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The Relationship between S&T Development and (Social) Science Productivity in Europe

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ABSTRACT This article analyses on a comparative basis, the relationship between S&T development and (social) science productivity in the EU countries.

The results reveal that Germany, Netherlands, France and United Kingdom are no longer the leaders in the development of S&T, and the top positions have been taken by Northern European countries namely Finland, Denmark and Sweden. These results could give rise to the reshaping of European leadership in economic and social development, if Germany, France and the United Kingdom do not reverse their S&T investment trends of the past 20 years. The data not only indicate a change in the leading countries, but also the alteration of the positions of other countries in the European Space for Science. With the exception of Greece, Southern European countries have made considerable advances as have Czech Republic and Slovenia.

As for (social) science productivity, it has been shown that the countries that are at the top of the S&T hierarchy are not necessarily those that publish most papers in WoS/JCR journals, but rather the contrary. This led to the conclusion that other indicators should be taken in consideration to analyse science productivity, including the orientation of academic reforms and the new models of universities governance. Science productivity is one of the tools used to implement this governance model which tends to manage all disciplines in the same way. Journal data bases are part of this new management and have a decisive role in the stratification of the European and global Science Space.

Key words: S&T development in European countries, S&T Index, stratification in European S&T, social science productivity

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1. Introduction

In an article published in Nature magazine, R. May (1997) concluded that the top seven science producing countries were the world's largest economies. The USA led with 35% of publications in the field of science, followed by the United Kingdom; the EU15 together had an output close to that of the USA (32%). David King (2004) subsequently updated and furthered this work for the period 1993-2002 and essentially reached the same conclusions.

This is the point of departure of this article. Assuming the theoretical principle that the higher the level of a country's scientific development, the greater its productivity in science, our analysis focuses on the European Union. We analyse the relationship between the development of Science and Technology (S&T) and scientific productivity in science generally and social sciences in particular, as measured by the number of articles published in each country.

This focus on the EU is due primarily to the fact that the strategy and goals specified for the development of Europe (Lisbon Strategy, 2006; EU 2020) rely heavily on the furthering of science for the construction of a *knowledge society*, supported by science-based economic activities. Moreover, the European science space is highly segmented (Oliveira & Carvalho, 2009), and a hierarchy is formed between the more developed and less developed EU countries. On the other hand, the European science policies implemented in the last two decades involve a set of measures aimed not only at major scientific development for Europe but also the integration of lesser developed countries. In this framework, we propose a hypothesis that the impact of these measures has changed the stratification pattern of the European science space (Cole, J. & Cole, S., 1981). On other hand the productivity of European science must accompany the increase in S&T investment if those objectives are to be achieved, a matter that we will analyse later.

The article is divided into two parts. In the first part we study the evolution of S&T in the European countries in the last 20 years and describe the structure of the European S&T space (ESTS), locating each country within the different strata. The second part examines how the number of articles published in "all sciences" and also in the "social sciences" is associated to the hierarchical position of countries within the European S&T space.

Social sciences are included as a specific field in our analysis as these are fundamental activities in the new development model of *knowledge societies* (Reich, 1992).

2. Method

2.1. Indicatores

Two indicators are used to analyse the structure of the European S&T space: gross domestic expenditure on research and development (GERD) which is a percentage of Gross Domestic Product (GDP), and total researchers per thousand in the labour force. OECD data from 1987, 1997 and 2007 (OECD Stat, 2010) is used.

The following two indicators are selected for science productivity: the number of articles in all science fields and the number of articles in social sciences, using ESI data base (2007)[1] from the Institute of Scientific Information (ISI).

2.2. Data analysis

An analysis was made of the association between GERD and total researchers per thousand labour force, as well as the evolution of the GERD in the last twenty years for EU 15 countries[2].

Different multivariate methods were used to determine and describe the stratification of the European S&T space and the place of each country in those strata. The EU 27 countries[3] were mapped according to the association between two indicators (variables): gross domestic expenditure on research and development (GERD) and total researchers per thousand labour force using a Principal Components Analysis for Categorical Data (CatPCA). This allows variables and objects (countries) to be visualised simultaneously (Van de Geer, 1993a; Van de Geer, 1993b; Gifi 1996; Meulman et al., 2004) and thus generates a graphical display of the European S&T space. This was followed by a clustering analysis using a hierarchical algorithm (Hair et al., 2007), in order to group the countries according S&T stratification.

Science productivity based on the number of articles in "all fields" and in "social sciences", per country, was assessed by relating the two indicators with the previously identified strata. CatPCA was again required to map the EU countries taking into account the association between S&T indicators and science productivity.

3. Results

3.1. S&T development

A comparison between the EU and countries in other regions reveals some unexpected results (Table 1). While the GERD increased in every country in the last

[1] ESI (Essential Science Indicators) is based on journal article publication counts and citation data from Thomson Scientific Databases, including Science Citation Index, Social Sciences Citation Index and Arts & Humanities Citation Index. This data base is currently known under the commercial name of WoS (Web of Science).
[2] There was no available data for the Eastern European countries for this period.
[3] The reference year was 2007 to manage stratification of European S&T space, so all of the EU countries were included.

decade, the figure for the USA was lower in 2007 than twenty years ago. Israel has the highest percentage of GERD (almost 5%), followed by Japan and Korea. Although China has the lowest percentage, it has more than doubled in the last 10 years. EU is not far behind China but has increased only 0.11% in the last 10 years.

Over the past 20 years, the EU's investment in S&T has risen slightly (from an average of 1.66% in 1997 to 1.77% in 2007, Table 1). The European average is lower than those of the majority of countries considered – with the exception of China – and lower than the OECD average. The target set by the European Strategy for 2020 (EU 2020) is to reach 3% of GDP in 2020.

Table 1
GERD as a percentage of GDP in the last 20 years

	1987	1997	2007
USA	2.70	2.57	2.66
Japan	2.81	2.87	3.44
Korea	–	2.38	3.21
China	–	0.65	1.44
Canada	1.41	1.66	1.90
Israel	–	3.00	4.76
EU 27 average		1.66	1.77
OECD average	2.22	2.10	2.28

Source: Own calculations from OECD, 1987, 1997, 2007.

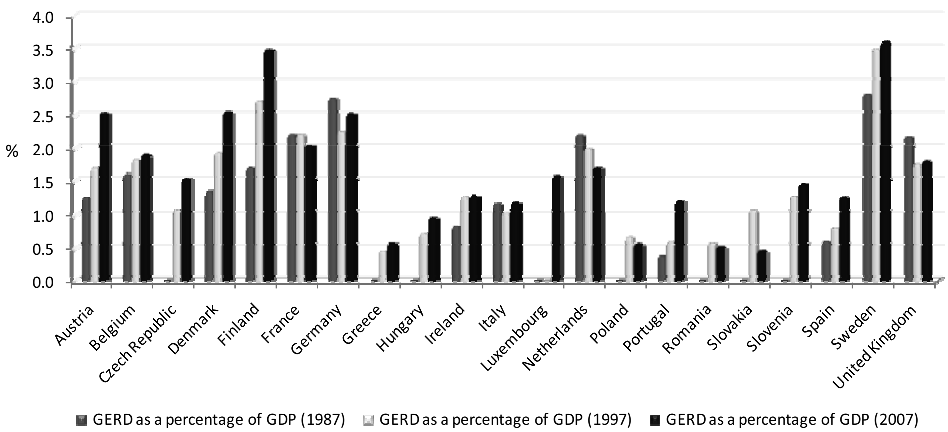
Europe's weakness in this area of fundamental importance to a new development model and the construction of a knowledge society may in part be explained by the membership of Southern and Eastern European countries following European Union enlargement (1997). The figures for most of these countries are lower than for the EU15 countries in general and this has had an impact on overall investment.

While most European countries increased their investment in R&D in the last twenty years (1987-2007) (Figure 1), in some exceptional cases this investment actually declined: France, United Kingdom, Germany and Netherlands.

It is surprising to note that this happened in the most developed countries. This evolution in S&T investment in European countries led to striking changes in their relative position in the European S&T space (ESTS) (Figure 2). Sweden, Germany, Netherlands, United Kingdom and France had the most developed S&T systems in

Europe in 1987, forming the highest strata; however, Sweden is the only country to retain this status and reached its highest level in 2007 (Figure 2).

Figure 1
The evolution of GERD per country in Europe (1987-2007)



Source: Own calculations from OECD, 1987, 1997, 2007.

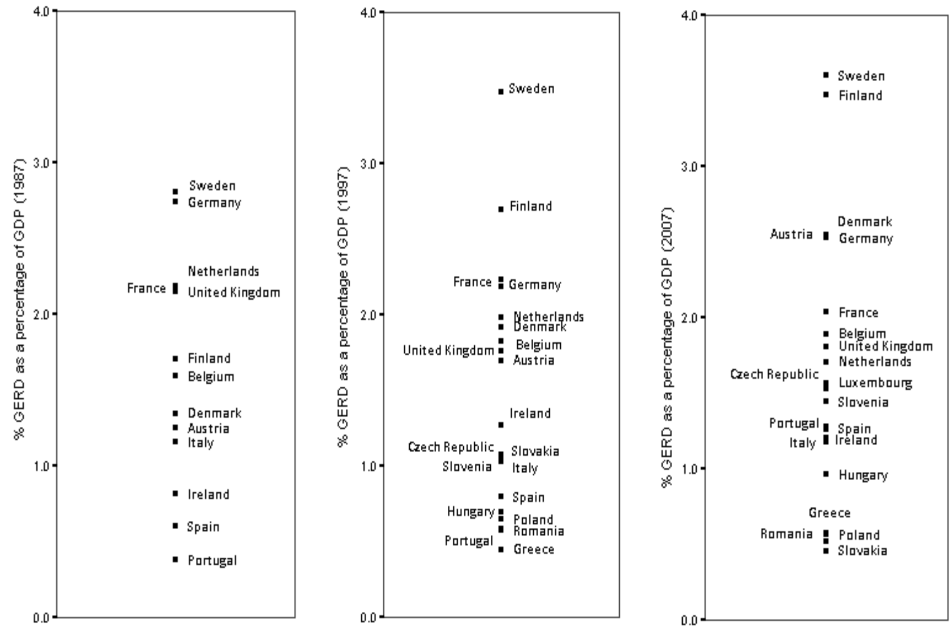
Germany's investment in S&T fell significantly in the 1990s; although this was accompanied by a lower ranking in the hierarchy of European countries, the country recovered its position in the following decade. The United Kingdom followed this downward trend and maintained its relative position in 2007, showing only a small recovery. As a result of the decline in investment in S&T for two successive decades, the Netherlands lost its position in the stratum of scientifically developed countries, moving closer to some of the weakest countries in Europe (excluding Eastern countries): Ireland, Spain, Portugal and Italy. Southern Europe countries, namely Spain and Portugal, made a remarkable investment effort during this 20 year period; despite doubling their investment they maintained their relative position between 1987 and 1997 if Eastern countries are excluded. S&T investment in the latter countries improved between 1997 and 2007. Romania, Poland and Greece remained at the lowest level, now joined by Slovakia.

Mention must be made of the extremely favourable position achieved by the Czech Republic and Slovenia in the last decade under analysis.

France's position remained almost unchanged in the 1980s and 1990s, but then decreased in the following decade and showed signs of decline.

Special note must be made of the outstanding rise in Finland and of Sweden's growing investment in S&T; this enabled them to remain in the lead, ahead of all European countries under analysis. Denmark is another case of marked upward mobility – with a sharp rise in two successive decades. Austria's position also improved considerably.

Figure 2
Hierarchy of European countries according to gross domestic expenditure on research and development (GERD) 1987-2007



Source: Own calculations from OECD, 1987, 1997, 2007.

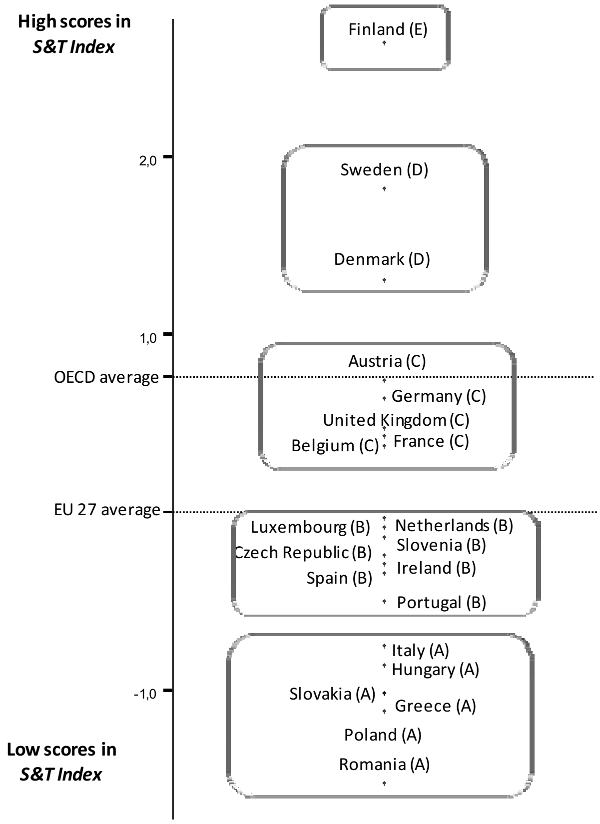
In the three decades analysed, there is a strong and positive correlation between the gross domestic expenditure on research and development (GERD) and total researchers per thousand labour force (R=0.971 in 1987, R=0.912 in 1997 and R=0.892 in 2007) which means that an increase in S&T systems is strongly associated with higher levels of employment in S&T across the three decades. Using this conclusion, an Index of S&T was defined for 2007 with a higher Cronbach alpha's coefficient (alpha = 0.942). This reliability index permitted the European stratification of the S&T space using a non-linear principal components analysis (CatPCA).

Figure 3 displays the hierarchy of the European countries in accordance with the S&T index[4]. The clear difference between the development of S&T systems leads to the conclusion that European S&T space is stratified. A Hierarchical Cluster Analysis grouping countries led to the definition of five strata. We thus redrew the strata, linking the countries to their cluster (Figure 3).

[4] Note that the index figures are standardized.

Denmark, Sweden and Finland were at the top of the S&T Index (both in terms of GERD and number of researchers) in 2007. Finland held first place in the ranking with sustained growth for at least 20 years.

Figure 3
Hierarchy of European countries according to S&T Index

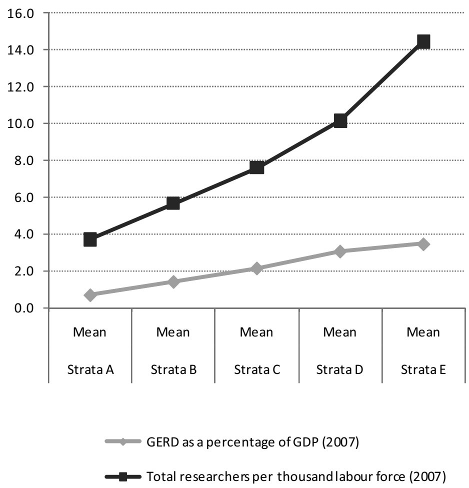


Source: Own calculations from OECD 2007.

A "middle R&D strata" was also higher than the EU average and included Belgium, France, United Kingdom, Germany and Austria. Two more strata are in lower positions and comprise Eastern and Southern European countries together with Netherlands, Luxemburg and Ireland.

Figure 4 shows the average of S&T measures (GERD and total researchers per thousand labour force) per strata. As expected, their profiles can be ranked. Strata A includes East and Southern countries and has the lowest mean in the two indicators. In contrast, Finland (strata E) has the most developed S&T system with the highest figures for both GERD and number of researchers.

Figure 4
Segmentation of the European S&T space: cluster profiles



Source: Own calculations from OECD 2007.

3.2. Science and social science productivity: comparing EU countries

Having classified the countries according to their relative position in the stratification of the European STS, the research question is to know to what extent there is any relationship between scientific production and the relative position of each country in that space?

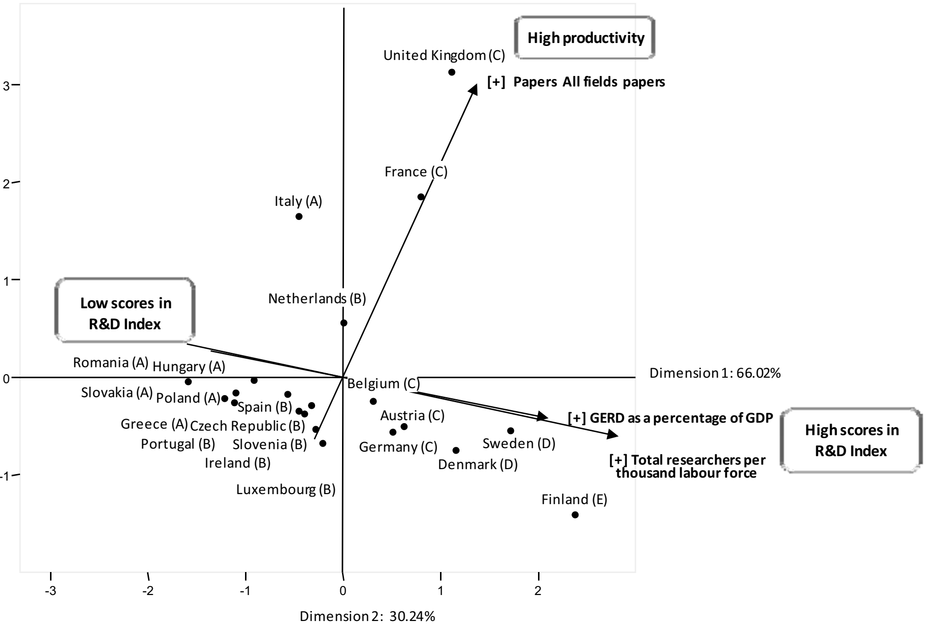
We will assess how scientific output – measured by the number of articles published in WoS indexed journals (considering all scientific areas) – is distributed across the countries ranked according to their level of scientific development and the strata identified within the European STS.

Surprisingly, the analysis shows that it is not necessarily the countries with the highest level of scientific development that have the largest number of articles published in WoS journals.

Indeed, scientific productivity is low throughout the majority of EU countries regardless of their S&T strata. Both countries associated with low scores and high scores in the S&T index have published few articles in WoS journals. This is corroborated by the low correlation between the S&T index and the number of papers in all fields (R=0.218, not significant). However, there are exceptions.

As we can see from Figure 5, the countries positioned along dimension 1 go from those with the lowest scores in the S&T index (reading from left to right) to those with the highest scores. The Southern and Eastern Europe countries are grouped together in the lower left quadrant (with low scores and also belonging to the lowest strata, A and B). Near these, Belgium, Austria, Germany, Denmark, Sweden and Finland (the highest scores from the C and D strata) are concentrated in the lower right quadrant. Surprisingly, both these groups have a low productivity in scientific production.

Figure 5
Stratification in European S&T space and "all fields" science productivity, per country (2007)



Source: Own calculations from OECD (2007) and ESI data base (2007).

Dimension 2 shows another type of differentiation separating the countries with lower productivity from those that stand out for comparatively high productivity – the Netherlands, Italy, France – until the upper end occupied by the United Kingdom.

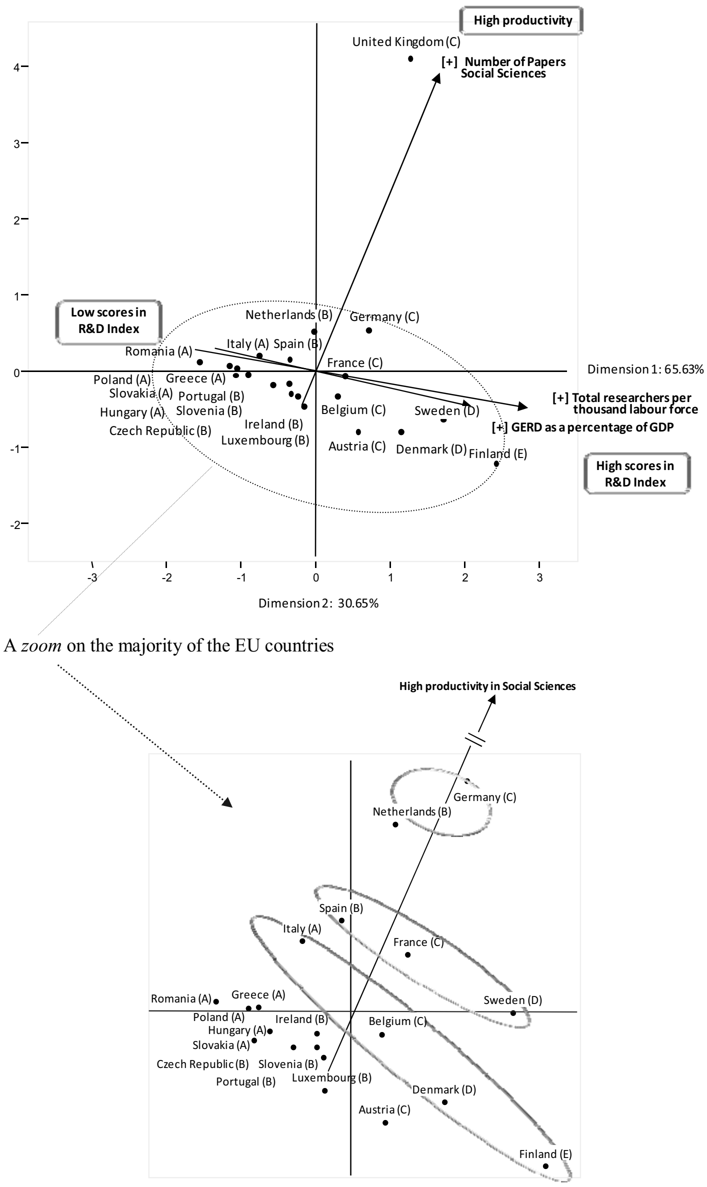
Italy is an exception and should therefore be mentioned. Although it belongs to the lowest strata in terms of the S&T index (stratum A), scientific productivity is high.

There are two plausible interpretations for these data: i) our initial hypothesis of a positive relationship between scientific development and scientific production has not been proved, or ii) the source used to measure scientific production has severe limitations, even though it is the most widely used in scientometrics studies.

The relationship between countries' scientific development and productivity in the social sciences was also analysed (Figure 6). As expected, given the high correlation between production of sciences as a whole and social sciences ($R=0.798$, $p<0.001$), the performance in the social sciences in most EU countries – ranging from stratum A to strata D and E – was identical i.e. low (see the bottom of the vector characterising the number of papers in the social sciences). The United Kingdom maintains its top position in this ranking, way ahead of other countries. The productivity gap between United Kingdom (C) and the rest of the countries is much larger than in "all fields".

Figure 6

Stratification in European S&T space and social sciences productivity per country (2007)



Source: Own calculations from OECD (2007) and ESI data base (2007).

However some differences can be highlighted in the social science productivity. To analyse the display of the majority of the EU countries a zoom was made. Clusters of countries with different levels of productivity can be seen (Figure 6). Germany (C) and Netherlands (B) have the highest productivity after the United Kingdom. Spain (B), France (C) and Sweden (D) are in third place. Italy continues to be an exception and is joined by Belgium (C), Denmark (D) and Finland (E).

4. Discussion and conclusions

Surprisingly, the results reveal that Germany, Netherlands, France and United Kingdom are no longer the leaders in the development of S&T systems, and the top positions have been taken by Northern European countries namely Finland, Denmark and Sweden where investment in R&D increased steadily over the past 20 years. There has been broad debate on the model of societal development in Nordic countries with regard to the sustainability of their Welfare State models and the viability of the European social model (Ferrera, M., 1996; Ferrera, M., Hemerijk, A. & Rhodes, M., 2000; Esping-Andersen, G., 1990, 1999; Silva, P. A. 2002). Their leadership in both S&T investment and the increase in researchers allow us to develop two hypotheses, which future research may confirm. Firstly, the social-democratic perspective on the viability of the European social model – sustained by an increase in the production of wealth according to the Strategic European Goal for 2020 – is likely to be confirmed through the experience of these Nordic countries, which would constitute a political challenge for the rest of Europe. Secondly, these results could give rise to the reshaping of European leadership in economic and social development, if Germany, France and the United Kingdom do not reverse their S&T investment trends of the past 20 years. The data not only indicate a change in the leading countries as mentioned above, but also the alteration of the positions of other countries in the European space for science. With the exception of Greece, Southern European countries have made considerable advances as have some Eastern Europe countries, notably the Czech Republic and Slovenia.

As for productivity in science, it has been shown that the countries that are at the top of the hierarchy are not necessarily those that publish most papers in WoS indexed journals, either in science generally or in social sciences. These results need to be discussed separately.

With regard to science (all fields), the United Kingdom's supremacy can probably be explained by the dominance of Anglo Saxon science in the WoS database. Indeed, while scientists specialising in scientometrics generally use this database in their analyses, it has recently been the target of some criticism e.g. in the latest UNESCO World Social Science Report (2010). Also Paasi (2005), for example, mentions that it is far from a reliable source for the measurement of scientific production as the journals included are mainly of Anglo-American origin, which implies a certain bias from the outset. Gutiérrez and López (2001) show that the majority of authors who publish geography articles in WoS indexed journals are British and American. Jöns (2009) argues that this English domination pushes world science towards hegemony by the main English-speaking academic systems.

Aalbers (2004) even states that the minority presence of countries outside the Anglo-Saxon stream is due to a protectionist policy by the gatekeepers of the WoS indexed journals. This also explains the proliferation of databases other than Thompson that have emerged, such as Scopus, Ulrichs and the Google Scholar (GS)[5]. The undoubted expansion of GS is fuelled by easy access to data and, above all, by cost-free use and coverage of Google, in light of the change in the new commercial policy of the indexed journals. It is now the article – or part of it – that is purchased rather than the journal, which leads to a significant increase in the price of scientific production. The rationale on which all scientific systems are based, including the increasingly important publication industry, is that of the commercialisation of science (Oliveira, 2000) inherent to the new mode of knowledge production (Gibbons et al., 1994) and the governance of science.

The social construction of science elite through the publication and mutual citations of Anglo-Saxons would in this case be a paradigmatic example of the Matthew effect based on Lotka's law[6] (1926), which was first mentioned by Merton (1968), and later recovered by other authors (Price, 1986:38-45; Cole and Cole, 1973:119-12). The Mathew effect refers to the recognition generated through the use of citations. Thus, the authors who publish first are cited more often, have greater visibility and prestige; this triggers a kind of vicious cycle that increasingly promotes the first authors and excludes others due to the cumulative nature of science, despite the (theoretically) anonymous refereeing process.

On the other hand, this database does not include other indicators of scientific production such as books, chapters in books and non-indexed journals. Many of these publications do not match the scientific interests of those Anglo-American countries, as they are empirically rooted in specific national issues e.g. the incidence of a specific disease and related research, the development of technologies to tackle local or regional problems, in many different areas, etc. According to Jokić and Šuljok (2009:144), "...ISI's citation databases have covered less than 10% of global scientific production in all fields since they were established in the 1960's, thus generating the so-called 'core' of the world's knowledge". Today they cover approximately 11,000 scientific journals as opposed to the 600 represented at that time. However, Jokić and Šuljok point out that the percentages remain the same because the global number of journals has greatly increased. According to Archambaud and Larivière (2010), the over-representation is even higher in the social sciences and humanities. Social science and humanities journals with publishers in

5 For a more in-depth analysis of these databases, see Jokić & Šuljok, 2009.
6 Lotka's law states that the more one has published, the easier it is to publish, and the more visible one becomes, the easier it is to be cited.

the Russian Federation, the USA, Switzerland, and the Netherlands are also over-represented, whereas virtually all other countries are under-represented.

This explains the predominance of articles published by the United Kingdom in WoS journals despite its limited investment in S&T in the last 20 years (with a current investment of less than 2% of GDP) and decreasing the number of researchers. Our results should therefore take this under-representation of global scientific production into account even though it is traditionally the most used source by experts in scientiometrics[7]. Moreover, this also explains the results for other countries. Our conclusions on science productivity are limited to their representation in the WoS database and this is how they should be read. These findings have another interpretation which is related to the rationale for the inclusion/exclusion of different European countries in this elite database of journals, which works as a form of invisible college (Price, 1971). Various factors compete in establishing these rationales, ranging from the journals' editorial policies and the inclusion criteria selected by WoS, to the discouragement scientists feel following refusals and their subsequent reluctance to submit articles to the indexed journals, or even a combination of these factors. This process remains somewhat of a black box requiring further research.

However, the productivity of science is explained by multiple factors that can only be addressed by extensive methodological work, including recourse to qualitative data, as shown by examples of studies on scientific productivity carried out in Croatia (Prpić, 2009) and in the United Kingdom (RAE[8], 2009). These explanatory factors should be contextualised within an analytical model which encompasses scientific policy, the changes taking place in universities and the new career management instruments for researchers. At a time of sweeping changes, the scientific development and scientific productivity of each country is strongly influenced by the globalisation of science, the reform of universities and their mode of governance (Amaral, et al., 2003; Clark, 1998; Etzkowitz, H., & Leydesdorff, L. 1997; Meyer, J. W. & E. Schofer, 2007) so that they can fulfil the role assigned to them in the social construction of the knowledge society.

The new organisational model for universities and the introduction of assessment tools both for these institutions and for researchers have clearly been imported

7 For an analysis of the differences between the ISI and the more recent (2004) SCOPUS database, see Jokić & Šuljok, 2009:143-147. There are writers who support GS using the argument that it provides a good picture of scientific activity, by covering a broader scale of scientific output than traditional databases. Inari et al. (2008) have argued that, given the popularity, cost-free use and coverage of Google, it has the chance to create a dominant position in determining scientific output and have a greater impact than the Thomson Scientific currently has. For a comparison between ISI and the Scopus and Ulrich database, see Archambaud and Larivière (2010).

8 RAE is the *Research Assessment Exercise* undertaken approximately every 5 years for the evaluation and ranking of research by British higher education institutions.

from Anglo-Saxon models. In this regard, Lissoni, Mairesse, Montobbio & Pezzoni (2010) have called attention to the fact that most available studies on this subject have been conducted on American universities and very little is known about the European context. In fact, there are striking differences between these two worlds, notably the degree of autonomy of universities, the size and flexibility of the labour market, the organisation of the S&T system and the means of financing science. In a comparative study between France and Italy in the area of physics, the same authors concluded that career opportunities play a decisive role in the productivity of scientists. Moreover, the working context, particularly involvement in large or participation in international projects, is fundamental for publication in highly prestigious international journals. However, some individual aspects, like age, are also relevant as the change in university governance can bring about a split in the scientific community and introduce a generational effect between those who have reached the top of their career paths under different rules and those who are its younger members. As such, the generational turnover rate of scientists is a factor to be taken into consideration. Some authors mention other aspects relating to the institutional context (Long, 1978; Allison and Long, 1990; Levin and Stephan, 1991; Lee & Bozeman, 2005), such as financial incentives for publication in more prestigious journals in light of the recent changes in Western universities with the introduction of publication-related evaluation mechanisms and its respective impact.

A study carried out on the publication strategies of British scientists (RAE, 2009) showed that the factor most influencing publication in indexed journal was the evaluation made by the RAE; this gives the highest rating to articles published in very prestigious database-indexed journals because they are the easiest to measure, rank and evaluate. It is within such a context that scientific journals are increasing their dominance over other forms of publication, thus raising the pressure to publish in these journals. Even many British scientists are unhappy about this pressure to publish in journals, notably those within certain subject areas in applied science, but also among social scientists. There is a kind of passive resistance movement among older British scientists in these areas against what they regard as unacceptable pressure to publish articles instead of books, as they argue that the latter are the most appropriate way to disseminate their work and their careers have been based on this.

Each of the above mentioned factors may explain both the United Kingdom's supremacy and also the relative positions of other countries; however, different factors may predominate depending on the stage reached in their university reform and only local in-depth studies can clarify this. National scientific cultures are understood to be powerful explanatory factors for our findings.

The results on the social sciences and the relative positions of the countries are of equal interest. It is not only the positions of Denmark, the Netherlands, Spain, France and Sweden that are surprising, but also those of Belgium, Denmark and Finland which occupy a more favourable position in the social sciences than in science as a whole. It is known that the cultures of academic areas differ (Becher and Trowler, 2001) and this has implications for publication practices. A biochemistry or molecular biology article may have been written by several authors and, as a rule, consists of no more than 8 pages. A history article has to meet other requirements and this is also the case of other social sciences. Economics and even organisational psychology are the exceptions as they work with statistical or econometric models that possess a universal language which is of potential interest to the entire academic community in those areas.

Other social sciences do not have this kind of practice, especially in research based on qualitative methods. This could explain why publication in journals has been more common in the natural sciences and medicine than in the social sciences. It is also why the social sciences have always tended to publish in the form of books and in the national language (UNESCO, 2010). However, the structural changes taking place today in the universities of the Western world and the focus on assessment models and criteria for the evaluation of scientists and universities have been the same for all academic areas, and are thus leading to the standardisation of publishing practices. In fact, universities are also being evaluated on their scientific performance. Another consequence of the rise of knowledge-intensive societies is the increasing need to internationalise science in the context of globalisation. The more peripheral scientific systems will have greater difficulty in asserting their presence in the globalised world of science and this is also being felt within different academic areas and in the social sciences in particular.

To conclude, it seems clear that orientation of science policies is to develop academic reforms and new models of universities governance in order to construct a science-based model of development (Donovan, 2005). Science productivity is one of the tools used to implement this governance model which tends to manage all disciplines in the same way. Journal data bases are part of this new management and have a decisive role in the stratification of the European and global science space. Thus, journal databases should not be viewed merely as neutral entities but as social actors that participate in this process of change, and in which strong tensions exist between countries and between academic areas. The recent emergence of new journal databases, both national and international, is indicative of precisely this.

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Veza znanstveno-tehnološkog razvoja i (društvo)znanstvene produktivnosti u Evropi

Sažetak

Ovaj članak komparativno analizira vezu između znanstveno-tehnološkog (ZiT) razvoja i (društveno) znanstvene produktivnosti u državama članicama EU-a.

Rezultati otkrivaju da Njemačka, Nizozemska, Francuska i Ujedinjeno Kraljevstvo više nisu lideri u znanstveno-tehnološkom razvoju, već su vodeće pozicije preuzele sjevernoeuropske države, i to Finska, Danska i Švedska. Ovi bi rezultati mogli potaknuti preoblikovanje u vodstvu evropskoga ekonomskoga i društvenog razvoja, ako Njemačka, Francuska i Ujedinjeno Kraljevstvo ne preokrenu trend svojih ulaganja u znanost i tehnologiju iz posljednjih 20 godina. Podaci ne ukazuju samo na promjenu među vodećim zemljama, već i na promjenu pozicija ostalih država evropskog znanstvenog prostora. S izuzetkom Grčke, južnoeuropske su zemlje postigle značajne pomake, a isto vrijedi i za Češku i Sloveniju.

Što se tiče (društvo)znanstvene produktivnosti pokazalo se da države koje su na vrhu znanstveno-tehnološke hijerarhije nisu nužno i one koje objavljuju najviše radova u WoS/JCR časopisima, već je stanje upravo obrnuto. Stoga se nameće zaključak da bi u analizi znanstvene produktivnosti u obzir trebalo uzeti i druge indikatore, uključujući i smjer akademskih reformi i nove modele upravljanja sveučilištima. Znanstvena produktivnost jedno je od sredstava pomoću kojih se implementira upravljački model koji nastoji upravljati svim disciplinama na isti način. Bibliografske baze dio su ovoga novog upravljanja i imaju odlučujuću ulogu u stratifikaciji evropskoga i globalnoga znanstvenog prostora.

Ključne riječi: znanstveno-tehnološki razvoj u evropskim državama, (ZiT) indeks, stratifikacija u evropskoj znanosti i tehnologiji, produktivnost društvenih znanosti.

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