A Decade of Growth in Enrolment for Engineering Studies in Romania

Can We Keep up the Momentum?

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INTRODUCTION

In the context of the Lisbon strategy, there is a common objective set for the education and training systems of the EU for 2010 that is of particular interest for engineering studies [1]: *increase of at least 15% in the number of tertiary graduates in Mathematics, Science and Technology (MST), with a simultaneous decrease in the gender imbalance*. According to the European Commission progress-reports, Romania was one of the best performing European countries in achieving this objective [2], exceeding by far the benchmark.

In order to analyse this performance, the first section of this paper presents a synthesis of the relevant statistical data in the decade 2001-2010 in Romania. Secondly, the authors analyse a number of objective factors that have the potential to explain the evolutions regarding the number of students and MST students and graduates in Romania, including the decline recorded from 2009. Among the objective factors, the authors refer to the legal framework, the economy and the labour market, and the major changes in the secondary education curricula. Finally, the authors draw a number of preliminary conclusions, under the form of some general guidelines with the potential to support good-practice transfers and decision-making processes at various levels.

1 STATISTICAL DATA

The source of all data in this section is EUROSTAT and all the calculations are made by the authors. The numbers of students refer to students in the first and second stage of tertiary education (ISCED97 5 and 6).

1.1 Demographics

In the period 2001-2010 Romania has recorded a **negative demographic trend** with an average annual growth rate of -0.45%. The total population decreased on average with 99.3 thousands per year, with the lowest decrease from 2000 to 2001 (-25.0 thousands) and the highest one from 2001 to 2002 (-597.0 thousands). In the last three years of the decade the decrease rate was less severe (on average -0.16% per year). The negative demographic trend exists from before 2001 and continued after 2010. Based on the EUROSTAT 5-year interval projection data, in the period 2010-2060 it is possible that the average growth rate of the population of Romania to become as low as -2.13%. Taking the population of year 2010 as reference, by 2020 the total population of Romania might decrease with nearly 0.5 million people, and with more than 4 million people until 2060.

The negative demographic trend has been accompanied by the **ageing of the population**, with a direct impact on the population aged 20-29 – the main target group for tertiary education enrolment. As percentage of the total population, the population aged 20-29 decreased from 16.8% in 2001 to 15.6% in 2010. In absolute numbers, the young population of Romania has decreased in the period 2001-2010 on average with more than 41 thousand people per year. Based again on the EUROSTAT 5-year interval projection data, this negative trend is possible to continue, even at an accelerated rate in the next decades.

Despite the negative demographic trend and the decrease in the young population, the enrolment in tertiary education and in particular for MST studies recorded an **overall growth** in Romania in the decade 2001-2010.

1.2 Total Number of Students

As indicated in *Fig. 1*, the total number of students in Romania had a clear **positive trend** from 2001 to 2009, followed by a **decline** in 2010 (-8.99% relative to 2009). The positive trend also existed in the period 1998-2000, and the decline continued in 2011 (-12.78% relative to 2010; not shown in the figure).

Fig. 1. Total number of students in Romania (rounded, in 1000; data: EUROSTAT)

To assess the year-by-year change in the number of students, as well as to make a comparison with the situation at the European level, *Fig. 2* presents the evolution of the **annual growth factors** (ratio of the number of students in year n to the number of students in year $n-1$) for EU27 and Romania in the period 2001-2010. We notice that from 2001 to 2009 the annual growth factors for Romania were higher than 1 and higher than the corresponding EU27 values.
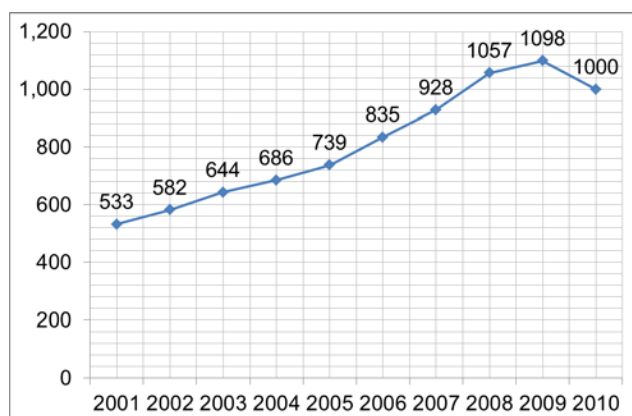
However, the growth factor decreased in 2010 (and 2011), becoming lower than 1, corresponding to the negative growth rates mentioned above.

The decline recorded in 2010 and continued in 2011, corroborated with the demographic trends, leads to the idea that the number of students might **continue to decrease**, even at an **accelerated rate** in the next years. This should be a matter of concern for policy-makers at all levels and should be addressed by consistent measures to increase **participation** in tertiary education – for the population aged 20-29 **and** for the population in higher age-groups (in line with **LLL policies**).

Fig. 2. Annual growth factors of the total number of students (EU27 includes Romania; data: EUROSTAT)

1.3 MST Students and Graduates

According to EUROSTAT methodology, MST students and graduates refer to the following fields: science, mathematics, and computing (EUROSTAT code EF4), and engineering, manufacturing, and construction (EUROSTAT code EF5). As outlined in the European Commission's progress reports regarding the "Education and Training 2010" Work Programme, there was a significant increase in the number of MST students and graduates in the decade 2001-2010 in Romania [2]. However, there are a number of characteristics of this evolution that need to be clarified.

First of all, similar to the evolution of the total number of students, the number of MST students had a **positive trend** in 2001-2009 followed by a **decline** in 2010 (continued in 2011). Nevertheless, the number of MST students **did not decrease as sharply** as the **total number of students**: -5.45% compared to -8.99% for 2009-2010, and only -2.89% compared to -12.78% for 2010-2011. This is consistent with the **increase** of the **share of MST students** of the **total number of students** in the period 2009-2011 (from 21.9% to 25.3%).

Secondly, the positive trend in the period 2001-2009 **and** the low values of the decrease rate in the period 2010-2011 are mainly explained by the evolution of the number of students enrolled in **engineering**, manufacturing, and construction (EF5) – as indicated in *Fig. 3*. Moreover, the number of students in science, mathematics, and computing (EF4) started to decrease from **2008** – whilst 2009 was the top year of all the positive evolutions discussed so far. In this context, it is important to mention that the *hardware* part of *computing* is included in *engineering* in Romania.
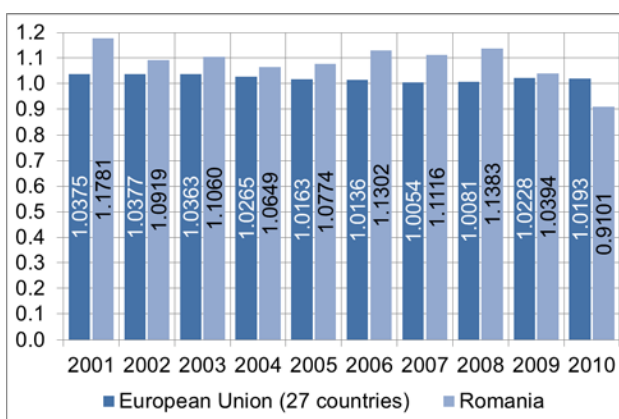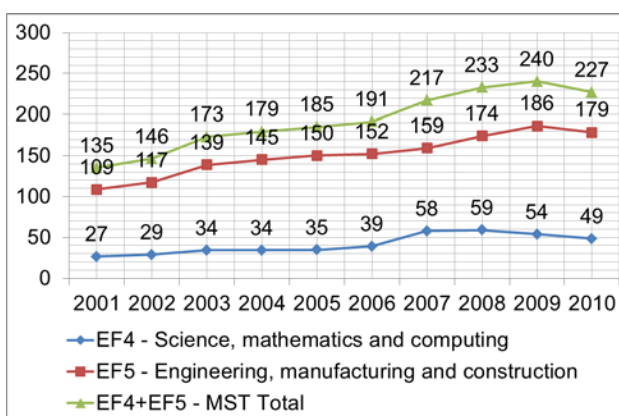

Fig. 3. Number of MST students in Romania (rounded, in 1000; data: EUROSTAT)

Finally, the annual growth rates of the MST students varied in a rather large interval – as indicated in *Fig 4*. Very high growth rates are recorded from 2002 to 2003 (18.33%) and from 2006 to 2007 (13.44%), whilst the lowest positive growth rate is recorded from 2004 to 2005 (3.14%). The large variability as well as the small number of data in the time-series make very difficult, if not impossible, any attempt on developing a model and making justified predictions [3]. However, the evolutions previously discussed seem to indicate that the **negative growth rates** might continue in the next years.
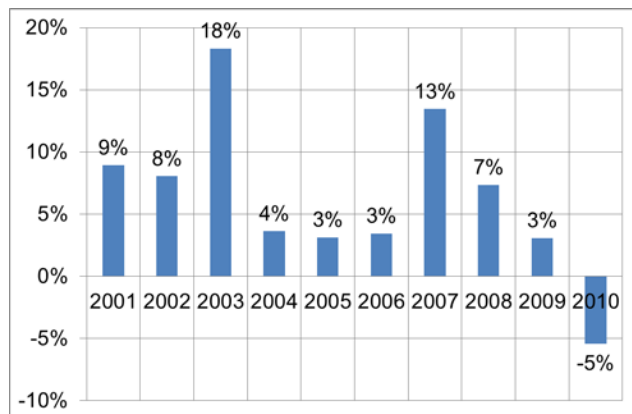

Fig. 4. Annual growth rates of the number of MST students in Romania (rounded; data: EUROSTAT)

Regarding the MST graduates in the period 2001-2010 in Romania the following facts are important to be mentioned:

- On average, 21.4% of the graduates of all fields were MST graduates (EU27: 23.0%). The contribution of the EF5 graduates was approximately **3 times** higher than the one of the EF4 graduates.

- MST graduates per 1000 population aged 20-29 grew by **3.18 times** from 2001 to 2010. The value of this statistical indicator was lower for Romania than the EU27 values until 2007 and became higher in the period 2008-2010, with a top-value in 2009 (EU27: 14.4; Romania: 20.0).

1.4 Gender Balance

The number of women in tertiary education in Romania followed a similar pattern with the total number of students (see *Fig. 1*): **positive trend** until 2009 and **decline** in 2010 (and 2011). The **percentage of women** of all students **increased** from 53.5% in 2001 to 56.4% in 2010 (average value 55.2%). A similar evolution was recorded at the level of the EU (average EU27 value: 54.9%) – although it should be noticed that the total number of students and also of female students in the EU **increased** in the entire period, including from 2009 to 2010 (data from 2011 not available for EU27).

Regarding the MST studies in Romania, in the decade 2001-2010 the share of women of the total number of MST students was on average 35.0%, increasing from 33.1% in 2001 to 35.2% in 2010. This indicator was on average 5 points higher than the corresponding EU27 values – implying a better and improving gender balance in Romania in this area [2]. This assertion is also demonstrated by other indicators for the decade 2001-2010: the annual growth rates of MST female graduates (on average RO: 13.24%; EU27: 4.21%), and of the MST female graduates per 1000 of female population aged 20-29 (on average RO: 14.78%; EU27: 4.62%). However, improving gender balance in engineering education is not equivalent to reducing the gender gap when it comes to **employment** and **working conditions** [4].

2 FACTORS

Out of the rather large variety of possible factors that could have determined the evolutions presented in the previous section, we will address in the following

qualitative analysis three objective factors (national level): **legislation**, **economy and labour market**, and **secondary education curricula**.

2.1 Legislation

Regarding the legal framework for tertiary education in Romania, first and foremost we should notice that universities' autonomy is secured by the law. This means that universities can establish their own policies, practices, curricula, etc. There are a number of **quality conditions** established by the legislation that set the boundaries in which this autonomy can manifest. These conditions refer equally to private and public universities and translate into specific criteria regarding the organization, the educational process, the curricula, the human resources, the facilities, etc.

In Romania, the number of the first year students whose studies are supported from the **state budget** is established for every academic year through a decision of the government. The breakdown of the number of students on educational fields and universities is then completed through a negotiation process involving the Ministry of Education, universities, and various representatives of the economy and society. These numbers (total, per field, per university) depend on several competitive factors: the budget of the state (probably the most important and the strictest factor), the requirements of the labour market, traditions (for example **engineering** has always been considered a very important educational field, with strong economic and cultural support – therefore it almost always receives a large share), the rating of the universities, etc. The analysis of the decisions of the government reveals that until the academic year **2008-2009** there was **little variation** in the total number of first year students financed from the state budget (on average 78.6 thousands per academic year), increasing **afterwards** – with approximately 20 thousands – and then stabilizing around 100 thousands students per academic year. Therefore, this does not explain the growth of the total number of students in the period 2001-2009. The explanation comes from another specific provision of the law: the **public universities** could enrol **tuition-paying students** above the number of students supported from the state budget. The number of tuition-paying students and the tuitions were established by the universities' senates based on criteria set by the law. However, by 2010 and onward, the increasing number of tuition-paying students enrolled by the public universities became a subject of public and political debates, leading to increased criticism regarding the lowering of the standards and generally of the quality of tertiary education. The accumulated tension finally led to more restrictive conditions regarding the enrolment of tuition-paying students in public universities, which in turn might have improved the quality of instruction, at the cost of reducing the number of students, however.

Another important development explaining the growth of the number of students in Romania resides in the increasing number, importance, and relevance of the **private universities**. A somehow peculiar fact about the legislation of the education in Romania demonstrates that the interest in opening private universities was very high as soon as this was possible (that is immediately after the overthrowing of the communist regime in 1990). **Before** the Law of Education from **1995** (first consistent act to entirely replace the former communist legislation of education), the Romanian Parliament passed in **1993** the **Law on Accreditation of Universities** – having as specific target not as much the public universities, already well-established, but the new and about to be established **private universities**. From 1993 up to 2011, the authorisation and accreditation conditions were changed many times, with a general trend to **increase minimum standards** and **improve quality**, often leading to

heated debates involving politicians, specialists in education, professors, beneficiaries, the media, etc. Although with a rather uneven evolution, with many private universities authorised and then closed after a few years, the contribution of the private universities to the increase of the number of students in Romania remains a fact – and this contribution can continue and even improve over the next years.

The period 1995-2000 brought a new option in Romania for accessing tertiary education – an option with a great impact on the evolution of the number of students in the following decade: **distance education**. Somehow similar to the evolution of the tuition-paying students in public universities and of the private tertiary education, distance education in Romania has undergone a spectacular expansion followed by a strong intervention of the state to **increase standards** and **improve quality**, which in turn **reduced** the number of programmes/students. However, it remains a clear positive fact that distance education has opened new opportunities to young people in remote areas as well as to people already working to continue or to complete their studies. The positive trends in ICT-development and internet access, along with better standards, reinforced by the law, indicate that distance (and blended) education might have an essential contribution in maintaining and even increasing tertiary education participation in Romania in the next years.

Finally, we cannot neglect the **support offered by the state** in the form of scholarships and other incentives to encourage youth's participation in tertiary education. Social scholarships, scholarships for students coming from the rural area, student discounts for public transportation, free access to medical and social services, low-cost accommodation on campuses, etc. – were all measures supported by the state and applied by the universities to attract and maintain young people in tertiary education. These measures have definitely had a positive impact on enrolment rates, and continuing and extending this type of policy might have long-term benefits – not only for tertiary education participation, but also for the society at large (for example by reducing rural-urban disparities, etc.).

2.2 Economy and Labour Market

It is beyond the scope of this paper to undertake a detailed analysis of the economy and labour market evolutions in Romania in the decade 2001-2010. Nevertheless, there are a number of specific changes that in our opinion might have influenced the evolution of the number of students and MST students and graduates in Romania.

First we noticed that the real GDP growth rate in Romania (in terms of volumes; percentage change on previous year) was **positive** from 2001 to 2008, and became **negative** in 2009 and 2010 – as a direct result of the economic crisis. The highest GDP growth rate was recorded in 2004 (RO: 8.5%; EU27: 2.5%). Although we do not claim to demonstrate a correlation, we just notice that the highest annual growth rate of the MST students/graduates in Romania was in 2003 (18.33% and 59.31% respectively) – that is **after** two years of promising economic growth and one year **before** the highest GDP growth rate in the analysed period. We also notice that in 2010 and 2011, **after** the negative GDP growth rates, the number of students, and MST students **decreased** relative to the previous period.

Secondly, regarding the labour market in Romania, according to the Romanian National Institute of Statistics, the unemployment rate decreased from 8.8% in 2001 to 4% in 2007 and then rose sharply to 7.8% in 2009 following the economic crisis. The next two years marked a return to lower values: 7% in 2010, and 5.2% in 2011. At the same time, according to EUROSTAT data, the employment of the population with **tertiary education** was relatively constant in Romania in 2001-2002, and then

started to **increase** from 2003 onward. Finally, it is also important to note the **redistribution** of the labour force among the economic activities – with employment in **services** and **industry increasing** and **exceeding** employment in **agriculture** starting with 2002. Considering these developments and taking into account the natural delay in the response of the population to the conditions on the labour market, we can assume that the prospect of finding a good/better job upon graduation has driven the enrolment in tertiary education [5], specifically for MST studies in Romania – at least until 2009.

2.3 Secondary Education Curricula

In our opinion, there are **two major changes** (both initiated in 2003) regarding the National Curriculum for secondary education in Romania that could have influenced in a positive way the enrolment for MST tertiary education.

First, the frame-curricula (number of classes per week in each subject and for each grade) have been changed to **increase** the focus on mathematics, physics, chemistry, biology, ICT, and technology (the latter especially in the case of T/VET upper secondary education). The share of the teaching time dedicated to mathematics and sciences in Romania became one of the highest in the EU.

Secondly, the syllabi for all the subjects in secondary education have been changed to reflect the LLL objectives: from the simple process of transmitting information to the pupils to the more complex process of training and developing **competences**. The concept of competency as well as the key-competences to be developed by each and every pupil as a foundation for LLL were adopted based on the recommendations of the "Education and Training 2010" Work Programme.

The accent on MST in secondary education and the competence-based syllabi were meant to increase the **attractiveness** of these subjects and to facilitate their **understanding from an early age**. From the perspective of the positive trend in the enrolment for MST tertiary education in Romania, we can assume that these objectives have been achieved and that the secondary education curricula can have, among other factors, an important impact on choosing a career in engineering [6].

3 CAN WE KEEP UP THE MOMENTUM?

Between 2001 and 2009, Romania witnessed a clear **positive trend** in the total number of students and in the number of MST students and graduates. Regarding specifically the MST students and graduates – the most important contribution came from **engineering, manufacturing, and construction**. In the same period there was an important improvement in the **gender balance** – with the share of women of the MST students and graduates increasing over the entire period. The year 2009 seems to mark the beginning of a **declining period**.

These findings have led the authors to analyse some of the factors to explain the recorded evolutions and moreover to identify potential ways **to stop** and **to reverse** the decline started in 2009. The following general **guidelines** for Romania (and probably not only) resulted:

- Universities should become aware and take seriously into consideration for all mid- and long-term planning the negative demographic trend and the ageing of the population. To negotiate this threat, consistent and long-term **LLL policies** should be developed and applied, and universities should extend their enrolment pool towards **higher age groups** and **working people**.

- Universities should improve the overall conditions offered to the students and increase their **national/international rating**. Public universities should secure funds to fulfil the quality criteria in order to increase their enrolment capacity for **tuition-paying students** (should the law allow it).

- National policies to encourage and support **private universities** should be developed and implemented on a long-term basis. Existing private universities should increase the **quality of the education** and extend their offer towards MST and specifically **engineering studies**.

- **Distance education** and **blended education** for MST/engineering studies should become part of the permanent educational offer of the universities.

- The support offered by the state to **disadvantaged students** should continue and extend, and universities should find **independent ways** to attract and maintain students from poor/rural areas.

- Universities should develop strong and permanent relations with the business community and with industry in order **to secure jobs** for their graduates.

- Secondary education curricula and teaching methods should support **MST subjects** and **guidance** of the pupils towards **MST/engineering studies**.

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