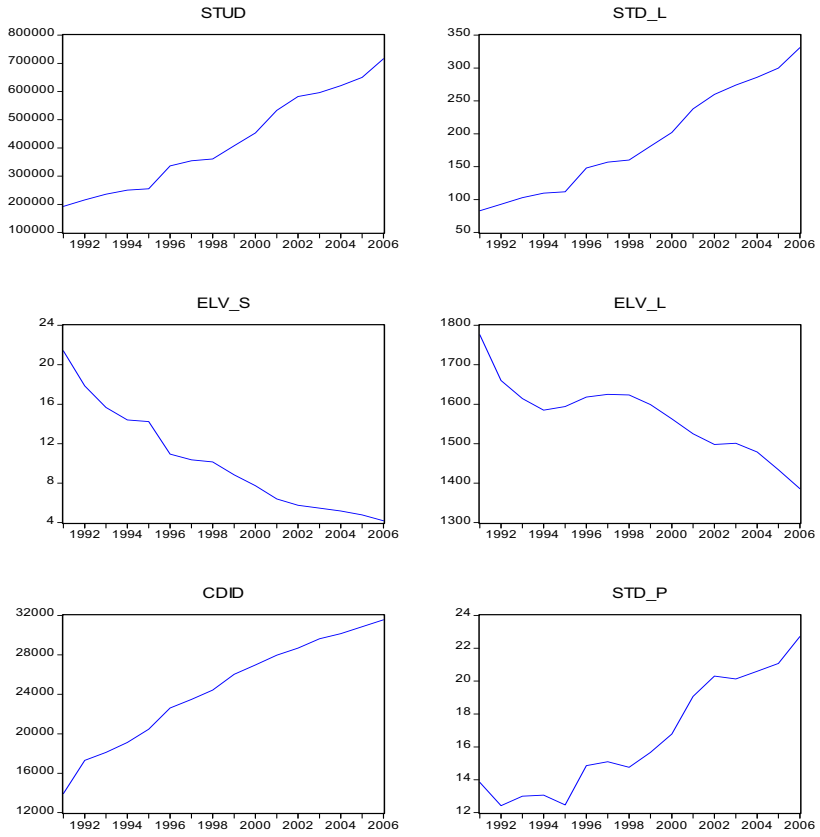
In the case of Hungary during the transition, the number of students increased from 108,376 in the academic year 1990-1991, to 397,704 in the academic year 2007-2008. The increase in the number of students over this period was nearly 3.7 times, being comparable to that of Romania. There was also an 1.8 times increase in the number of high school students in the 2007-2008 school year compared with the 1990-1991 school year. As a result of more rapid growth in the number of students in relation to the high school pupils, the ratio of the number of high school pupils to students has substantially reduced, from 1.26 at the beginning of the period to only 0.61 at its end.

Across the three countries there is a continuous decrease in the ratio of the number of students to the pupils enrolled. We study the stationarity of the STD_L and ELV_L

data series using the ADF test methodology which is described in Baltagi (2008). After applying the ADF test on the data series 1991-2006, we obtained that the two series are I(1) for Romania and Bulgaria, and I(2) for Hungary. The results obtained through the application of the test are presented in Table 1 for Romania and Bulgaria and in Table 2 for Hungary.

Figure 1

Variables that characterize the higher education in Romania

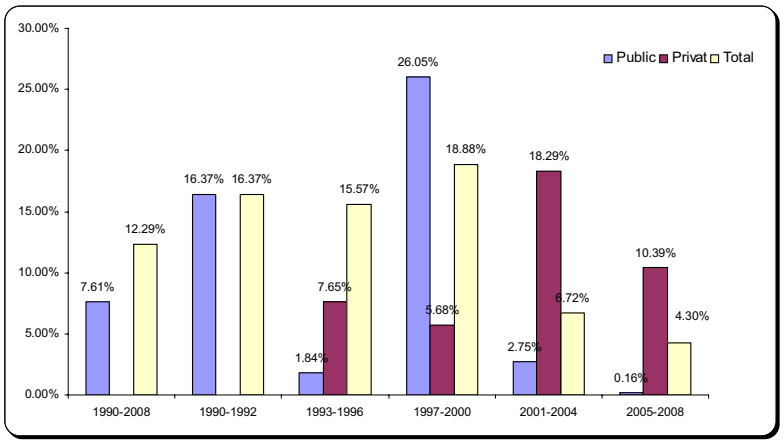


The development of the private education should be considered for the analysis of the characteristics of higher education in Romania. Since the data series relative to the number of students in private education is relatively short (data in official statistics have been available for private education only since 1993), in those presented below there are only a few descriptive statistics. Figure 2 presents the average annual rates of increase in the number of students in Romania, for total, public and private sector on the political cycles in the period 1990-2008. The results pointed out the following: the largest increase in the number of students was recorded in the period 1997-2000, the most important development of private education was in 2001-2004, the period

2005-2008 marked a significant reduction in the number of students in the public education system; for this period the increased number of students was due almost exclusively to students from private education institutions.

Figure 2

Annual increase rate in the number of students enrolled in first year in public education, private education and the total number



To determine to what extent the increase in the number of students is justified by a growth in the number of pupils we apply a Granger test for which the null hypothesis is „ELV_L does not Granger Cause STD_L".

The results obtained through the application of this test for the three countries are presented in Table 6. These results emphasize a lack of correlation between the number of students and the number of pupils. For example, for Romania this situation in conjunction with maintaining a relatively constant number of foreign students who study in this country emphasize an extensive development of higher education, without being correlated with the evolution of the demographic factors.

Table 1

Unit root tests for ELV_L and STD_L for Romania and Bulgaria

	ELV_L		STD_L	
	Romania	Bulgaria	Romania	Bulgaria
$\rho - 1$	-0.3949	-0.3305	-0.4000	-0.4425
t-Stat	-2.06	3.1700	-1.96	-3.70
10% (5%) critical value	-3.36	-3.05*	-3.32	-3.73*
Lags of differences	1,2	1	0	2, trend
$\overline{R^2}$	0.61	0.65	0.25	0.69
F	5.69	13.27	3.4	6.18

*Note: * 5% critical value.*

Table 2

Unit root tests for ELV_L and STD_L for Hungary

	Δ ELV_L	Δ STD_L
$\rho - 1$	-1.24	-1.3876
t-Stat	-4.32	-5.24
5% critical value	-1.97	-3.75
Lags of differences	0	0, trend
$\overline{R^2}$	0.60	0.69

The increase in the number of students in this period, without being correlated with material resources, and human and financial requirements of the labor market may affect the quality of higher education on medium and long term. Reducing the number of students in a short and medium time horizon will be important factors to reform education in the three countries, along with the increasing competition at the European level in the field of university education.

3.2. Wagner's law for education expenditures in Romania

To test Wagner's law for Romania in different forms we estimated the regression model parameters defined by Musgrave (1969), which shows a linear relationship between the share of education expenditures in GDP and the level of development of the country as measured GDP per capita:

$$\ln(ED90 / GDP_t) = \alpha + \beta \cdot \ln(GDP / POP) + \varepsilon_t \quad (4)$$

For this, we considered the data series on GDP and education expenditures (ED90) are in national currency in 1990 prices. The POP variable represent the population for each year. After estimating the parameters using OLS and TSLS and using the data series for the 1990-2007 period we obtained the following results:

Table 3

Musgrave model parameters estimates

Dependant variable log(ED90/GDP90)	OLS	TSLS
α	-2.777^{*} (−17.50)	-2.860^{*} (−12.54)
GDP90/POP	-0.023^{*} (−5.08)	-0.020^{*} (−3.11)
R^2	0.56	0.55
DW	2.14	2.11
F	18.99	9.65
F	18.99	9.65

*Note. * the parameters are significanlty different from zero for* $\alpha = 0.00$.

The Mann (1980) model emphasizes a linear relationship between the share of education expenditures in GDP and the GDP:

$$\ln(E / GDP_t) = \alpha + \beta \cdot GDP + \varepsilon_t \qquad (5)$$

The results obtained from estimating the above parameters model by OLS and TSLS are shown in Table 4.

Table 4

Mann model parameters estimates

Dependant variable: log(ED90)	OLS	TSLS
c	-2.700^{*} (−13.91)	-2.752^{*} (−10.84)
GDP90/POP	-0.001^{*} (−4.49)	-0.001^{*} (−3.22)
R^2	0.57	0.57
DW	2.20	2.20
F	20.20	10.34

Note. * the parameters are significanlty different from zero for $\alpha = 0.00$.

The results obtained from estimating models 4 and 5 reveal a negative correlation between the education expenditures and the GDP. This result invalidates Wagner's law in the field of education expenditures. Possible explanations for this situation are: during transition in a very few years the education expenditure amounted to what is stipulated in legislation; the underfunding of education was due to the allocation of government funds to solve social problems or to restructure the economy; the education policies, especially regarding higher education, were not correlated with the demographic developments and labor market requirements.

According to Eurostat, in the 1999-2006 period Romania allocatted for education a share of GDP much lower than Hungary and Bulgaria. Thus, in the three countries, the share of education expenditure in GDP for the period considered was: Romania has spent between 2.88% (in 1999) and 3.52% (2002), Hungary between 4.5% (2000) and 5.85 (2003) Bulgaria between 3.78% (2001) and 4.51% (2006). Developed countries in Europe have mainly allocated higher rates, of 5.0%.

For stationarity analisys we used Augmented Dickey-Fuller and Phillip-Perron tests. The results for the data series used to characterize some features of the higher education are presented in Table 5. The table presents the tests statistics used for testing the significance of the autoregressive parameters of the model defined for each variable for the analysis of the stationarity of the data series according to equation (2); t_c is t-statistic for testing the significance of c parameter, for the case when the model does not include a trend (test applied for model M_2 in the unit root testing methodology); t_a is t-statistic for testing the inclusion of the trend (test applied for model M_1 in the unit root testing methodology).

Table 5

Tests of Unit Roots

Variable	ADF				PP			Integration order
	t_c	t_b	t_a	p	t_c	t_b	t_a	
GDP90	-2.795**	-4.464*	3.219*	3		-1.831**		I(1)
ED90	4.516*	-4.518*		1	4.312*	-6.358*		I(0)
STD	2.723*	-3.016***		0	2.723*	-2.843****		I(1)
ELV	-2.308**	-4.018**	2.437**	2		-6.158*		I(1)
PRF	5.023*	-3.762*		0	5.023*	-5.350*		I(0)
POP	3.229*	-3.274****	-2.745*	3		-10.458*		I(1)

*Note: *, **, *** the signification for the tested parameter for significance level of 1%, 5%, 10%.*

We used an Engle-Granger test for testing the bivariate causality between the variables. The results show only three significant bivariate causal relationships between the variables considered in our models. Table 6 shows the F test statistics value for Engle-Granger test for the three cases. In all other cases we did not obtain significant causality dependence between the variables.

We mention here that the test revealed no Granger causality between the number of students in high school and the number of students. To emphasize the lack of correlation between higher education and secondary education, we track the folowing indicator: the evolution of the pressure on admission in higher education (this indicator was calculated as the ratio of the number of first year students to the number of high school graduates) during 1990-2008. Thus, if for public education this indicator was 5.3 in 1990, in 2008 it dropped to only 1.2. This indicator for university education fell from 2.1 in 1996 to 0.75 in 2008.

Table 6

Engle-Granger causality test

Causal relationship	$POP \rightarrow ELV$	$GDP90 \rightarrow PRF$	$STD \rightarrow PRF$
F-statistic	7.529*	3.103***	6.225*

Note: *, **, *** the signification for the tested parameter for significance level of 1%, 5%, 10%.

In the case of Bulgaria and Hungary the Engle-Granger causality test accepts the null hypothesis and concludes that ELV does not cause the STD. For the $STD \rightarrow PRF$ causality, application of this test rejects the null hypothesis and concludes that STD causes the PRF.

The applied tests highlight the presence of the unit root for all variables, except for education expenditures (ED90) and the number of teachers in higher education (PRF). By applying the two tests (Engle-Granger and Johansen) we obtained that the two variables are stationary. Under these conditions, we will study the existence of cointegration relationship between the variables and for the variables of first degree integrated we will use data series in first difference. In this respect, we apply a Johansen and Juselius type procedure. The results are presented in Table 7.

Table 7

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.996902	115.7706	47.85613	0.0000
At most 1 *	0.727006	34.89395	29.79707	0.0119
At most 2 *	0.623133	16.71768	15.49471	0.0326
At most 3	0.196081	3.055595	3.841466	0.0805

*Note: * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values.*

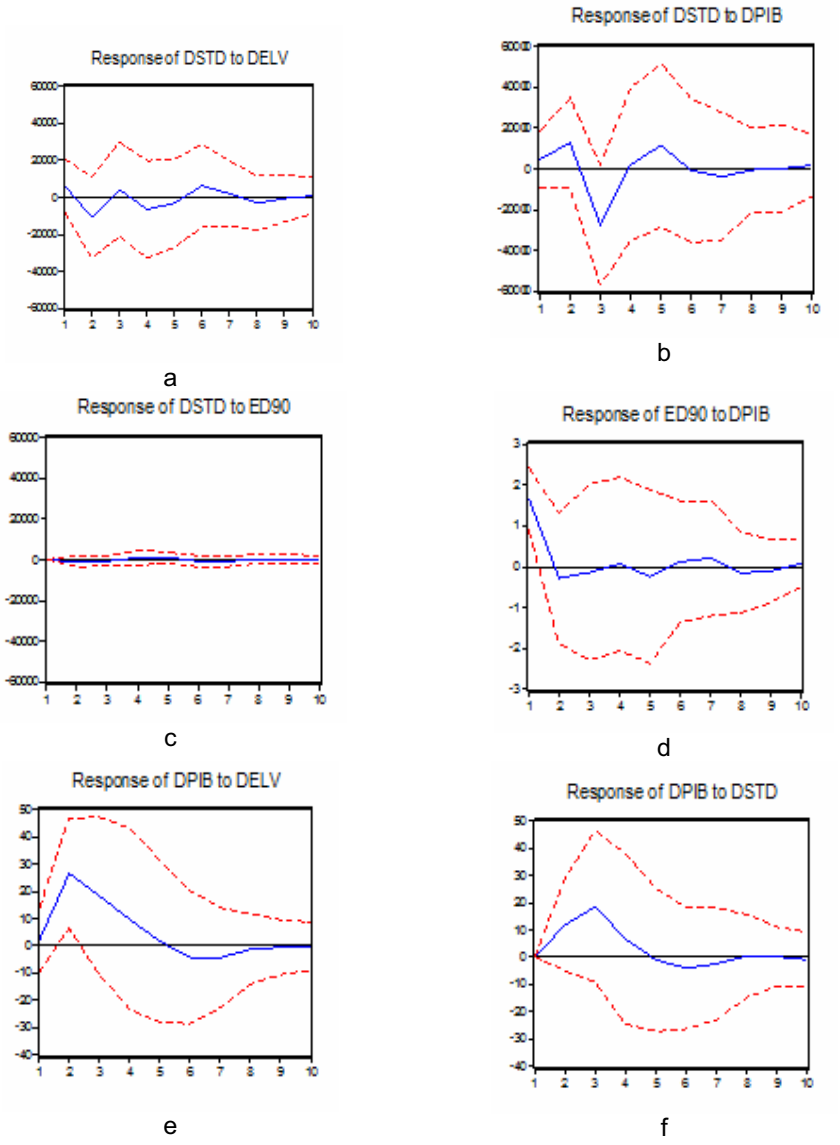
In Ruxanda (2008) the relationship between foreign direct investment and economic growth for Romania is analyzed using the impulse-response function. In this paper, using the methodology of the above paper, we try to identify the causal relationships between the four variables used to characterize the higher education in Romania.

The results in Table 7 emphasize three cointegration relationships between the four variables considered (GDP90, ELV, STD and ED90). Figure 3 presents the responses of the education variables as a result of changing one of the variables. The results highlight an insignificant reaction of the variables ELV, STD and ED90 to ED90 changes in the previous periods.

Figure 3 shows impulse-response functions for pointing out the response variables due to the shock of the other variables. Results based on the impulse-response function allows formulating the following comments.The dynamics of the number of high school pupils determine slow oscilations in the number of students. The first year after the initial impact causes an insignificant increase in the number of students, in the second period it registers a decline, but rather small (Figure 3a). The change in GDP cause changes in the dynamics of the number of students only during three periods. If the GDP changes lead to a slight increase in the number of students in the first two years, in the third year it registers a significant decline (Figure 3b). Instead, the change in the education spending has no impact on the number of students from year to year (Figure 3c). The changes in GDP determined significant changes in the education expenditure in the first year only. Thus, GDP growth generated an increase in education spending in the first year, then in the next year the change was insignificant (Figure 3d). Graphs 3e and 3f show the impulse-response function to characterize the response of GDP as a result of the shock in the number of pupils and students. The four impulse-response functions highlight insignificant changes in the number of students as a result of the shock applied to the variables describing the total number of pupils and students. For both variables it can be noticed that the shock is observed in periods 2-4 (Figures 3e and 3f). A similar result is obtained for the education system in Turkey by Sari (2006). Changes in GDP cause relatively similar changes in the number of pupils and students. The shock applied to GDP does not cause significant changes in the first year, but it determines a positive effect in the next two periods.

Figure 3

Impulse-response function



4. Final comments

For the final conclusions we consider summary results showed in Table 8 regarding the dynamics of some important variables used to characterize aspects of the educational system of some countries in Eastern Europe during the transition period.

Table 8

Synthetic indices for the educational system

	Romania	Bulgaria	Hungary
Students number increase index (%)	407.40	145.50	366.97
Pupils number increase index (%)	78.43	81.61	176.34
The high school pupils/students ratio in 1990	5.16	2.07	1.27
The high school pupils/students ratio in 2008	0.99	1.17	0.61
The number of students per professor in universities in 1990	13.84	9.10	6.26
The number of students per professor in universities in 2008	25.68	12.99	17.77

The data obtained on the basis of information processing in national statistics highlight a series of common features of the evolution of the number of students in Romania, Bulgaria and Hungary. For Romania and Hungary the increase in the number of students is very high in a short period of time. This increase is more moderate for Bulgaria. For Romania and Hungary, we notice a continuos reduction in the ratio of the number of high school pupils to students, this ratio being below unit. For all the three countries, the increase in the the number of students was not accompanied by a corresponding increase in the number of professors, so that during the transition period the number of students per professor has increased.

Testing Wagner's law emphasizes some interesting aspects. Our estimates show that the models proposed by Musgrave (1969) and Mann (1980) are verified, but in both cases we obtained a negative value of the parameter of the slope of the regression line, which underlines a divergence between education expenditures and the GDP. This result invalidates Wagner's law for the education expenditure. Similar situations are common in education in other countries such as Turkey, Greece, Portugal, etc.

The data series for education expenditures are I(0) and GDP and the number of students are I(1). The proposed model shows that there is no Granger causal relationship between the education expenditures and the number of students for Romania.

According to the impulse response function presented in Figure 3, the education expenditures react to a small extent to different impulses applied to other variables. The explanation is given by strict budgetary restrictions that are imposed in a country during the transition period.

The results show a reduced dependence between the number of students and the number of high school pupils during the analyzed period. Applying the Granger causality test shows that the number of Romanian high school pupils does not causally determine the number of students. If demographic developments in Romania

are envisaged too, we anticipate a decline in the number of students of universities in Romania in the near future. Considering the results in Tables 1 and 2, it can be noticed a different behavior of the number of students in Romania as compared to Bulgaria and Hungary. Furthermore, excessive increases in the number of students in relation to the number of teachers has resulted in a significant reduction in the indicator of student / teacher ratio in Romania as compared to the two other countries.

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