

## **Bibliometric study of Foundation for Polish Science grantees**

In 2015 the Foundation for Polish Science (FNP) commissioned a bibliometric study of publications by Polish scientists, with a particular focus on winners of FNP programmes. The goal of the study was to identify the strengths and weaknesses of Polish science, based on measurable results of research work, to map the research fields in which Polish scientists (including FNP grantees) achieve the best, world-class results, and to identify actual and potential networks of cooperation among researchers supported by the Foundation. The results would also be used to evaluate the growth opportunities for research careers in Poland in specific fields of science. Comparing researchers' achievements generates much controversy. The main barrier in making such comparisons is the specifics of the research, the working conditions, and the level of funding. It is well known that even the best mathematicians publish less than chemists, and less often cite other authors in their works. There are reservations when it comes not only to comparisons between disciplines, but also between subdisciplines and research specialties. A theoretical physicist publishes less than an experimental physicist, and neither of them can be compared in terms of their output with a specialist on elementary particles working in a team of several hundred scientists at CERN.

Another challenge is comparing research accomplishments between countries differing in socioeconomic terms, expenditures on science, and the number of research institutions and researchers. Polish researchers aspiring to scientific excellence feel that it is difficult for them to achieve results comparable to American or British researchers without gross domestic expenditure on research and development (GERD) comparable to those countries. Although these expenditures grew in Poland by 12% in 2014, to over PLN 16,000 million,<sup>1</sup> GERD is about 70 times greater in the US, 15 times greater in Germany, 8 times greater in France, and 3 times greater in Switzerland or the Netherlands.<sup>2</sup> GERD as a percentage of GDP was 0.94% in Poland in 2014. This is higher than in previous years, but still far below the figures for Germany (2.9%), France (2.2%), and the EU average (1.94%), not to mention R&D levels in Israel (over 4%) or Korea (4%).<sup>3</sup> Poland is one of the largest countries in Europe, but researchers represent only 0.4% of the working population, the same as in Bulgaria and a little more than in Turkey, as compared to 1.6% in Finland, 1.4% in Denmark, and 1.1% in Sweden and Norway.<sup>4</sup>

Moreover, research in Poland receives very little support from the private sector—unlike most European countries, as well as the US, China and Japan. It should thus come as no surprise that in Poland the number of patent applications filed by researchers is nearly the lowest in Europe (per capita, ahead of only Bulgaria, Romania and Cyprus). And in the ranking of innovativeness (the Innovation Union Scoreboard), Poland is included in the category of “modest innovators”—i.e. significantly below the international average—along with the Czech

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<sup>1</sup> *Działalność badawcza i rozwojowa w Polsce w 2014 (R&D in Poland in 2014)*, Central Statistical Office (GUS). Signal report, Warsaw, October 2015.

<sup>2</sup> *Science and Engineering Indicators 2014*, National Science Foundation.

<sup>3</sup> *Science and Engineering Indicators 2014*, National Science Foundation, figures for 2011.

<sup>4</sup> *Science, Technology and Industry Scoreboard 2015*, OECD.

Republic, Greece, Hungary, Italy, Portugal and Spain.<sup>5</sup> The situation in the field of basic research looks no better. Polish universities place far from the top in rankings of the world's best universities, and publications by Polish researchers rarely break into international scientific circulation.<sup>6</sup>

Notwithstanding these limitations, it is certainly worthwhile to analyze the research effectiveness of Polish scientists and compare it to the achievements in other countries. Such studies primarily serve to identify both barriers and opportunities for growth of Polish science and scientists. It is important to identify the fields where Polish researchers are the most effective and where they are most eager to work. The Foundation for Polish Science has particular reasons to conduct such analyses because—guided by the principles of “supporting the best” and “hard money”—it selects relatively few researchers in its competitions. Conducting programmes in which only 20%, 15%, or sometimes as few as 9% of applicants receive funding requires answers to the question of the accuracy of the selections and the possible synergies between studies supported by FNP.

In selecting the winners of its competitions, FNP never uses bibliometric factors, but always relies on a substantive evaluation by carefully selected reviewers drawn from the international research community, with high competence and prestige. The bibliometric analysis conducted in 2015 does not mean a departure from this rule. The subject of the study was aggregated data concerning publications by over 500 researchers, and the purpose was not to assess individual achievements but rather to map the best-developed fields of Polish science.

We realized that there could be many traps in analyzing research accomplishment using bibliometric methods. Therefore, we invited all of the major bibliometric centres to participate in the selection procedure, and we entrusted the task to one of the most reputable international centres in this field, the Centre for Science and Technology Studies at the University of Leiden. For the sake of the reliability of the data and the bibliometric methods, the study covered only researchers from the exact sciences, the natural sciences, and the technical sciences. We particularly wanted accomplishments to be evaluated in light of the specifics of the research and the publication practice of the particular fields of science. Thus every publication included in the study was compared to publications from the same narrowly defined field. The comparisons made in the analysis primarily involve the qualitative dimension of the research, and thus the citation impact of the published works: indicators depicting the average number of citations (normalized to the field of research and the time when the publication appeared) were used, as well as the proportion of the most highly cited works in the total number of publications, and the connection between citations and national or international cooperation of the authors.

The accomplishments of FNP grantees in particular subdisciplines were compared to the combined average indicators for all Polish researchers, as well as the averages for the entire European Union and selected countries. Identifying appropriate benchmark countries in this

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<sup>5</sup> *Innovation Union Scoreboard 2014*, ERA.

<sup>6</sup> *SCImago Journal & Country Rank*, National Science Foundation.

case was not easy: it is hard to find a country comparable to Poland in terms of size, wealth, socioeconomic system, research expenditures, number of researchers etc. Finally the following countries were selected as benchmarks:

- UK, France and Germany—as large countries leading in the rankings of the number of publications and citation impact, and also due to their well-developed research cooperation with Poland
- Czech Republic and Hungary—as countries with a similar geopolitical situation and historical heritage, although much smaller
- Italy and Spain—as large European countries from the “old” EU with a profile relatively the most similar to Poland
- Israel—as an innovation leader
- Turkey and Brazil—as countries with emerging economies and scientific “production” comparable to Poland, in terms of the number of published articles
- South Korea—as one of the innovation leaders among OECD countries, where the citation impact of scientific works is at a level similar to Poland.

The study commissioned by FNP is one of the first professional bibliometric studies ever commissioned by a Polish institution funding scientific research. The results of the analysis paint an interesting picture of Polish science and provide a valuable contribution to the discussion of its condition and potential. Bearing in mind all of the limitations of bibliometric methods, we believe that assessment tools of this type can help pursue research policy and examine the effectiveness of investments in scientific research.

We encourage you to read the report.

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