

An Analysis of the Influence of Some Incentives on Bibliometric Performances

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ABSTRACT

After an overview of the general fiscal and non-fiscal measures for stimulating the Research and Development system (R&D), with a punctual analysis of some countries, the paper examines Romania's situation from the bibliometric standpoint. The types of incentives are presented and analysed. The awarding programme is viewed as incentive, as its impact consists in an increase of bibliometric performances. The analysis underlines that the paper awarding programme leads to an enhancement of Romania's bibliometric performances and that it is necessary to develop similar programmes for the research institutions, which can result in increasing publication of research outputs. Alongside Romania's global performances, the performances obtained in three broad fields (Chemistry, Economics and Agronomy), over an interval of about 15 years, are analysed. Bibliometric performances demonstrate the connection with fiscal incentives, but performances depend on several aspects, including institutional management and the value of researchers.

Keywords: R&D Incentives, Awarding programme, Bibliometric performances, Hot and highly cited papers, Romania's publication achievements.

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INTRODUCTION

State of the art

General measures for stimulating Research and Innovation

The European States have been encouraged to invest in Research Development and Innovation (R&D&I) 3% of their Gross Domestic Product, till 2020. Two thirds of this invested amount should originate from public funds. This objective has been set for the first time in 2000, through the Lisbon Strategy, renewed in 2005. It should be mentioned that this objective regarding financing has never been achieved. Alongside financing, the R&D system needs incentives to become a viable factor of sustainable growth of the European Countries' economies. "The vast majority of tax incentives are based on corporate income taxes. Tax benefits applying to income from innovation (mostly patent boxes) are proliferating".^[1]

Stimulating scientific research can be performed in several ways, such as:

-fiscal measures;

-measures related to financing (of R&D&I entities, through institutional financing, financing of researchers);

-measures related to granting state-aids for encouraging R&D&I; therefore, the European Union identified a series of measures of R&D&I, for which state-aids could be compatible:^[2]

- a) state-aids for R&D projects, for which the part of the research projects that benefits from aid falls within fundamental research and applied research categories, the later being divided into industrial research and experimental development
- b) state-aids for feasibility studies, proper to R&D projects
- c) state-aids for constructing and modernization of research infrastructure
- d) state-aids for innovation activities
- e) state-aids for innovation clusters

Without going into details, the state-aids are granted especially in case of market failure. According to a Press Communicate of the Commission^[3] the EU aims at simplifying state-aid granting for enterprises, in view of encouraging R&D&I, so as EU states report to the Commission a maximum of 10% of the cases of state-aid, in comparison to 40% presently. It is considered that the new regulations allow investments in innovation clusters. In conformity to this Communicate, in the field of R&D&I, the number of state-aids reported has halved in 2014. Thus, in conformity to the Commission Regulation 2017/1084, dated 14th of June 2017, "under the Horizon 2020, projects can receive a Commission Seal of Excellence quality label. Such projects, given their limited aid amounts of maximum EUR 2.5 million per project and the

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fact that they are targeting exclusively SMEs, can be exempted from the notification requirement in accordance with the rules of Regulation (EU) No 651/2014”.

Tax incentives are considered as new development sources being applied in most countries, including those belonging to “innovation leaders” class, although in the world there are not unitary application schemes.^[4,5] Tax incentives aim actually at increasing R&D expenses of companies, as well as wages of researchers.^[6] In this respect, Montmartin, Herrera and Masard^[7] consider that “The French policy mix for R&D and innovation is one of the most generous and market-friendly systems in the world, particularly since the 2004–2008 reforms of French R&D tax credit”.

–other non-fiscal measures,^[8] such as the awarding of published papers.

Table 1 illustrates the types of eligible R&D expenditures in OECD and EU.^[9,10] Mont martin and Herrera^[11] assess internal and external effects of R&D subsidies and fiscal incentives.

The impact of the stimulating measures (incentives) has been demonstrated, beginning with the impact of R&D expenditure on the performances of the private companies and, implicitly, of the countries to stimulate knowledge creation,

in supporting innovation.^[12,13] An overview of the incentives is also presented by OECD in a Compendium published in January 2020^[14] as well as in Worldwide R&D Incentives Reference Guide, 2019.^[15] Among the aspects assessed, it is worth highlighting that incentives are factors that motivate publication.^[16]

Non-Fiscal Measures - Paper Awarding

Non-fiscal measures include article awarding that can be personal incentives and/or institutional incentives. As for the financing, the awarding sources can be Government or University funds. In South Africa, the government is stimulating the publication of papers by granting sums of money to the authors, to publishing purposes. The total sums granted fluctuated, but were around 120,000 South African Rands per paper, which today exceeds 7000 Euros. As a result, between 2000 and 2010, South Africa doubled the number of published papers.^[17] Nevertheless, there are opinions that publication incentives based on journal rankings disadvantage local publications.^[18] Kulkarni^[19] points out that China is ranked first in the world, Universities awarding about 43,000 USD, to the first author of an article published in the journal Nature. Quan, *et al.*^[20] show that “Chinese Universities offer cash rewards from 30 to 165,000 USD for papers published in journals indexed by Web of Science (WoS) and the average reward amount has been increasing for the past 10 years”. Between 2014 and 2018, the number of papers published by Chinese authors has increased from around 255,000 to over 406,000 (Figure 1).

Similarly, the number of papers classified by Essential Science Indicators (ESI-Clarivate Analytics) as Highly Cited Paper has increased. In conformity to ESI, Highly Cited Papers received enough citations to place them in the top 1% of an academic field based on a highly cited threshold for the field and

Table 1: Types of eligible R&D expenditures in OECD and EU.

	OECD	EU-28
Number of R&D tax incentive provisions	41	28
Number of countries	29	20
Current R-D expenditure		
R-D labour cost		
Wages and salaries of researchers and other R&D personnel	37	27
Subcontracted and collaborative R&D		
Payments for R&D services provided by consultants and other third parties	30	21
Payments for other services	12	12
Contributions to R&D carried out with 3rd parties (e.g. collaboration agreements)	25	16
Other current R&D expenditure		
Materials and other consumables	30	21
Overheads	20	13
Capital R-D expenditure		
Acquisition of plant and machinery used for R&D	19	15
Acquisition of software, licences and IP rights used for R-D	22	20
Acquisition of land and buildings used for R-D	14	11
Depreciation /amortisation of assets used for R-D	15	12

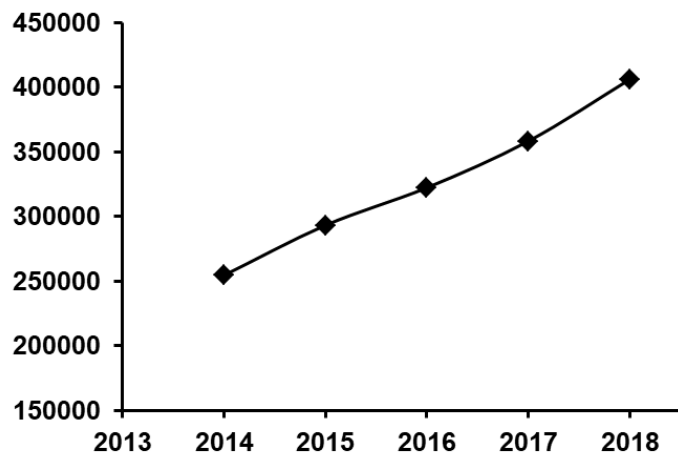


Figure 1: The evolution of the number of papers published by Chinese authors, indexed in Web of Science, Core Collection, Clarivate Analytics indexed journals.

publication year and Hot papers received enough citations to place them in the top 0.1% of papers of an academic field.

The Ministry of Science and Technology of South Korea, by the Korean initiative awards 3,000 USD to the first and corresponding author of papers published in prestigious journals. In Pakistan, a similar initiative introduced in 2002, awards the authors with 1,000 to 20,000 USD per paper, depending on the journal's impact.^[21]

Between 2000 and 2010, South Africa more than doubled its number of published papers, from 3,617 to 7,468 by bringing in the awarding for publication.^[17]

Saudi Arabia and Qatar award up to 13,700 USD for an article. Interestingly, articles published in journals with Impact Factors (IF) smaller than 1, are also awarded (approximately 820 USD). The Turkish Academic Network and Information Center (TUBITAK) has initiated since 1993 the Incentive Program for International Scientific Publications with the objective of promoting scientific publication. Within this program, financial incentives of more than 5 M USD in 2013 (3.5 M USD in 2012) are used according to the IF and to the cited half-life of a journal (defined as the median age of the citations a journal has received, during the Journal Citation Report year, or as the period of time for which the number of citations corresponds to 50% of the total citation number). For 2019, awards are comprised between 76 and 2,300 Euros, as a function of Article Influence Score (AIS), considered to ensure greater accuracy. After Australia and New Zealand, Norway, Belgium, Denmark and Italy implemented similar policies during the past decade for allocating a share of the budget for paper awarding.^[22] In India, alongside Government incentives^[23] the Universities grant financial incentives for published papers.^[24] Figure 2 presents the number of papers classified as Highly Cited Paper (%), calculated as percentage of the total number of articles published by Chinese authors, between 2014–2018.

Romania's Situation

In the absence of important investments in R&D, recently, in Romania three important incentives have been introduced:

- tax exemption on researcher's income;
- income tax exemption for employees performing software development activities (perform research and develop software) – 16% of employment income;
- profit tax exemption for the first 10 years of activity, for contributors who exclusively perform R&D&I activities.

This fiscal facility will be applied under the terms of observing the regulations regarding state-aid. According to the data provided by the Ministry of Finance, quoted by Romanian media, in 2015, 700 enterprises with Research-Development

activities have presented their balance sheet and paid 5.4 million Euros taxes. This sum will not be paid any longer in next 10 years, which results in significant savings for enterprises performing R&D activities. On the other hand, reports of financial auditing and consultancy firms mention that Romania offers a super deduction for eligible R&D expenditure, leading to a 8% net profit.^[25] As well, grants and other financing instruments with maximum assistance available to large enterprises – 50% of eligible costs- are also considered incentives. An output of scientific research is represented by the number of published papers (productivity), these, depending on their scientific quality, resulting in citations, that represent a recognition of the impact, alongside other bibliometric indicators such as the h-index. Bibliometric assessment is an instrument that sets out a type of classification. This classification can allow establishing the place of a country in the world, of a domain in the world, of an institution in the world, in a region or in a country, as well as the place of a researcher in the scientific community.^[26,27]

For increasing bibliometric performances of Romania, an awarding programme has been introduced in 2007, for those who publish in prestigious journals, indexed in Web of Science (WoS), ensuring a better visibility of Romanian science. We consider this programme as an incentive for performance increase. As we previously showed, the system of supporting publication also exists in other countries.^[28]

The importance of publication is evidenced by Julia Lane^[29] who shows that “The intense focus on publications as a way to measure scientific output has led to three suboptimal outcomes. First, researchers hoard knowledge in order to be the first to publish new findings. Second, institutional structures incentivize lower-risk, incremental research. And third, too many graduate students are produced who are then put into the academic holding tank of postdoctoral fellowships”.

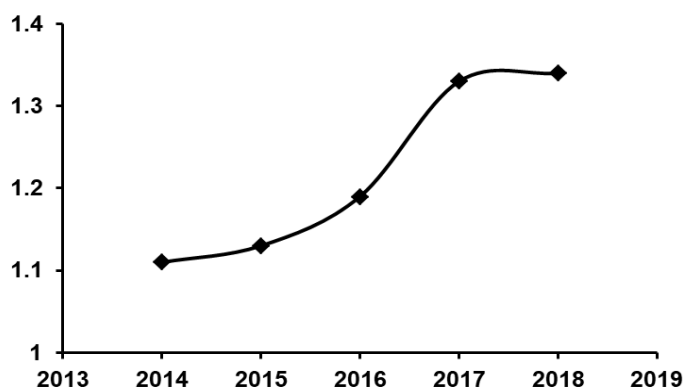


Figure 2: Percents of papers published by Chinese authors classified as Highly Cited Papers, as calculated from the total number of WoS Core Collection, Clarivate Analytics indexed papers.

In the same time, the bibliometric performances, including citations, represent important factors in recognized international classifications, such as Academic Rank of World Universities (Shanghai Ranking's), QS World Universities Ranking, Times Higher Education World University Rankings, etc. For these reasons the bibliometric indicators^[30] should be closely followed aiming at increasing the number of papers and the number of citations.^[31,32] For instance, in performance assessed through Shanghai Jiao Tong University Ranking, 20% represents the number of articles indexed in Science Citation Index - Expanded and Social Sciences Citation Index.

The Awarding Programme in Romania

The awarding programme has been introduced within the frame of the National Plan of R&D&I-2007-2013 and continues successfully within the frame of the next National Plans. It targets individual researchers or research teams that are authors of scientific papers published in WoS indexed journals. Subsequently, the awards have been granted as depending on the IF or the AIS. The journals possessing an IF or an AIS > 0 are ranked (by Executive Agency for Higher Education, Research, Development and Innovation Funding) in decreasing order, for each WoS domain. The papers published in the first 25% (quarter) of classified journals are awarded a greater sum and those published in next 25% (second quarter) are awarded a smaller sum.

The eligibility criteria are:

The paper should mention the affiliation of the author/authors to a Higher Education or Research institution in Romania;

Papers that can be found in the WoS in the first or second quarter of the classification are awarded, for publication during the progress period of the programme;

The award is granted once for a published paper. The sums granted for awarding had different amounts along the years (2007-2018);

An excellence award is granted for each paper published in the journals Science or Nature and an award for each paper published in a journal classified as first in the WoS domain;

For the journals belonging to more than one domain, the more favourable alternative is to be considered. The same thing is valid for the journals fundable in more Indexes of Journal of Citation Reports (AHI, SSCI, SCI).

RESULTS AND DISCUSSION

In Romania, according to the law, the Government promotes, sustains, develops and stimulates the activity of Research-Development of national interest and among others, to achieve this aim, it adopts policies of stimulation and coordination at

national scale, of the Research-Development and Innovation activity." Nevertheless, the budget allocation of the Research and Development system are very modest, rarely exceeding 0.5% of GDP. The amount of the investment is also reflected in the innovation performance Romania being classified in the category "modest innovators".^[33] The annual Innovation Union Scoreboard provides a comparative assessment of the Research and Innovation performance of the EU Member. The scoreboard captures a total of 25 different indicators, which encompass the external conditions for innovation, the level of firms' own innovation activity and how this translates into benefits for the whole economy. Some of the indicators also include bibliometric performances. Thus, the indicator "New doctorate graduates per 1000 population aged 25-34" is linked to publication, Romania recording a decrease since 2011. The indicator "International scientific co-publications per million population" represents a proxy for the quality of scientific research, as collaboration increases scientific productivity. The indicator "Scientific publications among the top-10% most cited publications worldwide as percentage of total scientific publications of the country" is a measure for the efficiency of the research system, as highly cited publications are assumed to be of higher quality and for Romania performance has increased. From the bibliometric standpoint, Romania is characterized by increases in time, according to the data presented in Figures 3-6.

The number of awarded papers and amounts granted from 2007 till 2018, in Romania, are presented in Figures 7 and 8.

Even though the number of WoS-indexed papers has significantly increased, the number of indexations in the field of Chemistry for papers authored by Romanian researchers has constantly diminished, between 2000 and 2018. For each publication year, the articles, proceeding papers, meeting abstracts, reviews, have been added up for the following fields of Clarivate Analytics WoS Core Collection: Chemistry Multidisciplinary, Materials Science Multidisciplinary, Engineering Chemical, Chemistry Physical, Chemistry Analytical, Chemistry Inorganic, Chemistry Organic,

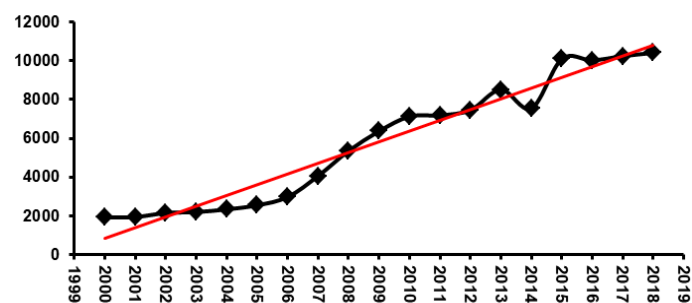


Figure 3: The number of articles published by Romanian authors in WoS Core Collection, Clarivate Analytics indexed journals.

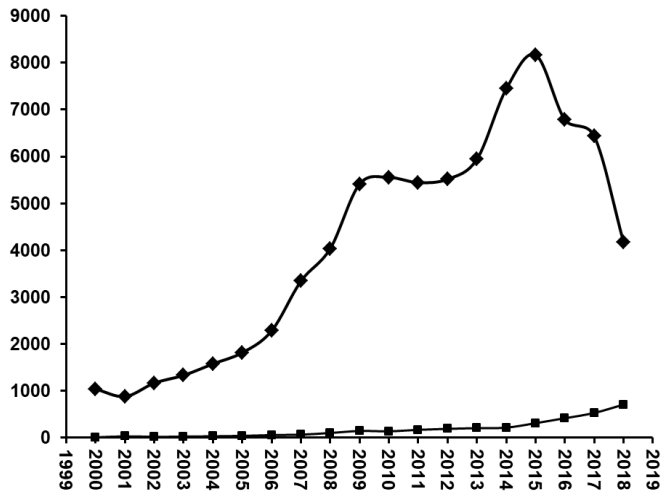


Figure 4: The number of proceedings papers (▲) and review papers (■) published by Romanian authors in WoS Core Collection, Clarivate Analytics indexed journals.

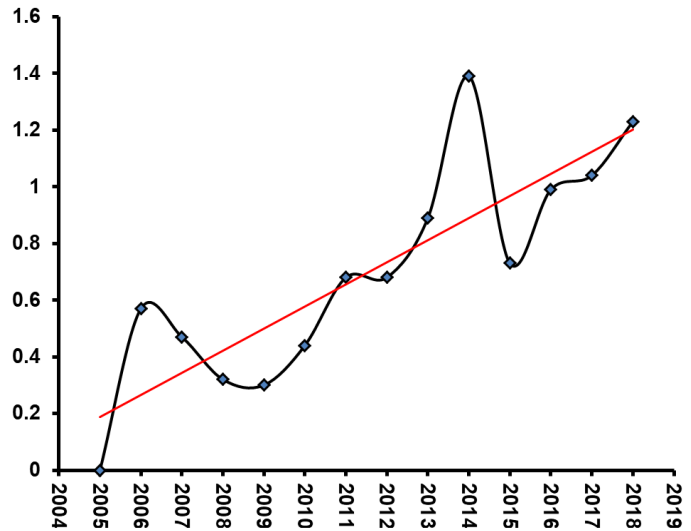


Figure 6: Percents of papers classified as Highly Cited Papers, as calculated from the total number of WoS Core Collection Clarivate Analytics indexed papers, published by Romanian authors.

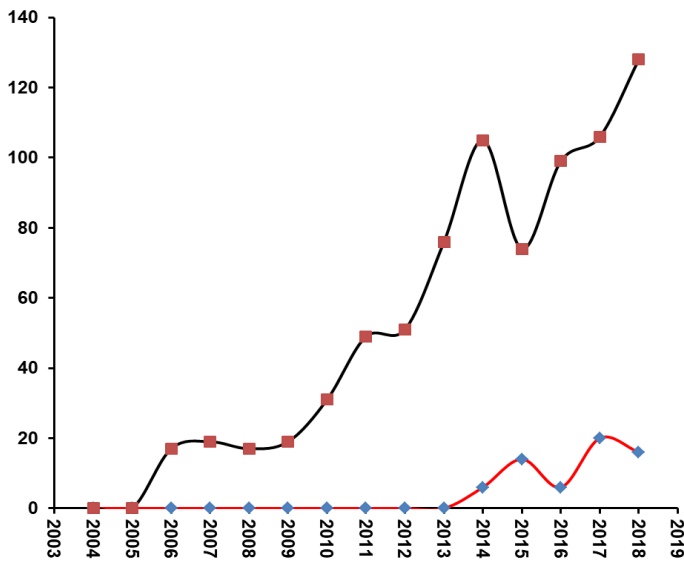


Figure 5: The number of papers published by Romanian authors and classified as Highly Cited Papers (■) and Hot Papers (♦) by Essential Science Indicators, Clarivate Analytics.

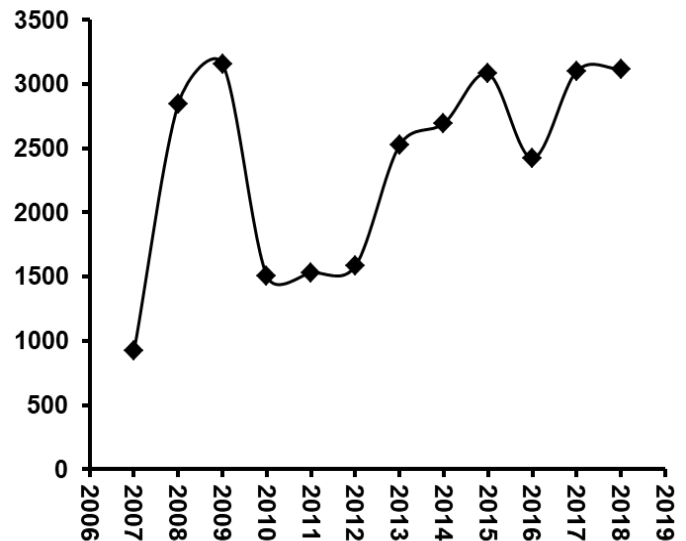


Figure 7: The number of awarded papers published by Romanian authors.

Chemistry Applied, Chemistry Medicinal, Polymer Science, Electrochemistry, Thermodynamics, Biochemistry Molecular Biology, Chemistry Inorganic Nuclear, Biochemical Research Methods, Material Science Composites. The number of papers approaching Chemistry topics has been calculated, as percentage of the total number of papers. The results are presented in Figure 9.

To evidenciate the bibliometric performances in Economics, we added up the papers indexed in WoS, yearly, for the categories General Economics, Management, Business, Business Finance and Agricultural Economic Policy. The results are presented in Figure 10. In Figure 11, the percent of WoS indexed papers (field Economics), calculated as percent

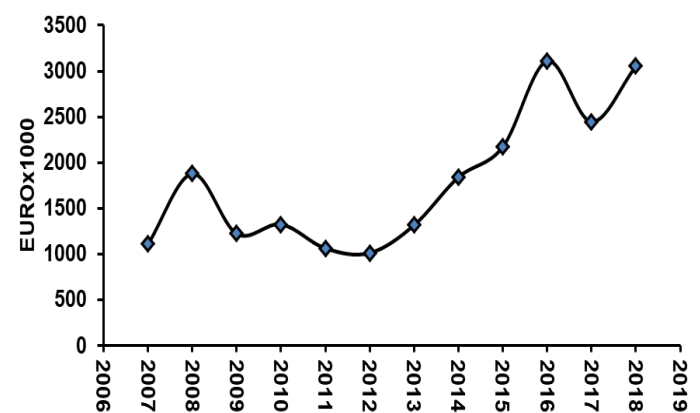


Figure 8: Annual budgets granted for awarding papers published by Romanian authors.

from the total number of Romania's WoS indexations (reviews and proceeding papers) is presented.

The annual bibliometric results in the field of Agronomy were also investigated. Articles from Clarivate Analytics fields

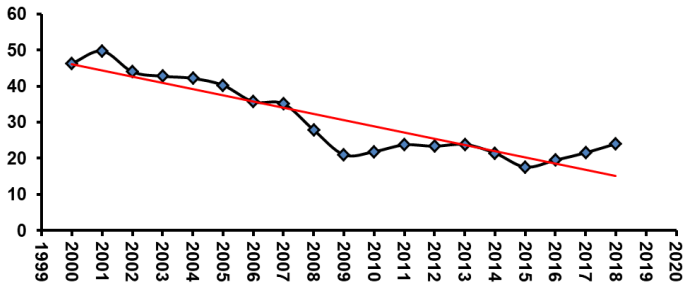


Figure 9: The percent of articles (field Chemistry), calculated from the total number of papers published yearly by Romanian authors and indexed in WoS Core Collection, Clarivate Analytics.

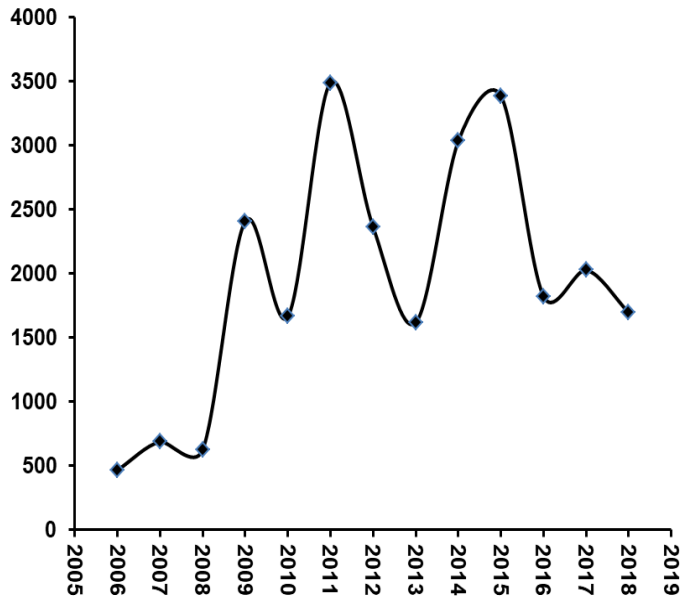


Figure 10: The number papers (field Economics) published by Romanian authors.

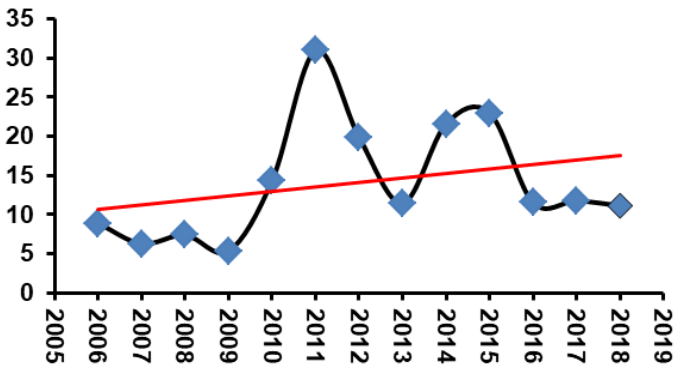


Figure 11: The percent of articles (field Economics), calculated from the total number of papers published yearly by Romanian authors and indexed in WoS Core Collection, Clarivate Analytics.

Agricultural Economic Policy, Agronomy, Horticulture, Plant Sciences, but also articles from related fields such as Biology, Biochemistry, Developmental Biology, Environmental Sciences, etc. were added up. The results are shown in Figure 12. Figure 13 presents the percent of articles (field Agronomy), calculated from the total number of papers published each year, by Romanian authors.

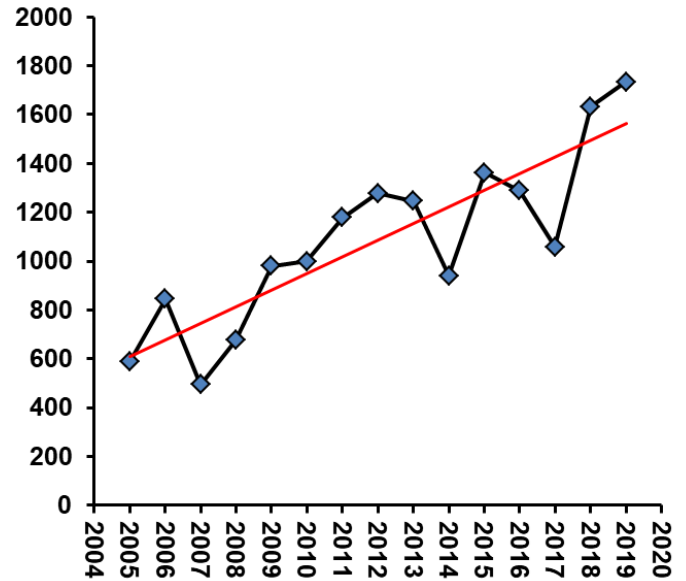


Figure 12: The number papers in Agronomy-related fields, as published by Romanian authors, indexed in WoS Core Collection, Clarivate Analytics.

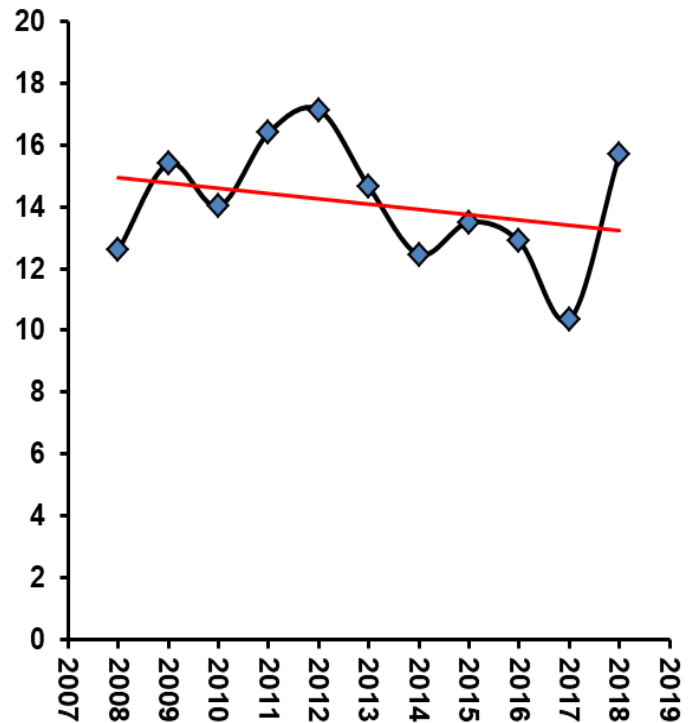


Figure 13: The percent of articles (Agronomy-related fields), calculated from the total number of papers published yearly by Romanian authors and indexed in WoS, Core Collection, Clarivate Analytics.

The results of article awarding for 2019 are not presented, because the situation for this year is not finalized yet. Thus, the competition was closed on November 30, 2019. The articles visible in WoS after this date were to be awarded in 2020, but the competition has not opened so far (01.09.2020).

CONCLUSION

For the assessment performed in this paper, only the WoS indexed papers (articles and review papers) were considered.

From the data presented in Figure 3, a relatively constant bibliometric performance till 2006 can be observed, as total number of papers published by authors affiliated to Romanian institutions. No visible increasing trend can be noticed till 2006. Starting with 2007, along with the implementation of the awarding programme, a constant increase of the number of papers can be observed. From this trend, it can be inferred that the awarding programme is largely responsible for increasing bibliometric performances. The trend followed is an increasing one for articles, so is the case of review papers (Figure 4). For proceedings papers (that are not awarded), a decrease in number was recorded after 2015. The increase of the bibliometric production entails the increase of the number of Highly Cited Papers and Hot Papers (Figure 5), as well as of the percent of Highly Cited Papers, calculated from the total number of papers (Figure 6). The percentage increase of Highly Cited Papers, as calculated from the total number of papers published in WoS indexed journals, though relatively small, is constant, reaching an average of 1%.

The data that present the increase of the paper production are also confirmed by the expenses on paper awarding, these following an increasing trend in time, but with certain fluctuations. The trend of increase of Romania's bibliometric performances is consistent with the incentives, but this increase is largely improvable. Even considering all these increases of Romania's bibliometric performances in the field of Chemistry, the global performances resulted by summing the performances of all Chemistry subdomains, have not registered an increasing trend, in conformity to the data presented in Figure 9, a small improvement being recorded after 2016. The diminution is determined by a series of factors, from the organization and financing of Higher Education, to the labor market. Thus, between 2007-2017, the number of employees in the field of Chemistry (including specialists) of the main companies decreased from 12,000 to 5,800. For this reason, in the field of Chemistry-Metallurgy there was a decrease in time of the applications for patents.

In fields of Economics indexed in WoS (General Economics, Management, Business, Business Finance and Agricultural Economic Policy), we observe notable fluctuations of bibliometric performances, but the trendline is characterized

by a slightly increasing slope, 2011 being the most performing year, with 35% of Romania's total number of WoS indexed papers.

The performances in Agronomy - related fields are following an increasing trend over time, as shown in Figure 12 and Figure 13.

Despite all the annual fluctuations, the trend followed and proved by the data presented in Figure 13, is to maintain the contribution of this domain at a constant level of about 16% of the total number of articles.

To perform the analysis, three broad and significant fields (Chemistry, Economics and Agronomy) have been chosen in this paper, to representatively depict two distinct trends that are followed: a decreasing and an increasing trend of bibliometric performances.

The budget fluctuations (Figure 8) are due to changes in the sums corresponding to the awards, as well as in the requirements for awarding: as depending only on the journal IF; as depending only on the journal AIS; as depending on the most favorable classification/position (by IF or AIS). According to our assessment and to the presented data, the awarding programme represented and still represents a useful tool for enhancing performance, with obvious results.

Moreover, it is necessary to keep, after so many years of experience, a constance of the requirements for awarding. It is therefore recommended that, depending on the available funds, the Universities and other Research Institutions introduce awarding as incentive for increasing individual and institutional bibliometric performances. In the same time, only the awarding programmer does not constitute the saving solution. In the absence of sufficient financing of the R&D system, in the absence of a great number of financed projects resulting from competitions with significant success rate (of at least 30%), the system cannot progress.

An increasing number of R&D financed projects will necessarily lead to the enhancement of national bibliometric performances, the WoS Clarivate Analytics indexed papers representing performance indicators reported. It is worth being noted that many countries apply incentives for the R&D system, aiming mainly at increasing performances including by publishing research outputs and that the programs of awarding papers published in prestigious journals constitute a success contributing to enhancing national, institutional and personal bibliometric performances.

Referring to Highly Cited Papers and Hot Papers is important, as they can lead to a thorough understanding of individual scientific carriers, including potential applications to Nobel Prize.^[34,35]

The increase of Highly Cited Papers percent, as calculated from the total number of papers published in WoS indexed journals (Figure 6), although relatively small, is constant, reaching an average of 1%. This average value is comparable to that of Czech Republic (0.94% in the last three years), but smaller than that of Bulgaria (1.61% in the last three year) and Hungary (1.88% in the last three years). The United States have reached an average of 1.60% in the last three years.

In conformity to the data provided by Clarivate Analytics in 2019, among 47 million articles indexed since 1970, only 4900 (representing 0.01%) have received 2000 citations or more.^[34] Hence, in this very small group, the potential Nobel laureates can be found. It has been shown that Nobel laureates are chosen among the authors receiving most citations, an existing correlation being proved between high citation rates and prizes. Highly cited scientific articles are linked to outstanding discoveries and advances, generally rewarded by Nobel committees.

CONFLICT OF INTEREST

The authors declare no conflict of interest

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