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Equity in Academic Publishing: the Impact of Socioeconomic Background on Open Science Within Europe

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Abstract. Nowadays, everything is related to the economic power of a country. But what is the relevance with Open Science? The aim of this research is to find out whether there is an impact of the socio-economic background on open science, and specifically to the number of publications that are produced every year. In order to find out which is the relevance, we performed research dedicated to two countries in a completely different rank in the GDP (Gross Domestic Product) for the last three decades and compared our results graphically. We came to the conclusion that indeed the impact of the socio-economy is huge, but this is not the only factor that influences the publications' productions.

Keywords: socio-economic background, GDP, publications' production

1. Introduction

It is undeniable that the evolution of science is uneven depending on the geographical location in which we are located. It is not only a matter of advancement in a particular subject, but also a matter of multiple factors, be they economic, social, or even political. We are no longer talking only about differences in the amount of research, the above factors can affect the type and categories of studies that are carried out.

Derived from traditional publishing, new terms have been coined, of particular interest being the so-called '*colonization of information*' [1].

During the last decades, the emergence of the Internet has made it increasingly possible to bring the latest scientific discoveries closer to any part of the world, thus giving rise to a *globalization* or *democratization* of information [1].

1.1 Open Science, Open Data, Open Access

Open science constitutes a new concept in the scientific process, relying on collaborative work and innovative ways of spreading knowledge with the use of digital technologies and new collaborative tools. [2] The elements which shape open science are: open methodology, open source, open data (OD), open access (OA), open peer review, and open educational resources. Particularly for the library and information field, the emphasis is most commonly placed on: Open research data and open access to scientific publications. [3]

The definition of open access is: *the practice of having the ability to have access through the internet to scientific information without being charged and to also to have the ability to reuse it*. By providing the research results and making them available to anyone, the science community, public, and profit industries can profit greatly. [4]

When referring to open data, we mean data that can be published and accessed without being charged or having authorization obstacles. However, nowadays, even if the scientists consider the data that have been published as part of the scientific community, a lot of publishers stick to the idea of copyrights over data and demand permission in order to reuse the data. [5]

1.2 The impact of socio-economic backgrounds on open science.

The aim of this work is to study the impact that geographic location can have on the number and characteristics of open access scientific publications. In addition, it is studied whether this globalization of information is reflected in publication trends.

For this purpose, two European countries with different levels of wealth have been selected to get a first idea of how these factors may have affected the number of publications in the last few years.

Specifically, the study will take into account publications from the last three decades for greater temporal relevance, i.e., publications from 1990 to the current year, 2021.

As mentioned, wealth has been taken into account for the selection of two European countries, based on Gross Domestic Product (GDP).

In addition, we wanted to study the progress in the discipline of astrophysics, due to the fact that we are looking for the study of a subject not related to the professions of first necessity, since it is more common to find publications of this nature.

2. Research methodology

In order to answer our hypothesis, we imported data from Scopus, a multidisciplinary bibliographical database. This database provides a lot of information about publications such as articles, papers, references etc., as well as useful information that can help us assess and measure scientific output. Consequently, it appeared to be a simple and clear tool for us to:

- Create a new database with the target information from the filtered Scopus platform.
- Make quantitative comparisons between the number of publications in the countries of interest.
- Visualization of results, to make comparisons in progression trends and draw conclusions.

2.1 Target selection.

In this work, before we turned to Scopus, we took into account the wealth of each country in Europe based on nominal GDP. After studying their ranking, we decided to choose one country with a high nominal GDP and one who was lower in the rank. As a result, we selected Germany, the country with the highest nominal GDP in Europe and the second highest in the world. On the other hand, the Czech Republic has been chosen as it is usually ranked around 20th place in this index, depending on the year. Despite this difference in the ranking, it should be noted that both countries are considered high income countries, although in the case of the Czech Republic this denomination is quite recent, according to the World Bank (Fig. 1).

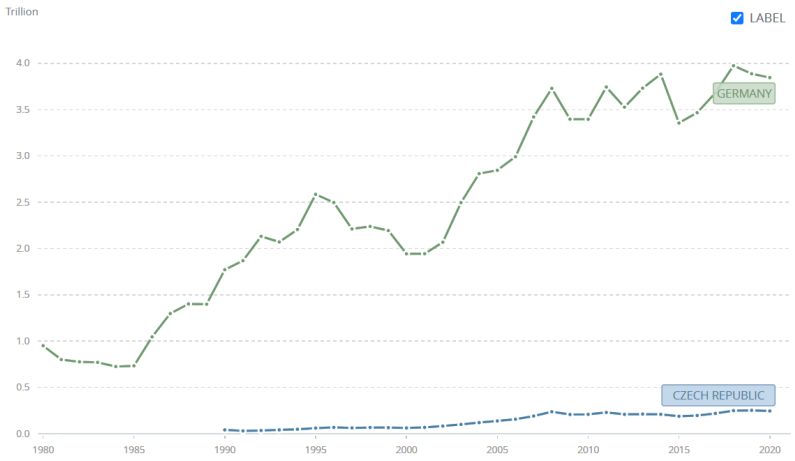

Figure 1. GDP (current US$) - Germany, Czech Republic

We specified our research in the area of Physics and specifically in the field of Astrophysics so as to limit our boundaries as Physics has a lot of branches.

2.2 Filtering information through the Scopus platform.

Having the previous structure in our mind, we executed it in Scopus using the following words in the search:

("Astrophysics") AND (LIMIT-TO(AFFILCOUNTRY,"Germany") OR LIMIT-TO (AFFILCOUNTRY,"CzechRepublic")).

This implies that the filter being applied will return the results of publications associated with the topic 'Astrophysics', in which there is an author affiliated with the countries 'Germany' or 'Czech Republic'.

By conducting the search, a number of publications appeared. In particular 85.873 of publications resulted for Germany, and 8.110 for Czech Republic. Following this, we decided to take the last 3 decades, from 1990 till 2021, into consideration as a timeline in order to have a wide range during the passage of time which could be then analyzed graphically by the tools of Scopus. We ended up with 84.157 publications for Germany and 8.054 for Czech Republic. By taking these data, not only was it possible for us to compare the number of publications between these two countries and define the importance of the wealth factor (according to GDP) to them, but also study the variance of publications during the passage of time and indicate some factors (like big statements) that have led to it.

3. Results

In accordance with the previous process followed, we got the results that are being presented next. In order to better compare trends, data visualization has been used to make progressions over time easier to analyze.

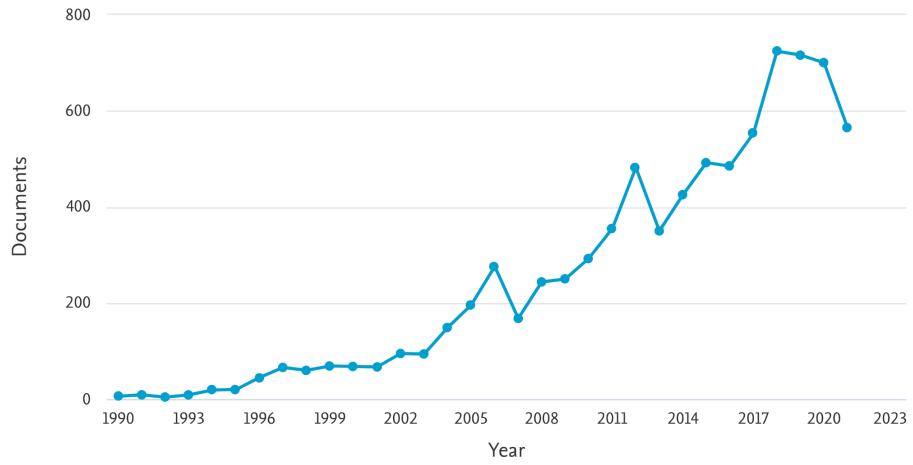

Figure 2. Trend in the number of publications on astrophysics in Czech Republic, during the last three decades.

Figures 2 and 3 represent the number of publications in the Czech Republic and Germany, respectively. The data obtained correspond to the last three decades and it can be seen that, in both cases, the trend is increasing. Despite having similar trends, the beginning of this growth occurs at different times, since in Germany the number of publications begins to increase significantly from 1996 onwards, while in the Czech Republic this happens in 2004, almost a decade later.

The graphs should be contextualized in the political circumstances of the countries prior to these dates:

- In Germany, 1995 is the year in which many authors mark the end of the country's economic reconstruction after the three decades of dictatorial rule (1933-1989) and the withdrawal of Soviet forces from East Germany in 1994.

- In 1993 the dissolution of Czechoslovakia took place and the Czech Republic was formed, after the departure of the communist party from the government in 1989 in the so-called Velvet Revolution. During these years, measures for the economic incorporation into the European framework were implemented, but it was not until 2004 that the Czech Republic entered the European Union.

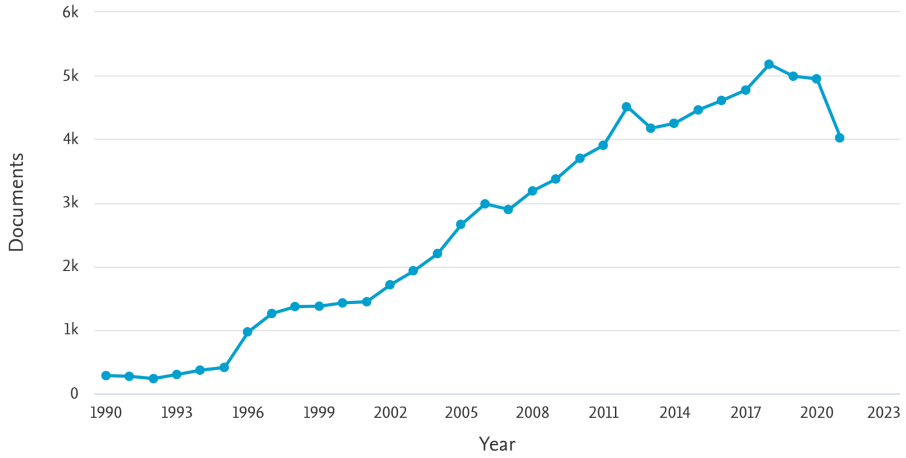

Figure 3. Trend in the number of publications on astrophysics in Germany, during the last three decades.

It is of great relevance to mention the range of values in which the number of publications in each of the two countries moves. While in the Czech Republic the average number of publications per year is at 260, in Germany the average number of publications increases to 2715.

Furthermore, it is worth noting that in both countries, although it is even more noticeable in the Czech Republic (Fig. 2), there are three years in which the number of publications shoots up, standing out from the rest. This happened in 2006, 2012 and 2018, which is due to three major milestones in the history of astrophysics in the last century.

In 2006, Pluto came to be recognized as a minor-planet at the General Assembly of the International Astronomical Union (IAU) held in Prague, Czech Republic, that year [6].

Later, in 2012, graphical evidence for the existence of black holes was published for the first time, records of images of a supermassive black hole 2.7 million light-years away swallowing a red giant were achieved. Also that same year, the deepest optical view of space to date was obtained; in addition to obtaining the most detailed image of the early Universe also known as the first existing light.

Finally, on November 5th 2018 the Voyager 2, travelling in a different direction from Voyager 1, left the solar system, becoming the first interstellar probe [7].The Voyager interstellar mission has the capability of collecting valuable interplanetary, and eventually interstellar, scientific data on fields, particles and waves until about 2025. In 2025, the spacecraft's ability to generate sufficient electricity to keep the science instruments running will expire. [8]

Lastly, both graphs (Fig. 2 and 3) show a clear decrease in the number of publications in the last year. We have assumed that this is due to the health emergency situation in which we find ourselves since the end of 2019, which may have slowed down or even paralyzed the research that was being carried out.

Conclusions

Taking everything into consideration, we can say that the socio-economic background plays a massive role in the publication production. However, that is not the only factor that determines this scientific spread, especially in the field of Astrophysics. We saw that various phenomena, like a pandemic can easily reduce the export of publications (as was noticed a decrease in both countries of our interest, when Covid-19 first appeared). Moreover, we should take into account that we are comparing two countries with a different size and different amount of population (83.24 million people for Germany and 10.7 millions for Czech Republic), which gives a logical meaning to that difference that occured.

In conclusion, when analyzing trends, it must always be taken into account that there are many factors that can affect the facts we see in the data, there is no analysis without contextualization. The situation in a country will undoubtedly affect the research being done in that country, but thanks to globalization there are likely to be trends in common. As seen, big scientific announcements can bring the top down and reach to the peak the number of publications. It seems that, when it comes to science and big “revolutions” , there are no discriminations and all scientists get triggered and try to contribute to any possible extent.

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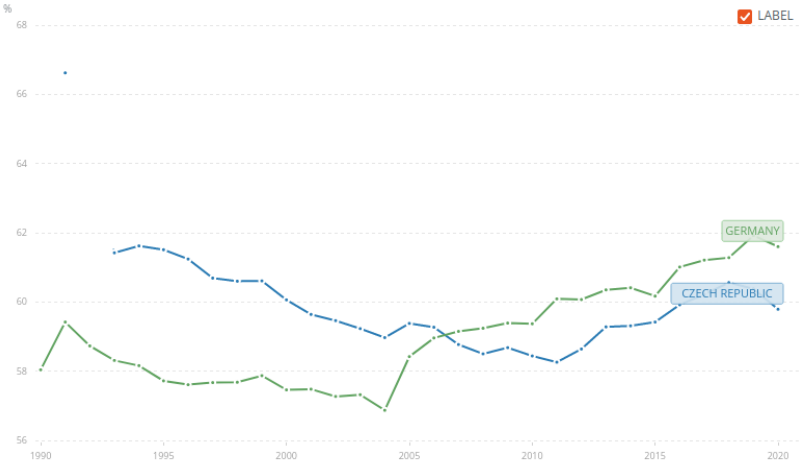
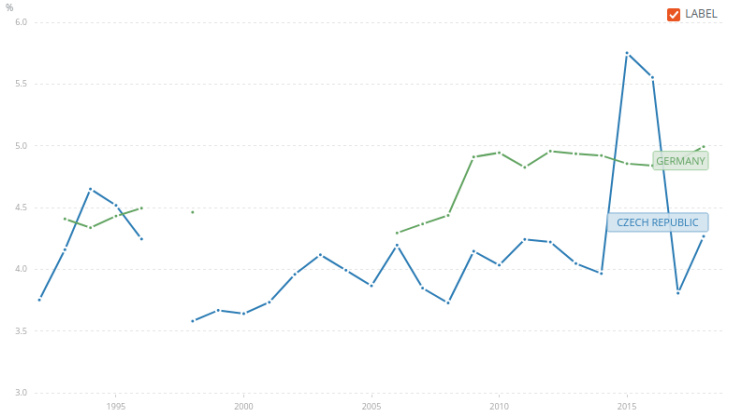
Appendix

This appendix includes other social and economic metrics with which we have tried to explain the trends obtained in our study but which we have found to have no apparent influence on them.



1.1 Labour force participation rate, total (%of total population ages 15+)



1.2 Government expenditure on education (% on GDP)