

# Science in post-communist Romania

The future is not inviting

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## 1 Is Science Important?

The ultimate measure of a country's scientific and technologic success is the quality of life enjoyed by its people. Research and development (R&D) is not a vain pursuit but the quest for a better life, that should be carefully nurtured and monitored by any government that cares for its citizens. Unlike sports, no prowess should be demonstrated. However, comparing science investment and output in the international context allows one to evaluate the health of national science systems, their productivity, and their perspectives.

Has Romanian science been on the right track after the fall of communism in 1989? Taking advantage of newly available statistical data, we address this question in a regional context. As Soviet satellites, during most of the second half of the last century, communist countries of Eastern and Central Europe were likely to experience similar R&D conditions. The degree of ideological interference varied from country to country, but basic social structure and lines of development were the same. Therefore, a comparison of their post-communist evolution offers a well-balanced way to assess their performance. For simplicity, we address data concerning three other countries besides Romania: Bulgaria, Hungary, and Poland. These countries have a rather different profile of economic development and human potential. Hungary and Poland are leading contenders for joining the European Union in 2005, while Bulgaria and Romania's economic indicators in the last decade are less stellar. Poland and Romania are relatively populous countries, while Bulgaria and Hungary have comparatively smaller population. For a meaningful comparison most data will be normalized to the population size for each country.

Although of great social significance, any discussions about reforming the R&D system in Romania have been restricted to the research community. To our knowledge, the few available performance analyses of Romanian R&D are private initiatives, stemming from concerned individuals and non-governmental organizations [see References]. Few of these studies have permeated the public opinion within Romania, or elsewhere. As the European Union (EU) prepares for a new cycle in its research and technological development (the 6th Framework Programme – FP6), it is crucially important to honestly assess and openly discuss the preparedness of Romanian R&D in taking advantage of these new opportunities.

## 2 Expenditure and Personnel in Romanian Science

In 2000, EUROSTAT published a comprehensive report on R&D expenditures and personnel in candidate countries, report which had almost no echo in Romania [1]. Data for 1998 shows that expenditure on R&D was significantly lower in all candidate countries than in EU. However, important differences were shown to exist: Romania had the third lowest figure for R&D expenditure among all candidates, 0.5% of the gross domestic product (Fig. 1). By comparison, Bulgaria invested 0.59%, Hungary 0.68%, and Poland 0.73% of their GDPs in science and technology (Fig. 1). The EU average R&D expenditure was 1.86%. Both Bulgaria and Romania spent \$8 million ECU per million inhabitants for R&D, while Hungary and Poland spent about 3.5 times more than their southeastern neighbours (\$29 and \$27 million ECU per million inhabitants respectively).

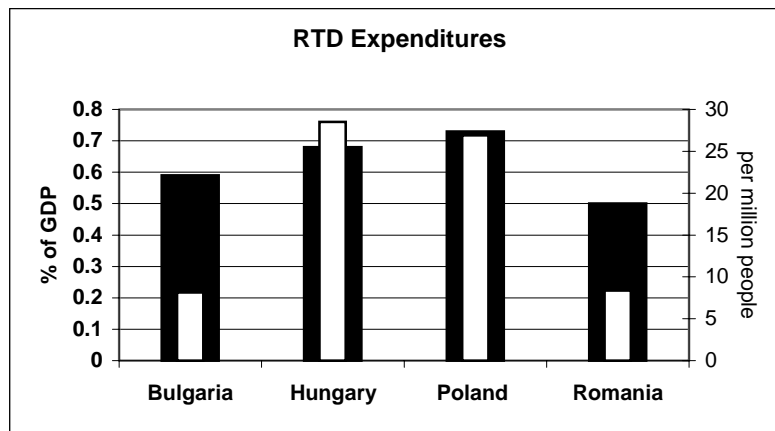


Fig. 1. R&D expenditures in 1998 by country as % GDP (black bars) and per million inhabitants (white bars) for Bulgaria, Hungary, Poland, and Romania (after data reported in [1]).

Unlike the other three countries discussed here, most of the R&D expenditure in Romania went to applied research performed by the enterprise sector (77% vs. 20–40%). Although the latest available data by field of science shows that most candidate countries preferentially fund engineering and technology, in Romania this tendency is exacerbated (Fig. 2) at the expense of R&D expenses in medical sciences, and social sciences and humanities.

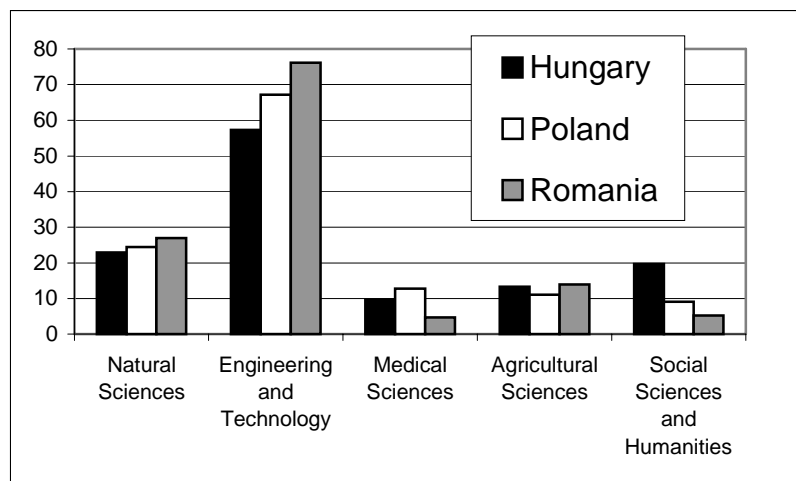


Fig. 2. R&D expenditure by field of research (as % of total expenditure) for Hungary, Poland, and Romania (data for Bulgaria not available) after data reported in [1].

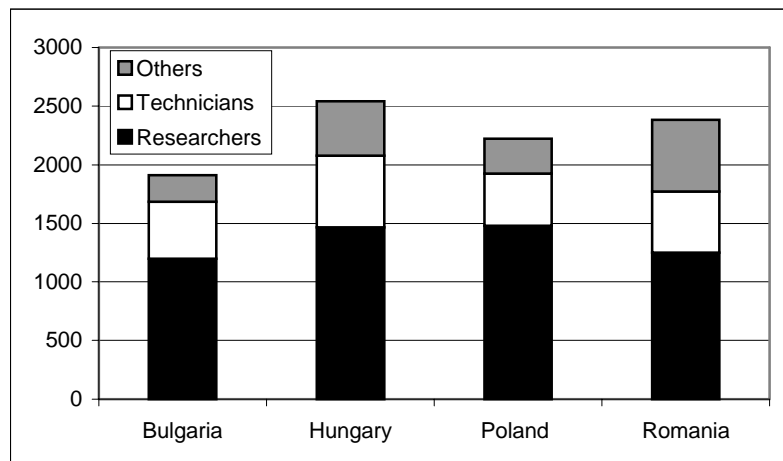


Fig. 3. R&D personnel per million inhabitants grouped by position in 1998 in Bulgaria, Hungary, Poland, and Romania (after data reported in [1]).

The research and development sector employs a similar number of personnel in all four countries, i.e., between 1,900 and 2,500 employees per million inhabitants (Fig. 3), but only 52% of these are researchers in Romania, compared to 63% in Bulgaria, 58% in Hungary, and 66% in Poland. Romania employs the lowest number of research personnel in the labor force among all candidate countries. The growth rate for research personnel reported by the EUROSTAT study for the 1994-1998 period is negative for Bulgaria (31.8%) and Romania (12.3%) and positive for Hungary (3.8%) and Poland (8.8%).

### 3 The Quality of Romanian Research

Bibliometric/scientometric analyses are used to assess scientific productivity; many countries factor in such productivity indexes when distributing funds to their research institutions. Most analyses use publications indexed by the Institute for Scientific Information (ISI) in Philadelphia [<http://www.isinet.com>]. ISI's databases allows researchers to rapidly query the literature and to identify individual scientists or institutions working on particular topics. Bibliometric analysis is not currently employed in evaluating research performances in Romania, although some studies and analyses are available, thanks to individual and non-governmental efforts [2-10].

Hereby, we survey scientific output grouped by countries in Bulgaria, Hungary, Poland, and Romania over the last two decades (1981-2001), in order to provide a straightforward, albeit crude estimate of the quality of science produced in Romania. For this survey, we analyzed the SciSearch and Social SciSearch databases, available from ISI. Publications indexed by SciSearch cover natural sciences, technology, biomedicine, and related disciplines while Social SciSearch covers literature in social, behavioral, and related sciences.

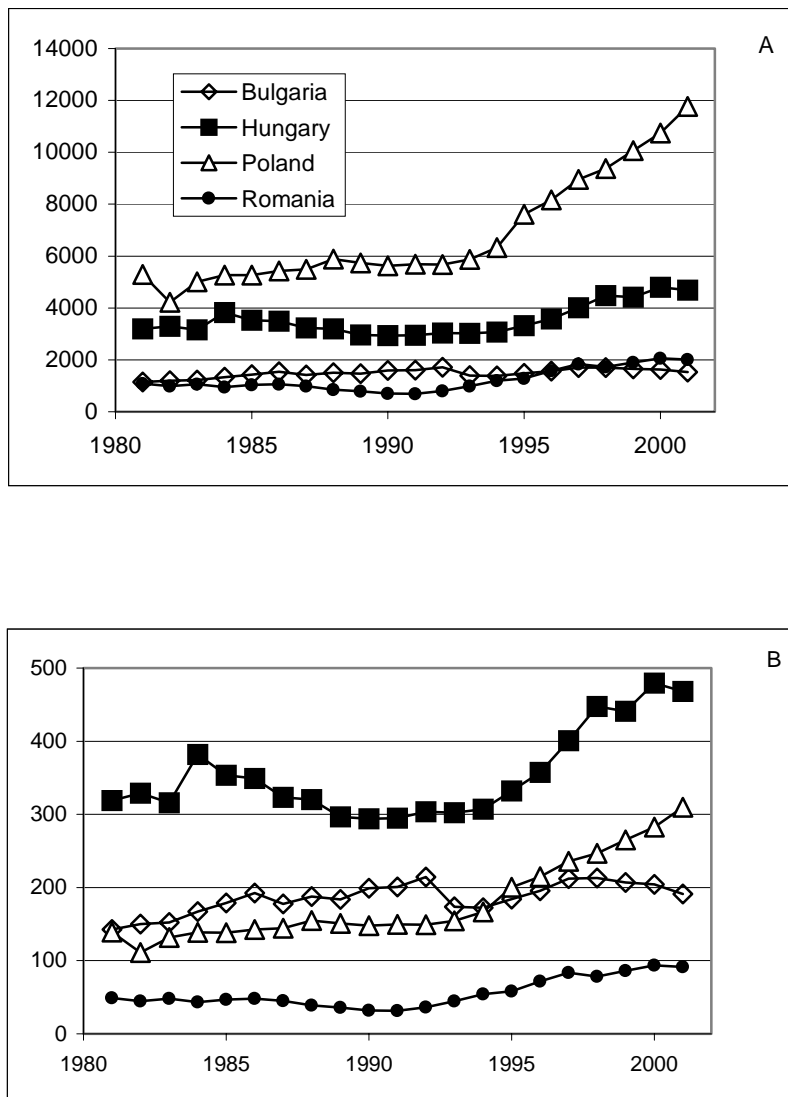


Fig. 4. a. Scientific papers indexed by SciSearch since 1981 that have authors affiliated with research institutions in Bulgaria, Hungary, Poland and Romania; b. Same as in (a) calculated per million inhabitants.

The total number of publications with at least one Romanian author indexed by both SciSearch and Social SciSearch was consistently lower than publication with Hungarian and Polish authors (Fig. 4a and Fig. 5a). When reported relative to its human potential, Romanian scientific production is well below the production of any of the other three countries considered (Fig. 4b and Fig. 5b). A consistent positive trend in natural sciences and engineering publications is apparent since 1989 when the country has become democratic (Fig. 4). Although publishing in international journals in social sciences also increased in post-communist Romania, a positive trend is not distinct (Fig. 5). Relative to the baseline for the communist years (i.e., the average number of publications between 1981 and 1989), the rate of increase in publications with Romanian-affiliated authors in natural sciences and engineering (SciSearch database) is highest among the four countries: 190% in Romania, compared to 120% in Bulgaria, 130% in Hungary, and 185% in Poland.

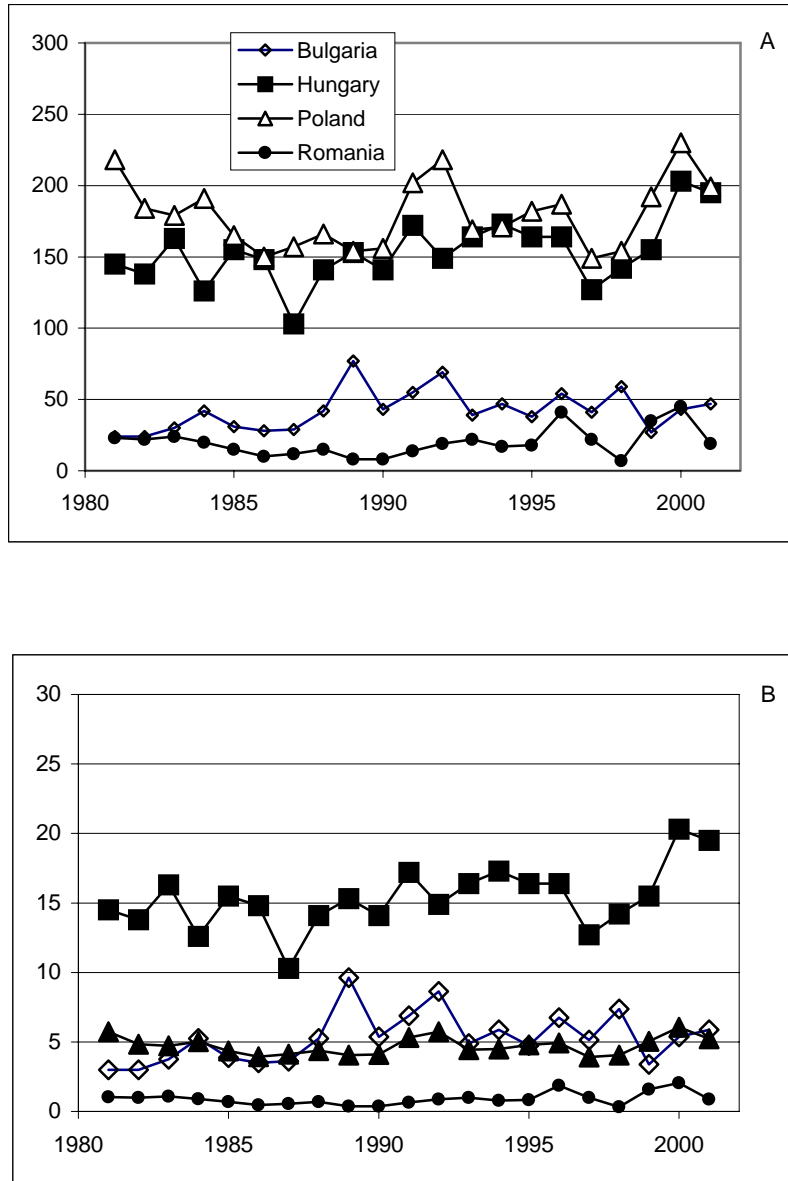


Fig. 5. a. Scientific papers indexed by Social SciSearch since 1981 that have authors affiliated with research institutions in Bulgaria, Hungary, Poland and Romania; b. Same as in (a) calculated per million inhabitants.

Data published in [10] and reported in [5] show that Romania's scientific output is primarily in the fields of chemistry, physics, engineering, and mathematics. Publications in mathematics are significantly higher compared to Bulgaria, Hungary and Poland, while publication in bio-medicine and health are significantly lower. After the fall of communism (1984 vs. 1999) Romanian publication output increased in biology, earth and space sciences, and physics and decreased in medicine, social sciences, and engineering.

## 4 Quo Vadis?

The above statistical analyses paint a bleak picture for Romanian science that should sound an alarm bell for both the Romanian public opinion and Romania's government<sup>1</sup>. The principle that one should expect no better return from any activity than one's investments is confirmed in post-communist Romania. By comparison, relatively large R&D expenditures lead to notable improvements in Hungary and Poland, especially in the fields of natural sciences and engineering research.

Scientific production is well below Romania's human potential. Although Romania employs as many researchers as the other three countries discussed here, the knowledge output is by far the lowest, underlining serious problems in productivity. It is clear that the communist legacy weighs heavily in Romanian science: during the communist period, especially in its latest decade, when the scientific and academic community in Romania was isolated, the rate of publishing in international journals was by far the lowest among the analyzed countries. It is also clear that the reforms in Romania's R&D system were of few, if any, positive consequences in the last decade.

Since 1989, there is an encouraging positive trend in publishing in natural sciences and engineering. A more detailed analysis is needed to assign this trend to more effective financing, international collaborations, and/or to professional necessities of the individual researchers susceptible of "brain-drain". This trend should not be a reason for complacency, however. Maintaining the present increase rates and assuming saturation of scientific production in the other countries at the 2001 level, Romania will need 15 years to catch up with Bulgaria, 30 years with Poland, and 60 years with Hungary, when normalizing the number of publications per million inhabitants. For social sciences this period extends even further: 50, 50, and 200 years (!) for Bulgaria, Poland, and Hungary, respectively.

Given the precarious state of Romanian R&D, Romanian scientists were unable to take full advantage of the funding available from the EU during FP5 [9]. Weak Romanian participation to the Programme has been a reason of concern for European funding bodies [11]. Data from 2000 show that Romania has submitted only 16 proposals for funding (calculated per million inhabitants), of which 3 were successful (i.e., with signed contracts). Compared to 29:6 in Bulgaria, 81:21 in Hungary, and 25:5 in Poland, this indicates that Romanian scientists are well below their neighbours with respect to their ability to seek, and attract, international funding [9]. The average for EU was 116 submitted proposals and 53 signed contracts per million inhabitants – suggesting that post-communist countries in general continue to lack the know-how and the possibilities to compete in open-funding systems such as the Framework Programme.

Previous independent analyses [2-10] and data presented herein show that two intrinsically related problems should be tackled to reform the Romanian R&D system: funding and scientific productivity. For justifying publicly an increase in funding, development of scientific research and technological development should become a political priority in the earnest and not only on paper, following the good example of leading EU candidate countries. R&D expenditure should exceed 3-4 times the current levels in Romania, only to match the on-going efforts in Hungary and Poland. There is further an urgent need for balancing the funding among various fields and sectors of science. Particularly low funding in Romanian bio-medical sciences do not bode well for a health system already under duress.

Scientific productivity could be helped to increase only through an open evaluation of research institutions and individual researchers. Research evaluation should be based on internationally accepted criteria and should be tailored to the needs of a post-communist society. Bibliometric analyses should build on previous efforts and go beyond the raw number of publications toward using impact factors calculated for Romanian published science. For example, citation analysis should consider in-house biases that have been rampantly inherited from communism, where all publications in any research unit are automatically credited to the head of that unit.

By definition, science is above national boundaries; the public that judges research results are peers from all over the world. It is imperious that new research be published where it can be read, debated, and used. By not recognizing the international criteria for scientific excellence Romania's science

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<sup>1</sup> **N.B.:** The authors of this study are well aware that, during the past decade, similar ideas have been put forward by other Romanian scientists. To this day, however, these ideas have not been heard, discussed, or debated in any significant portion of the Romanian society. While this may be another futile attempt, we continue to hope that, sooner – rather than later – the conscience of Romanian politicians will reach that level of social awareness that leads to positive reform. Until that day, the gulf between possibilities and reality keeps increasing.

evaluation committees make use of criteria that mimic international norms, substituting, or down-playing publications in respected journals with scores of “salami science” publications, namely the over 500 “scientific journals” that mushroomed in Romania in the last decade. While touted as a major improvement in Romanian science by politicians and academe alike, the vast majority of these journals do not use the peer-review system for quality control and are not indexed in international database systems such as ISI, even when published in English. Only those Romanian journals that are recognized and supported by the international scientific community should be supported through public funding.

An open evaluation of Romanian research should lead to preferential funding for those teams and individuals that are deemed to be productive according to international norms, and should further lead to overhauling and consolidating those research units that are not competitive. An increase in the ratio of researchers to auxiliary personnel (technicians and others) is clearly needed. Human resources are available: a study in preparation shows that, scaled to its population, Romania and Bulgaria provide the highest number of US graduate students among all Eastern and Central European countries [12]. The same is true in France [5, 10]. However, poor performances in the Romanian educational system [13] might put these resources in peril; therefore, a coordination between educational and research systems reforms is essential.

During the evaluation process, objectivity should be insured by inviting foreign nationals, with no vested interests in Romanian funding and research, to supervise the scientific reforms. European funding agencies could assist in this process by stressing on quality requirements and by promoting direct proposal submission and funding from and to individual researchers and independent teams, in order to avoid national bureaucratic entanglements.

Last but not least, improving the social image of science in Romania is a task that is both urgent and long-term. During communism, science was falsely hailed as a social priority – in fact ideological interference reached pathological proportions (e.g., [3,14]). Although funding was more consistent than today, it was mostly directed to applied research for gigantesque, unrealistic projects. However, it should be acknowledged that the bulk of Romanian R&D in natural sciences and engineering has been developed during communism, and little is understood about these processes. Key players and witnesses to these historic events are rapidly disappearing. Documenting the development of science in Romania would be an excellent opportunity for collaboration between humanists and social scientists on one hand, and natural scientists and engineers on the other hand. Promoting science in the media is another opportunity for collaboration. “Culture wars” sprouting between the two communities fuelled by “traditional” or “postmodern” arguments are suicidal at best, given the current levels of attrition. Until Romania reaches a development level that will take advantage of achievements of modern science and technology to permit decent living conditions for its citizens, such in-fighting is condemned to sterility.

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