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Particularities of the Recent Evolution of Higher Education in Romania. Analysis and Forecasts

ABSTRACT

Objective: The purpose of this article is to present a brief analysis of the Romanian higher education system from the perspective of basic indicators, as well as the use of Markovian techniques for studying the evolution of the schooling process.

Methodology: The descriptive statistical analysis was mainly used to visualize and synthesize the information extracted from the data on the Romanian higher education system. Markovian methods were used to study and predict the evolution of the schooling process.

Findings: The rapid dynamics of the number of students in Romania in the last two decades has been accompanied by a series of structural changes, of which the most important are: a) constantly increasing the degree of feminisation of student achievements and b) increasing the relative importance of economic studies, legal studies and other social sciences, while reducing the relative importance of technical sciences and of medical-pharmaceutical studies within university specialties. Also, the distribution of the graduates' specializations correlated to a very small extent with the requirements of economic and social activity. It can be said that the development of tertiary education in Romania was stimulated mainly by the action of factors of social and cultural nature and only at second level by the demand for qualified personnel generated by the productive apparatus.

Value Added: This study highlights the current state of Romanian higher education. The fact that the evolution of tertiary education has been "explosive" over the past two decades makes some econometric methods, involving the use of stationary data or which have a high degree of complexity, more difficult to use. In this context, the use of Markovian modelling methods for studying and forecasting the evolution of the schooling process can contribute to improving access to and participation in higher education.

Recommendations: In the current conjuncture, when trying to increase the insertion of graduates into the labour market, it is natural for decision-makers to use various estimation methods and techniques that allow them to correlate university study programs with the needs of the labour market and at the same time provide them with scientific support for their prognosis.

Key words: labour market, tertiary education, Markov models, forecasts

JEL codes: C53, I23

Introduction

The investments in education and vocational training for skills development are essential in order to boost the economic growth and competitiveness both at European and national level (Copenhagen Declaration, 2002; Bruges Communiqué, 2010 and Conclusions of Riga, 2015).

Competencies can stimulate innovation and economic growth, add value to production within the value chain, stimulate higher concentration of skills and shape the future labor market.

The education and training systems in many European countries and in Romania are still failing to provide the appropriate skills needed to increase

the degree of professional insertion and do not work properly with the business environment or employers to bring the learning process closer to the reality of the working environment.

The analysis of the number of graduates of the bachelor university cycle in Romania in the last years shows a general tendency of decreasing the number of staff. Clearly, this fall affects the labor market directly and in the long run.

The analysis of indicators and benchmarks that underlie policy development in the field of education and training in Romania indicates that the initiatives taken in recent years have led to an improvement in the situation, but the gaps towards the EU average still remain significant. Thus, the tertiary educational attainment (age 30-34) was of 26.3%, well below the EU average of 39.9%.

Consequently, specific actions are needed in order to reduce early school leaving, reduce the rate of unemployment and the NEET rate among young people. At the same time, the mission of education and vocational training is also to provide high-quality skills necessary for employability in the context of reducing the workforce due to the aging of the population.

The analysis of the higher education system using basic indicators

The educational system in Romania at the end of the 20th century and the beginning of the 21st century has undergone through major changes, this being determined both by the profound changes in the economic and social environment and by the need to regenerate and revive the national education system on all its levels (National System of Indicators for Education, 2014).

Starting with the academic year 2005–2006, Romania has moved on to the implementation of the Bologna objectives by adopting, in the higher education, the three cycles of study: bachelor, master, doctorate. The implementation of Law no.1/2011, the Law of National Education was carried out under the conditions in which the Higher Education System was already

functioning in accordance with the Bologna Process, ensuring the complementarities of the requirements through: comparability, compatibility and fairness, necessary requirements for the creation of the European Higher Education Area (SEIS-European Higher Education Area-EHEA).

The reforms in the Romanian higher education system aimed to “generate and transfer knowledge to society through:

- 1) initial and continuing education at university level for the purpose of personal development, of professional insertion of the individual and satisfying the need for skills of the socio-economic environment;
- 2) scientific research, development, innovation and technological transfer through individual and collective creation in the fields of sciences, engineering, arts and letters, by ensuring performance and physical and sporting development and the valorization and dissemination of their results” (Law no.1 / 2011, National Education).

Despite a rapid rate of massification of the participation in higher education after 1990, Romania continues to be on the last place in the European Union (Eurostat statistics) regarding the participation of young people in tertiary education, only 24.6% of the young people between 30-34 years had a graduation diploma in 2018 (Report on the state of higher education in Romania, 2016/2017, 2017/2018).

The problems of quantitative access result partly from the qualitative situation and the way in which the secondary education works and from the access problems existing in early forms of education. These problems are manifested not only at the level of the absolute rates of participation in higher education but also in the situation of the Romanian pupils’ results at international tests (e.g. PISA Testing, PISA results 2017).

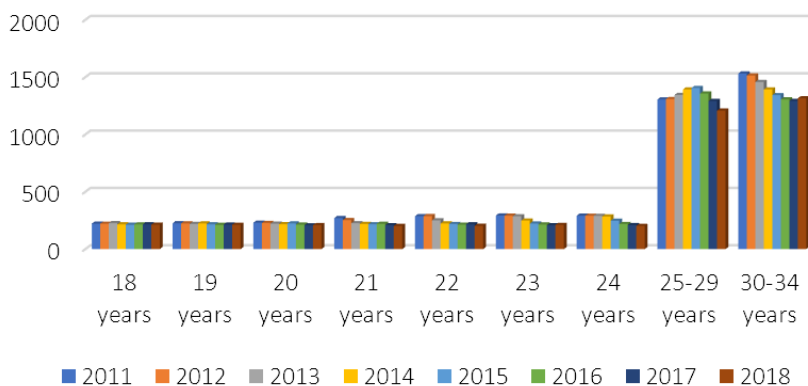
The different rates of access to higher education are due to both the demographic characteristics and the particular access problems that some groups of young people face: the poor, the rural population, and especially the young Roma, those from groups with a high-risk of exclusion.

Synthetically, the major changes faced by young people are:

a) The population of young people is subject to rapid demographic flows, especially by correlation with extremely high emigration rates: the share of those remaining in the country as residents is continuously decreasing, relative to the original number of newborns per cohort. In this context, *negative demographic trends* have been observed in recent years regarding the age-related population corresponding to higher education, with decreases in most age groups, with priority being given to the ages of 21-24 (TEMPO-online database of the National Institute of Statistics; Gheţău, 2018). The demographic evolution represents one of the factors influencing the fluctuation of the number of persons registered in higher education (Figure 1).

b) The youth population is changing. Starting from 2012 and 2014 respectively, young people of 18 years and 19 years are over-represented in their age segment. The same phenomenon has been recorded since 2019 in young people aged between 20 and 24. Also, there is also a particularly low participation of young people from rural areas to higher education (Statistical notebooks on Higher Education, NIS, 2012–2018). In this context, for the rural students there have been awarded an increasing number of scholarships, study grants, or hostels (for the academic year 2018–2019, 2000 places were allocated for them). The students in rural areas have a very low share in arts universities (the National University of Theatre and Film has only 5% of rural students) or in case of the universities with high study fees (in areas such as architecture or medicine). The Universities of agronomic sciences and veterinary medicine or the technical universities have significantly more rural students. The higher education institutions with the highest number of rural students in 2017-2018 are the “Ştefan Cel Mare” University of Suceava (52% of rural, 48% of urban) and the University of Agronomic Sciences and Veterinary Medicine from Timișoara (46 % of rural areas, 54% of urban areas) (Annual Reports);

Figure 1. The evolution of the resident population on 1st of January by age (thousands of persons)



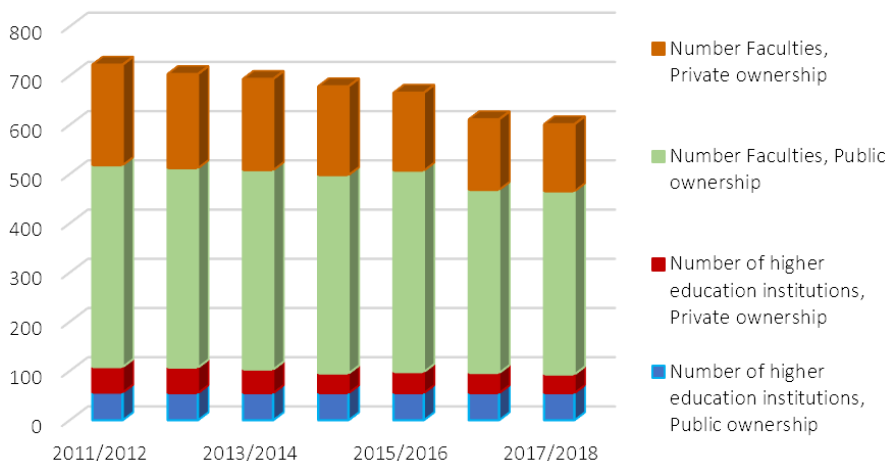
Source: own work.

c) the young people without a full pre-university education represent a particularly vulnerable and largely inhomogeneous category. Romania faces an early school leaving rate of 18.3% in the year 2017, slightly decreasing compared to year 2015 (19.1%) (the national objective of the „Europe 2020 Strategy” (11.3%) remaining unattainable), a decline in the rate of passing the baccalaureate exam (of 67.7% in 2018, with 5.2 pp lower than 2017) and with the highest rate of functional illiteracy in the European Union (about 40%) (according to PISA testing 2017);

d) the people with disabilities is another group facing difficult conditions in accessing higher education, often due to the lack of support found in most institutions.

In the recent years, the number of higher education institutions had an oscillating evolution so that at the level of years 2017/2018, the national higher education system comprised 93 higher education institutions, in which there were operating 508 faculties (the state education representing 59% of the higher education institutions and 73% of the total faculties) (Figure 2).

Figure 2. Evolution of the national higher education system network

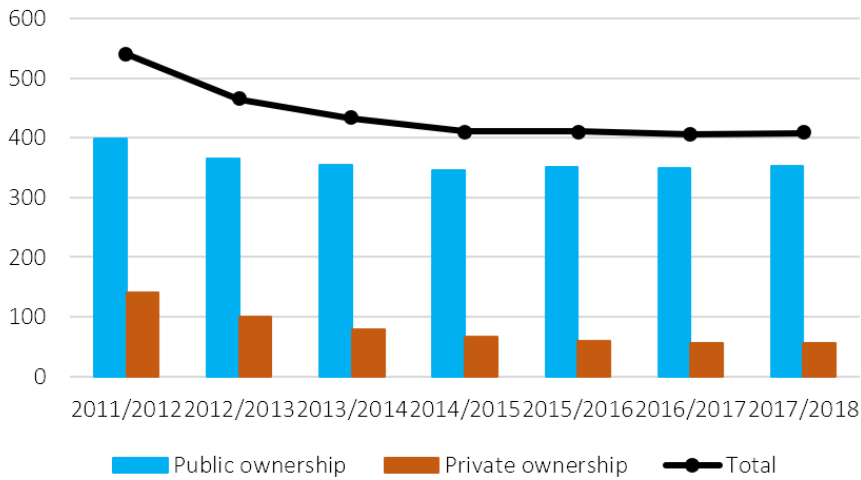


Source: own work.

The analysis of the data in Figure 2 shows that the total number of universities and faculties registered a descending trend in the period 2011-2018, a situation determined on one hand, due to the decrease of the number of universities and private faculties, while maintaining approximately the same parameters, of the network of higher state education and, on the other, the decline of the number of students

Out of the total number of persons enrolled in higher education in 2017/2018, 87.4% were following study programs in state institutions and 12.6% in private education (Figure 3). Also, in the academic year 2017/2018, in the higher education institutions in Romania, out of the 538.9 thousand registered persons, 75.75% were following bachelor’s degree programs, 19.74% – master’s degree programs, 3.66% – Doctoral studies programs, and 0.85% – Postgraduate programs.

Figure 3. The evolution of the number of students enrolled in Bachelor Higher Education (thousand)



Source: own work.

The evolution of the schooling process based on Markov models

The basic assumption of this model is that the passing of a young man into a higher position can be described with the help of the Markov chains (Klock & Nimmer, 2001; Iosifescu et al. 1984; Ratitch & Precup, 2001; White, 1993; Ashley, 2002; Ștefănescu, 2000).

Let it be M the number of number of steps a young man must go through until the end of the studies.

Let it be p_{ij} ($j = i, i+1, \dots, m$) the probability that an individual in the state i at a certain moment will go to state j at the next moment in time.

It is also assumed that $\sum_{j=1}^m p_{ij} < 1$, so that $1 - \sum_{j=1}^m p_{ij}$ is the probability that a person will leave the system in the next period.

Let it be $c_i^{(n)}$ the number of individuals in the state i after n periods of time and the dispersion: $E[c_i^{(n)}] = \eta_i^{(n)}$ (1)

It is assumed that in the n period of time, N_n is the number of pupils/students enrolled in the education system.

The values $\eta_i^{(n)}$ satisfy the recurrence relation:

$$\eta_i^{(n)} = \sum_{r=1}^i P_r \eta_r^{(n-1)} + N_n \rho_i \quad (2)$$

If Q is the transpose of the passing probability matrix:

$$Q = \begin{pmatrix} P_{11} & 0 & 0 & \dots & 0 \\ P_2 & P_2 & 0 & \dots & 0 \\ P_3 & P_3 & P_3 & \dots & 0 \\ \dots & \dots & \dots & \dots & 0 \\ \dots & \dots & \dots & \dots & 0 \\ \dots & \dots & \dots & \dots & 0 \\ P_{1m} & P_{2m} & P_{3m} & \dots & P_m \end{pmatrix} \quad (3)$$

the matrix of which can be written as:

$$P = \begin{pmatrix} I & O \\ R & T \end{pmatrix}$$

where I is the unit matrix, and the components of the T matrix are appropriate to the six educational levels considered.

and

$$\eta_n = \begin{pmatrix} \eta_1^{(n)} \\ \eta_2^{(n)} \\ \dots \\ \dots \\ \eta_m^{(n)} \end{pmatrix} ; \quad \rho = \begin{pmatrix} \rho \\ \rho_2 \\ \dots \\ \dots \\ \rho_m \end{pmatrix}$$

In matricic notations, relationships (2) can be written in the form

$$\eta_n = Q \eta_{n-1} + N_n \rho \quad (4)$$

where

$$\eta_n = Q(Q \eta_{n-2} + N_{n-1} \rho) + N_n \rho = Q^2 \eta_{n-2} + N_{n-1} Q \rho + N_n \rho$$

By proceeding in the same manner, we obtain:

$$\eta_n = Q^{k+1} \eta_{n-k-1} + \sum_{j=0}^k N_{n-j} Q^j \rho \quad (5)$$

Taking into account that $Q^k \rightarrow \infty$ for $k \rightarrow \infty$ (because they are substochastic processes), we obtain:

$$\eta_n = \sum_{j=0}^k N_{n-j} Q^j \rho \quad (6)$$

relationship that can be used to predict the number of individuals existing in each state after n periods.

For the Romanian educational system and considering that there are public and private educational institutions that absorb graduates at different levels of education, it is reasonable to assume that $P_{ij} = 0$ for $j \neq i, i+1$. It is obtained the following:

$$Q = \begin{pmatrix} P_1 & 0 & 0 & \cdot & \cdot & 0 \\ P_2 & P_2 & 0 & \cdot & \cdot & 0 \\ 0 & P_3 & P_3 & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & 0 \\ 0 & 0 & 0 & \cdot & P_{m-1,m} & P_m \end{pmatrix} \quad (7)$$

Assuming that all the elements of the matrix P_i are distinct for $i=1,2,\dots,m$, and P_1, P_2, \dots, P_m can be interpreted as own values of the Q matrix, then it can be written in the form:

$$Q = A^{-1} \tilde{E} A \quad (8)$$

where

$$\tilde{E} = \begin{pmatrix} P_1 & 0 & 0 & \cdot & \cdot & 0 \\ 0 & P_2 & 0 & \cdot & \cdot & 0 \\ 0 & 0 & P_3 & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & 0 \\ 0 & 0 & 0 & \cdot & 0 & P_m \end{pmatrix}$$

and A and A^{-1} are lower triangular matrices with 1 on the main diagonal and in the rest with elements having the form of:

$$a_{ij} = \prod_{k=j}^{i-1} P_{k,k+1} (P_i - P_k)^{-1} \tag{9}$$

and

$$a_{ij}^{-1} = \prod_{k=j+1}^i P_{k-1,k} (P_j - P_k)^{-1} \quad i > j \tag{10}$$

Therefore, it is obtained

With the help of the T-matrix components and using the relationships:

$$\begin{cases} n(i,i) = \frac{1}{1-r_{i+1}} & 0 \leq i \leq 6 \\ n(i,j) = p_{i+1} \dots p_j \frac{1}{1-r_{i+1}} \dots \frac{1}{1-r_{j+1}} & i \leq j \\ n(i,j) = 0 & i > j \end{cases} \tag{11}$$

it is possible to determine the elements of the matrix N, and then

$$\eta_n = \sum_{j=0}^{\infty} N_{n-j} A^{-1} N^j A \rho \tag{12}$$

Results

For the proposed analysis the data on the population included in the 6 levels of study of the Romanian education were used and a series of assumptions were made namely:

- it is assumed that a schooling process consists of 6 stages, each of which has a certain duration depending on the type of appropriate education: 4 years for primary, secondary and high school, 3 years for post-secondary and foremen and 3- 6 years for the superior;
- at the end of each stage, the promotion in the next stage (or completion of schooling) is decided on the results of the passing/examination;
- it is admitted that a student can withdraw from the courses at any time, but once retired he never returns. Thus, a learner’s situation at the end of a study period can be described by one of the alternatives:

- 1) the student promotes the class/exam and will attend the next stage;
 - 2) the student does not promote the class/exam;
 - 3) the student withdraws before the end of a school year/exam.
- it is admitted that the probability of promotion at a higher stage, of repetition of the stage reached or withdrawal does not depend on the results obtained by the student in the previous years.

In these circumstances, the process of passing successive stages by a learner, which can end either by the successful completion of schooling or by withdrawal, can be described by a Markov chain with the states 0, 1, ... 6. State 0 characterizes a learner in the first stage of schooling, state 6 a student who successfully completed schooling, state 7 a trainee who withdrew. An intermediate state, i , $1 < i < 6$, characterizes a student who promoted the first i stages of schooling. State 6 and 7 are in these conditions absorbent states.

The data used for the period 2015–2018 are:

- the school population by educational level;
- the school population that promoted each educational cycle;
- the number of young people who left the education system, by levels of education.

With these assumptions, the computations led to:

- the crossing matrix:

$$Q = \begin{pmatrix} 0,928 & 0,056 & 0 & 0 & 0 & 0 & 0 & 0,009 \\ 0 & 0,879 & 0,0945 & 0 & 0 & 0 & 0 & 0,0151 \\ 0 & 0 & 0,836 & 0,125 & 0 & 0 & 0 & 0,0214 \\ 0 & 0 & 0 & 0,835 & 0,142 & 0 & 0 & 0,0198 \\ 0 & 0 & 0 & 0 & 0,968 & 0,039 & 0 & 0,00512 \\ 0 & 0 & 0 & 0 & & 0,928 & 0,053 & 0,0053 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

- the **T** matrix:

$$T = \begin{pmatrix} 0,928 & 0,056 & 0 & 0 & 0 & 0 \\ 0 & 0,879 & 0,0945 & 0 & 0 & 0 \\ 0 & 0 & 0,836 & 0,125 & 0 & 0 \\ 0 & 0 & 0 & 0,835 & 0,142 & 0 \\ 0 & 0 & 0 & 0 & 0,968 & 0,039 \\ 0 & 0 & 0 & 0 & 0 & 0,928 \end{pmatrix}$$

• the **N** matrix:

$$N = \begin{pmatrix} 9,9 & 5,7 & 4,6 & 3,9 & 9,8 \\ 0 & 6,7 & 5,2 & 5,1 & 1,8 \\ 0 & 0 & 6,250 & 1,5 & 3,2 \\ 0 & 0 & 0 & 0,0 & 5,0 \\ 0 & 0 & 0 & 0 & 6,7 \end{pmatrix}$$

• the **R** matrix:

$$R = \begin{pmatrix} 0 & 0,0 \\ 0 & 0,015 \\ 0 & 0,0 \\ 0 & 0,0 \\ 0 & 0,005 \\ 0,055 & 0,005 \end{pmatrix}$$

Therefore, with the results obtained previously and based on the relationships:

$$\begin{cases} a(i, d) = \sum_{j=0}^{d-1} n(i, j) p(i, j) = p_{i+1} \dots p_d \frac{1}{1-r_{i+1}} \dots \frac{1}{1-r_d} \\ a(i, d+1) = 1 - a(i, d) \quad 0 \leq i \leq d-1 \end{cases} \quad (13)$$

we can calculate the absorption probabilities from one stage to the other in the education process.

It can be noticed that the probability of absorption $a(0,d)$ and $a(0,d+1)$ represents the probability that a beginner student will successfully complete the schooling, respectively to withdraw.

Based on the data used, there were obtained the values for the absorption probabilities presented in Table 1.

Table 1. The absorption probability values for studying a learner's evolution during the schooling period

$a(1,6)$	0,86	$a(1,7)$	0,46
$a(2,6)$	0,82	$a(2,7)$	0,37
$a(3,6)$	0,01	$a(3,7)$	0,05
$a(4,6)$	0,26	$a(4,7)$	0,09
$a(5,6)$	0,94	$a(5,7)$	0,08

Source: own work.

The average length of schooling for a student, which ends either through graduation or retraction, was determined on the basis of the relationships:

$$E_i(v) = \sum_{j=0}^{d-1} n(i, j) = \begin{cases} \frac{1}{1-r_{i+1}} \left[1 + \sum p_{i+1} \dots p_j \frac{1}{1-r_{i+2}} \dots \frac{1}{1-r_{j+1}} \right] & 0 \leq i \leq d-1 \\ \frac{1}{1-r_d} & i = d-1 \end{cases} \quad (14)$$

The analysis of the obtained results allows to determine the average value of the duration of the schooling for a beginner learner (schooling ending either by graduation or by withdrawal) at each level of education. Thus, for the case considered these values are presented in Table 2.

Table 2. Duration of schooling

Form of education	Duration of schooling (years)
Form of education	3.87
Lower secondary education	7.58
Vocational education	10.26
Upper secondary education	11.05
Post-secondary non-tertiary and foremen education	14.11
Tertiary education	16.3

Source: own work.

Conclusions

Romania has assumed in the Bologna Process (launched in 1999) a series of commitments regarding the development of the social dimension of education and equity in higher education.

The decrease in the number of students in the bachelor's cycle was manifested especially at the level of private higher education. The decrease in the number of students amid the constant maintenance of the level of funding in the public university sector has led to a doubling of the share of students who do not pay fees.

A problematic evolution typical of the recent years is due to the increased emigration. This constitutes an alternative for young people in the detriment of higher education and is particularly important in poor regions.

Because there are no details of the student dropout profile, the indirect deduction of the dropout rate may be problematic. For example, students who follow two faculties may drop out of a faculty without placing themselves outside the higher education system.

Also, increasing cross-border mobility or enrollment for continuing to study at another university are factors that can distort the calculation of a general abandon rate. Perhaps the most palpable outcome in calculating the actual dropout rates is given by comparing admissions by cohort with

the share of young people completing a form of university education until the age of 30–34.

In this context, the differences between the incomes and outcomes (the percentage difference between the beginning and the end of the academic year) in tertiary education tend to increase to 9.3% in the academic year 2016/2017 and have similar values in state and private education.

In the current situation, when trying to increase the degree of insertion of graduates of higher education into the labor market, it is natural for the decision-makers to use different methods and estimation techniques to allow them to study the interdependencies between the indicators of the education system and those of the labour market and at the same time to provide them with scientific support for their prognosis.

Using Markovian modeling methods to study and predict the evolution of the schooling process can contribute to improving the access to and the participation in higher education, to correlating the university studies programs with the labour market needs, to involving universities in developing sectoral policies and strategies, to encouraging the formation of the poles of excellence in education and research, to a more efficient use of resources and increasing the performance of Romanian universities.

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