

EDITORIAL

■ No Crisis Here! – The Twentieth One



Introducing a new media product to the market is always a risky business. We were, of course, aware of it when we launched the ISSI e-Newsletter 5 years ago, nevertheless our optimism was stronger than our healthy doubts.

And it seems that the positive attitude pays off: once again, thanks to our valued authors and other contributors, we could close another successful year – the fifth one this time. Let's see what major milestones 2009 brought to the ISSI Newsletter:

The year started with a report about the ISSI board member election. Shortly afterwards two VIPs, Péter Vinkler and Michel Zitt, awardees of the Derek de Solla Price Award in 2009, were interviewed and introduced to the readers (not that they would have needed any introduction), but the list of prominent persons appearing on our pages was far not over with it: we photo-reported about the honorary doctorate ceremony of Isidro F. Aguillo and contributed in a congratulating festschrift that had been made for another well-known extraordinary gentleman: Olle Persson.

We announced 5 conferences/meetings (including the ISSI 2009 conference in Rio) in these columns; and amongst many news, notes, short communications, book reviews, conference reports and editorials we also published 10 longer articles throughout the year.

Not less than 58 photos, 25 charts, 11 tables, 3 figures and 8 other visualizations illustrated the 35 different kind of contributions of the Newsletter in 2009.

We wish a happy and prosperous New Year for every reader of the ISSI e-Newsletter – and similar (or even better) statistics for us (all of us!) at the end of 2010!

Balázs Schlemmer technical editor
on behalf of the editors of ISSI e-Newsletter

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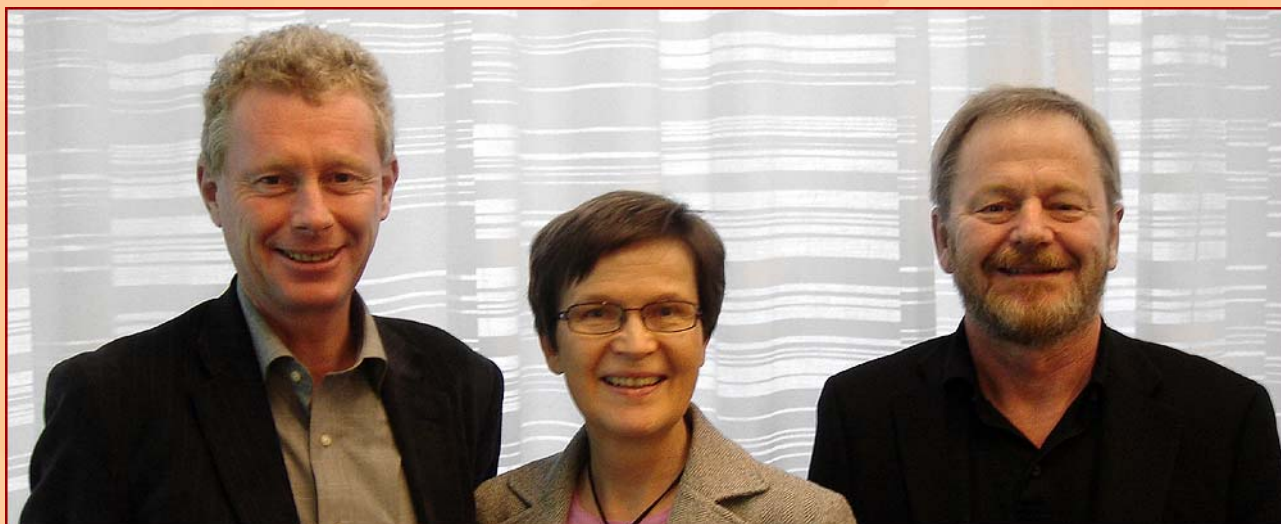
Balázs Schlemmer (*HUN*)

Published By:

International Society for Scientometrics and Informetrics

NEWS

CELEBRATING A NORDIC PAPER WITH MORE THAN 100 CITATIONS



Picture taken during the 14th Nordic Workshop on Bibliometrics and Research Policy, 29-30 September 2009 at the Swedish Research Council in Stockholm, Sweden (Click on this link to see the presentations from the Nordic workshop 2009: <http://vr.se/nwb2009>.)

From left to the right: Gunnar Sivertsen, Terttu Luukkonen and Olle Persson. (Photo courtesy of Terttu Luukkonen)

In 1992 Luukkonen, Persson and Sivertsen published a paper on international collaboration in science. The authors study the interpretation of macro-level data on international co-authorship collaboration. They address such questions as how one might explain country-to-country differences in the rates of international co-authorship, networks of international scientific collaboration among countries, and patterns of international collaboration in scientific fields. Attention is drawn to cognitive, social, historical, geopolitical, and economic factors as potential determinants of the observed patterns. They present a methodology that gives one a measure, independent of size, of countries' propensities to collaborate internationally.

During the 14th Nordic Workshop on Bibliometrics and Research Policy it was concluded that the paper:

- Is one of the earliest studies of country co-authorship
- It has received more than 100 of citations
- It is still cited and has become a part of the citation repertoire in this line of research
- Used in other fields of research - advanced network analysis

The paper has been reprinted in: R Helga Nowotny, Klaus Taschwer (eds.), *The Sociology of the Sciences*, Vol. I, *The International Library of Critical Writings in Sociology*,

An Elgar Reference Library. Cheltenham, UK: Edward Elgar Publishing Limited, 1996, 194-219. The other papers reprinted in this two-volume book are really seminal papers, by famous authors like Karl Mannheim, Robert K. Merton, Derek J. de Solla Price, Pierre Bourdieu, Bruno Latour etc etc.

Geoffrey Oldham, former director of SPRU, went to Japan at the time and presented the paper's findings, among which the extremely low international collaboration rate of Japan (2%) drew a lot of attention and the author's findings ended up in a Japanese government White Paper on science policy. That was presumably the pinnacle of fame.

Data on international scientific collaboration only then became available via the Computer Horizons for researchers to analyse and that there was a kind of race amongst potential analysers on who would first analyse these data and who had the best methods. Director of the Computer Horizons, Francis Narin said about the Luukkonen-Persson-Sivertsen paper that its methods were the most sophisticated ones then used.

Terttu Luukkonen, Olle Persson, Gunnar Sivertsen (1992). Understanding Patterns of International Scientific Collaboration. Science, Technology, & Human Values, Vol. 17, No. 1 (Winter, 1992), pp. 101-126.

CONFERENCE CALLS

6th INTERNATIONAL CONFERENCE ON WEBOMETRICS, INFORMETRICS AND SCIENTOMETRICS (WIS) & 11th COLLNET MEETING

19 to 22 October 2010
Mysore, India

announcement & call for papers

COLLNET (<http://www.collnet.de>) and the University of Mysore (<http://www.uni-mysore.ac.in/>) jointly organise the 6th International Conference on Webometrics, Informetrics and Scientometrics (WIS) & 11th COLLNET Meeting at the University of Mysore, India, on 19-22 October 2010.

The joint conference is focused on quantitative aspects of science of science, on collaboration and communication in science and technology, on science policy and on the combination and integration of qualitative and quantitative approaches. The main themes of the conference include

- Emerging topics and history of Scientometrics/Informetrics /Webometrics
- Science policy and collaboration
- Collaboration studies for science & society
- Collaboration, knowledge management & industrial partnership

- Collaborative bridge between academic research and industry
- Techniques for collaboration studies
- Visualization techniques in collaboration studies
- Quantitative analysis of S&T innovations
- Informetric laws and distributions, mathematical models of communication or collaboration
- Nature and growth of science and of collaboration in science and its relation with technological output
- S&T indicators
- Quantitative and qualitative aspects of collaboration in science and in technology

The language of the conference will be English.

University of Mysore

The Conference is hosted by the University of Mysore. The University was founded in 1916, and became the first University outside the domain of the English administration in India, the sixth University in India as a whole, and the first ever University in Karnataka. When founded, four faculties were constituted viz., Arts, Science, Engineering and Technology, and Medicine. The University now encompasses 122 affiliated colleges and 5 Constituent Colleges (with an aggregate of 53,000 students). Its post graduate departments are reputed for excellence in advanced studies and research, and have attracted projects and grants from many national and international institutions.

Organisation

Programme Chair: Hildrun Kretschmer (Germany, China); Programme Co-Chair: S.L. Sangam (India); Organising Chair: V.G.Talwar, Vice Chancellor, Mysore (India)

Contact

Please send extended abstracts no later than 15 April 2010 to Hildrun Kretschmer (Kretschmer.h@onlinehome.de) with copy to S.L. Sangam (slsangam@yahoo.com).

See a conference report about the 5th WIS Conference and 10th Collnet Meeting on page 64.

SCIENCE AND TECHNOLOGY INDICATORS CONFERENCE 2010

8 to 11 September 2010
Leiden, the Netherlands

announcement & call for papers

It is our great pleasure to announce the 11th International Conference on Science and Technology Indicators "Creating Value for Users" (STI 2010) from 8-11 September 2010 in Leiden.

The STI 2010 will highlight cutting-edge advances in all themes related to science and technology indicators. This four-day event will feature recent findings from both leading experts as well as young promising researchers in the field, in the form of key note presentations, lectures and posters. The conference offers sessions on major topics such as assessment of strengths and weaknesses of a country's science system, ranking, benchmarking and classification of universities, finding excellence in research, identification of emerging and interdisciplinary research themes, measuring knowledge transfer between academia and industry. In all topics the value of S&T indicators for a wide range of users will be addressed.

New challenges: the influence of Open Access on the construction of S&T indicators, research performance on the basis of Web of Science data versus Scopus data, the role of the social sciences and the humanities, mapping, data-mining and networking in ever-growing electronic resources. Current and past experiences have made clear that we have to remain critical of the fundamentals of S&T indicators: their conceptual basis, statistical properties, consistency, explanatory power, predictive power, and appropriateness in a given context such as fields of science, time periods, and units of assessment.

We look forward to your participation in this important conference and hope to welcome you next year in our beautiful city!

Sponsorship and exhibition opportunities are available. Special arrangements for accompanying persons will be organized.

Organizer

Centre for Science and Technology Studies,
Leiden University

Conference Manager: Maria Klijn-Wuisman

e-mail address: sti2010@cwts.leidenuniv.nl

For more info check the conference website:

<http://www.socialsciences.leiden.edu/cwts/hot-topics/stic2010.html>

Call for abstracts: time schedule

- Deadline for submitting paper or poster: 16 April 2010
- Deadline review process: 15 May 2010
- Notification of acceptance: 30 May 2010
- 2nd Deadline submitting posters: 5 June 2010
- Deadline review process: 18 June 2010
- Notification of acceptance posters: 25 June 2010
- Final programme: 30 June 2010
- Final version PowerPoint: 1 September 2010



photos by Balázs Schlemmer



INTRODUCING VINCENT LARIVIÈRE

AWARDEE (2009) OF THE
EUGENE GARFIELD DOCTORAL SCHOLARSHIP

Title of dissertation: On the shoulders of students: A bibliometric study of Ph.D. students' contribution to the advancement of knowledge

Vincent Larivière is a PhD candidate at the School of Information Studies at McGill University, where he works under the supervision of Professors Jamshid Beheshti (McGill) and Yves Gingras (UQAM). He also holds a bachelor's in Science, Technology and Society (STS) and a master's degree in history of science, both from UQAM. Since 1999, Vincent is a researcher at the Observatoire des sciences et des technologies (OST-UQAM), where he is responsible for most of the research contracts in bibliometrics sponsored by Canadian research councils, governments and universities. Vincent is also the author of many research papers published in international journals, as well as of several conference proceedings and book chapters. Many of these studies have received extensive media coverage – both in scientific journals and in Canadian and foreign newspapers. Scholarship-holder from the Social Sciences and Humanities Research Council of Canada, the Centre interuniversitaire de recherche sur la science et la technologie and the European University Institute Vincent teaches bibliometrics and research methods to undergraduate students in UQAM's STS programs since 2003 and is frequently invited by Canadian universities and governmental agencies to lecture on bibliometrics.

(photo by Nathalie St-Pierre/UQAM)

Abstract: Graduate students are an important part of the academic workforce. However, little is known on their overall contribution to science. Using the participation in Web of Science indexed peer reviewed publications of the complete population of doctoral students in Quebec over the 2000-2007 period (N=27,393), this thesis achieves three main contributions to the advancement of knowledge.

The first contribution of is a technical one and involves the creation of an algorithm which allows the automatic attribution of an important percentage of individual researchers' papers. Using the patterns found in Quebec professors' use of keywords, cited references and discipline of publication, the algorithm automatically assigns or rejects a scientific paper to 88% of doctoral students.

The second contribution is to provide a large scale analysis of doctoral students' socialization to research, using the percentage of doctoral students who have published at least one paper during their program as an indicator. It shows that this integration varies greatly among disciplines, with students in the natural and medical sciences being more integrated into research than their colleagues of the social sciences and humanities. Collaboration is an important component of this socialization: disciplines in which collaboration is important are also those where doctoral students are the most integrated into research. Such socialization to research also has a positive effect on students' degree completion and careers in research.

Finally, the third contribution of this thesis is to measure the importance of the research output produced by doctoral students for the science system. It shows that PhD students account for 33% of the publication output of the province, a percentage that is considerably higher than that of Quebec hospital researchers taken together and more than 5 times higher than that of federal and industrial researchers of the province. In terms of scientific impact, doctoral students' papers obtain significantly lower citation rates than other Quebec papers to which they have not contributed, although the average impact factor of the journals in which they publish is significantly higher.

Overall, this interdisciplinary thesis provides a significant insight into the extent, the context and the effect of socialization to research in the Ph.D. curriculum as well as a better understanding of the importance of doctoral students' scientific contributions within Quebec's science system. These findings should be of great interest to university administrators as well as for research councils and the science policy community in general.

5TH INTERNATIONAL CONFERENCE ON WEBOMETRICS, INFORMETRICS AND SCIENTOMETRICS & 10TH COLLNET MEETING

a conference report by



Hildrun Kretschmer

The Conference took place between 13 and 16 September 2009 at the Dalian University of Technology, China. It was jointly organised by COLLNET (Global Interdisciplinary Research Network), Berlin, and WISE Lab (Webometrics – Informetrics – Scientometrics & Econometrics Lab) of the School of Humanities and Social Sciences at Dalian University of Technology (DUT). The conference was co-organised by the Chinese Association for Science of Science and S&T Strategy Policy and Thomson Reuters Group. More than 150 scientists and students from all over the world have attended the meeting.

Scope

The main theme of the conference comprised knowledge visualisation, mapping knowledge domains and visualising global S&T cooperation networks. Besides this main issue, several other important topics have been tackled in twelve

sessions. A non-exhaustive list includes the following issues, which reflect the general scope of COLLNET and WISE Lab activities.

- Scientometric analysis of individual authors and articles
- Scientometric studies in medicine;
- Communication and collaboration in science;
- The World Wide Web and webometric studies;
- Theoretical and methodological approaches;
- National oriented studies: China and India;
- Technology oriented studies;
- Interdisciplinarity and development;

Highlights

The attendance of the Founder and Chairman Emeritus of the Institute for Scientific Information - ISI (now part of Thomson Reuters) and the first awardee of the Derek de Solla Price Memorial Medal, Eugene Garfield, was certainly one of the highlights of the conference. As a honorary speaker he delivered the first keynote speech, which raised general questions and the effect of the scientometric use of citation databases (From information retrieval to scientometrics - is the dog still wagging its tail?). In an official ceremony Dr. Garfield was conferred Honorary Professor of the Dalian University of Technology.

The second honorary keynote was delivered by Shivappa L. Sangam from Karnatak University, Dharwad (India); it was devoted to a systematic approach to the variety of research areas in Scientometrics and Informetrics. Other important issues of present-day scientometrics, informetrics, technometrics and webometrics were covered by the invited keynote speakers Chaomei Chen (Drexel University, USA, and WISE Lab, DUT, China), Hsinchun Chen (Artificial Intelligence Lab, University of Arizona, USA), David Fenske (Drexel University, USA), Wolfgang Glänzel (ECOOM, KU Leuven, Belgium), Haiyan Hou (WISE Lab, DUT, China), Hildrun Kretschmer (COLLNET, Germany and WISE Lab, DUT, China), Howard D. White (Drexel University, USA) and Weiping Yue (Thomson Reuters - Beijing, China).

A second highlight of the conference was the conference dinner with its rich and astonishing cultural programme presented by the host of the conference. An unexpected surprise was the celebration of Professor Eugene Garfield's birthday turning the conference dinner into a giant birthday party. Some pictures taken during the event reflect the atmosphere of this memorable night.



(photos by Zsuzsanna and Wolfgang Glänzel)

REPORT ON THE METRICS 2009 SYMPOSIUM AT THE ASIST ANNUAL MEETING

Ronald Rousseau Dietmar Wolfram

KHBO (Association K.U.Leuven),
Industrial Sciences and Technology

School of Information Studies,
University of Wisconsin-Milwaukee

A metric pre-conference symposium was held at this year's American Society for Information Science and Technology (ASIST) Annual Meeting in Vancouver on November 7th, co-sponsored by ASIST and ISSI. The symposium consisted of 10 papers authored by researchers from six countries, divided into four sessions. Introductory remarks were made by Ronald Rousseau, president of ISSI, and Dr. Eugene Garfield, Founder & Chairman Emeritus of the Institute for Scientific Information. The attendance made for lively sessions and vigorous debates during the presentations.

The event ended with a discussion of possible future events associated with the ASIST meeting and a dinner gathering at a local restaurant. Selected papers presented at the symposium will be published in a special issue of the Journal of Informetrics in 2010. The web site for the symposium is located at: <http://www.sois.uwm.edu/MetricsPreCon/>

ABSTRACTS OF PRESENTED PAPERS

Rankings of Information and Library Science Journals by JIF and by h-type Indices (Judit Bar-Ilan, Bar-Ilan University, Israel)

Abstract: In this paper we compute journal rankings in the Information and Library Science JCR category according to the JIF and according to several h-type indices. Even though the correlations between all the ranked lists are very high, there are considerable individual differences between the rankings, showing that the correlation measure is not sensitive enough. We employ an additional similarity measure, the M-measure that is able to differentiate better between the different rankings.

Public Sharing of Research Datasets: A Pilot Study of Associations (Heather Piwowar & Wendy Chapman, University of Pittsburgh, U.S.A.)

Abstract: Making primary research datasets publicly available has the potential to improve the efficiency and integrity of research progress. Because benefits of data sharing accrue to the research community at large but the costs are largely born by the data-producing investigator, many funders and publishers have introduced initiatives to encourage

investigators to share their research datasets. Previous work has examined patterns in data sharing intentions and self-reported withholding, but not the effect of policies on demonstrated data sharing actions. In this pilot study, we analyze the association between the frequency with which study investigators share their gene expression microarray data in public databases and whether the study is subject to the NIH data sharing plan requirements, journal data sharing requirements, journal impact factor, and investigator experience. Across 397 recent microarray studies, we find that investigators are more likely to share their raw dataset when their study is published in a high-impact journal, when their study is published in a journal with an enforceable data-sharing requirement, and when the first and/or last authors have higher levels of career experience and impact. We estimated the NIH data sharing policy applied to only 19% of the studies in our cohort; being subject to the NIH data sharing plan requirement was not found to correlate with increased data sharing behavior in multivariate logistic regression analysis. Studies published in journals that require

a database submission accession number as a condition of publication were more likely to share their data, but this trend was not statistically significant in this pilot study. These early results will inform our ongoing larger analysis, and hopefully contribute to increasing the effectiveness of data sharing initiatives.

Core Journal Literatures and Persistent Research Themes in an Emerging Interdisciplinary Field: Exploring the Literature of Evolutionary Developmental Biology (Katherine McCain, Drexel University, U.S.A.)

Abstract: This paper reports research in progress on two interrelated citation-based studies of the intellectual structure of Evolutionary Developmental Biology (Evo-Devo). The core journals of Evo-Devo and its supporting/parental disciplines are identified and their strong citation links mapped based on data from Journal Citation Reports, 2005-2007. The Evo-Devo core consists of three journals: *Evolution & Development*, *Development*, *Genes & Evolution*, and *Journal of Experimental Zoology*, pt. B *Molecular & Developmental Genetics*. Strong citation links exist between core journal sets in Evo-Devo and Developmental Biology and between Evo-Devo and Paleontology but not between Evo-Devo and Evolutionary Biology. Persistent, visible research themes are visualized as citing-cited networks of articles extracted from the Web of Science. Core research themes, represented as separate networks, focus primarily on studies of arthropod, sea urchin, and chordate evolution and development, the broader themes are sub-networks within a single large network; they include the core topics as well as evolutionary developmental studies of organisms in the phylum Cnidaria (jellyfish, sea anemones, coral, and hydras). Topics to be addressed as the research progresses include the lack of author or article overlap between the core and broader network research themes and the lack of connections between evolutionary biology and Evo-Devo.

Diffusion of Latent Semantic Analysis as a Research Tool: A Social Network Analysis Approach (Yasar Tonta & Hamid R. Darvish, Hacettepe University, Turkey)

Abstract: Latent Semantic Analysis (LSA) is a relatively new research tool with a wide range of applications in different fields ranging from discourse analysis to cognitive science, from information retrieval to machine learning and so on. In this paper, we

chart the development and diffusion of LSA as a research tool using Social Network Analysis (SNA) approach that reveals the social structure of a discipline in terms of collaboration among scientists. Using Thomson's Web of Science (WoS), we identified 65 papers with "Latent Semantic Analysis" in their titles and 250 papers in their topics (but not in titles) between 1990 and 2008. We then analyzed those papers using bibliometric and SNA techniques such as co-authorship and cluster analysis. It appears that as the emphasis moves from the research tool (LSA) itself to its applications in different fields, citations to papers with LSA in their titles tend to decrease. The productivity of authors fits Lotka's Law while the network of authors is quite loose. Networks of journals cited in papers with LSA in their titles and topics are well connected.



A Theoretical Discussion of Prathap's h2-index for Institutional Evaluation with an Application in the Field of HIV Infection and Therapy (Ronald Rousseau, KHBO (Association K.U.Leuven), Industrial Sciences and Technology, Belgium; Lying Yang & Ting Yue, National Science Library of the Chinese Academy of Sciences, China)

Abstract: Hirsch-type indices are not only used for the evaluation of individual scientists but also for institutional evaluation. In particular, Prathap's suggestion, using the pair of h-indices (h_1 - h_2) seems a promising approach. This paper discusses these h-indices, incorporating moreover a Molinari correction for size. We provide a theoretical framework and provide practical examples in the field of HIV infection and therapy. It is shown that the National Cancer Institute (NCI, USA) and Harvard University are the leading institutes in this field (in the world). If, however, size is controlled according to the Molinari approach, the National Institute of Allergy and Infectious Diseases (NIAID, USA) becomes the leader. In addition, we provide a new structural index: the ratio h_2 / h_1 . It is suggested that this ratio indicator is related to the stability of

the research performed at an institute or university. The term stability is used here in the sense of not depending on a small group of scientists that could easily move to another university.

Academic Spectrum: A Visualizing Method for Research Assessment (Fred Y. Ye, Zhejiang University, China)

Abstract: A new visualizing method for research assessment, academic spectrum, is introduced. While the common logarithm of citations, square root of citations per publication and natural logarithm of h-index are integrated into a diagram, academic spectra show referable academic characteristics and parameters. Different information-productive sources produce different academic spectra, including both field spectra and time spectra. With data from the ISI-ESI database, publications and citations, the field academic spectra can be formulated based on simple computation and the estimation of h-index by the Glänzel-Schubert formula. Via search data from the ISI-WoS database, the time academic spectra can be obtained according to cumulative publications, citations, and h-indices. All academic spectra provide comparable information for research assessment, particularly for comparison at group level. The evidential data give us a new estimation of h-index as $h \sim \exp(\lg C)$, which may stimulate further studies.

North America Academic Web Space: Multicultural Canada vs. The United States Homogeneity (José Luis Ortega, VICYT-CSIC, Spain & Isidro F. Aguillo, CVHS-CSIC, Spain)

Abstract: A visual display of the most important universities in North America is the aim of this paper. It shows the topological characteristics and describes the relationships among universities of different countries and continents. The first 300 higher education institutions from the Ranking Web of World Universities were selected and their link relationships were obtained from Yahoo! Search. Network graphs and geographical maps were built from the search engine data. Social Network Analysis techniques were used to analyse and describe the structural properties of the whole network and its nodes. The results show that the United States university network dominates the North American network and this has a cohesive sub-network. However, we found cultural and linguistic groups in Canada between Anglo and French-speaking universities.

Subject Clustering Analysis Based on ISI Category Classification (Lin Zhang, Xinhai Liu, Frizo Janssens & Wolfgang Glänzel, K.U. Leuven, Belgium)

Abstract: The study focuses on the analysis of information flows among the ISI subject categories and aims at finding an appropriate field structure of the Web of Science using the subject clustering algorithm developed in the previous studies. The elaborate clustering of more than 8,000 journals and the clustering of the ISI subject categories provide two subject classification schemes though different perspectives and levels. The two clustering results have been compared and the according accordance and divergence have been analyzed. Several indicators have been used to compare the communication characteristics among different ISI subject categories. The neighbour map of each category clearly reflects the affinities between the "core" category and its planets around.

Combining Commercial and Open Access Citation Databases to Delimit Highly Interdisciplinary Research Fields for Citation Analysis (Andreas Strotmann & Dangzhi Zhao, University of Alberta, Canada)

Abstract: Field delimitation, the process of collecting a set of metadata records of research articles that represent a research field, is the first step in any citation analysis study of a research field. Due to a number of limitations, the commercial citation indexes have long made it difficult to obtain a comprehensive dataset in this step. This paper discusses some of the limitations imposed by these databases, and reports on a method to overcome these limitations that was used with great success to delimit an emerging and highly interdisciplinary biomedical research field, stem cell research. The resulting field delimitation and the citation network it induces are both arguably very close to ideal. This multi-database method relies on using PubMed for the actual field delimitation, and on mapping between Scopus and PubMed records for obtaining nearly complete cited-reference information for the resulting literature. This provides high-quality field delimitations that can be used as benchmarks for studies of the impact of data collection biases on citation metrics, and may help improve confidence in results of scientometric studies for an increased impact of scientometrics on research policy.

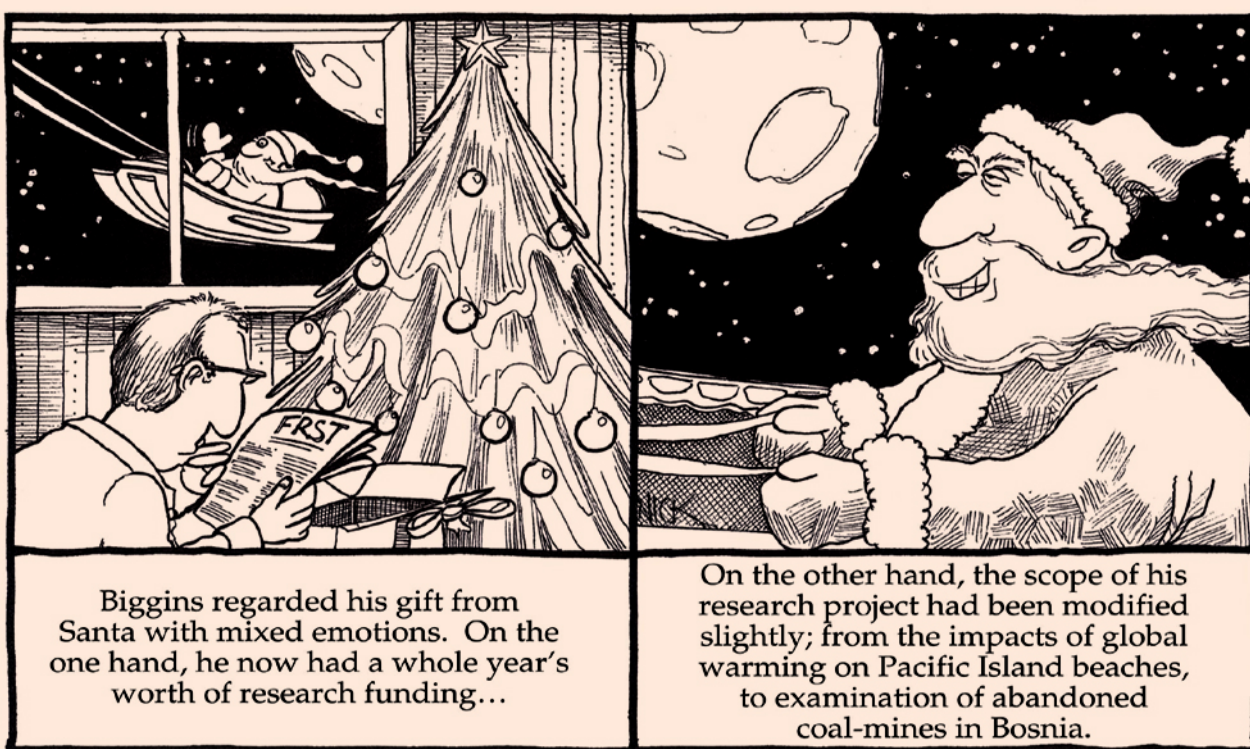


Measuring a Journal's Input Rhythm Based on its Publication-reference Matrix (Liming Liang, Institute for Science, Technology and Society, Henan Normal University, China & Ronald Rousseau, KHBO (Association K.U. Leuven), Industrial Sciences and Technology, Belgium)

Abstract: The difference among journal reference characteristics in various fields causes a field-based difference in their citation counts. For the purpose of improving indicators used in cross-field evaluations it is necessary to continue explorations corresponding to the characteristics of journal references. Such an exploration would offer new clues for solving the problem of cross-field journal evaluation. During the past years studies of the rhythm of science have obtained some achievements: constructing various types of publication-citation matrices, creating a series of rhythm

indicators, studying the fundamental mathematical properties of rhythm sequences and exploring some journals' rhythm sequences. Rhythm indicators can be applied to many rhythm studies, if the system is a source-item system with two time dimensions, ensuring the construction of a p-c-like matrix, then such a study is theoretically feasible. In this article we create a journal's publication-reference matrix (p-r matrix). Based on the p-r matrix the IR' indicator is defined, which is used to measure the input rhythm of a journal. As two case studies, the input rhythms of the journal JASIS(T) and JDOC are presented and analyzed. The heavy fluctuations observed in these rhythm curves surprise us. We offer the study of (heavy) fluctuations in this type of rhythm sequences as a suggestion for further examination.

CARTOON



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RESEARCH FOCUS: SPAIN

A COMPARATIVE SCIENTOMETRIC STUDY OF CARDIOVASCULAR RESEARCH IN SPAIN



Máxima
Bolaños-Pizarro

Unidad de
Información e
Investigación Social y
Sanitaria
(UISYS).
CSIC-Universitat
de València
(Spain)



Bart
Thijs

Katholieke
Universiteit
Leuven,
Centre for R&D
Monitoring
(ECOOM)
and Dept. MSI,
Leuven (Belgium)



Wolfgang
Glänzel

Katholieke Universiteit
Leuven, Centre for R&D
Monitoring (ECOOM) and
Dept. MSI, Leuven (Belgium);
Hungarian Academy of
Sciences, Institute for Re-
search Policy Studies,
Budapest (Hungary)

Abstract: A bibliometric analysis of Spanish cardiovascular research is presented. Special attention is given to international collaboration. The underlying bibliographic data are collected from Thomson Reuters's Web of Science on the basis of a 'hybrid' search strategy combining core journals, lexical terms and citation links.

1. Introduction

Cardiovascular diseases have become the main cause of death in the developed countries (Cosín Aguilera et al., 2000). According to the data available from the WHO (2004) about 50% of all deaths in Europe are related to diseases like rheumatic, hypertensive, ischaemic, cerebrovascular or inflammatory heart diseases. Lenfant (1997) even predicted that this will become the first cause of death worldwide by 2020. These observations

have created a significant challenge for many researchers in life sciences to find cures in this area and for many governments to invest and allocate funding to scientific research in cardiology and on cardiovascular systems (Fuster, 2002).

Spain forms an interesting case within Europe with respect to cardiovascular diseases and to research in this area. According to the same WHO data (WHO, 2004), about 34% of all deaths in Spain in 2002 were caused by cardiovascular diseases.

This ranks Spain among the countries with the lowest share in Europe, other countries ranking low are France (31%), Andorra (33%) and Monaco (34%). Also with respect to other health related indicators Spain is performing well within Europe. The Spanish government spends more on health than average in Europe, the life expectancy is higher and the adult mortality rate is lower than the European average (WHO, 2009). In this field Spain occupies a similar position as in other biomedical areas, too, ranking sixth in Europe and ninth in the world of scientific production (Aleixandre-Benavent et al., 2009). The growing productivity, visibility and co-operativity of Spanish scientists has been traced by Bordons, Zulueta and their colleagues over a quite long time period (e.g., Bordons et al., 1996, Zulueta and Bordons, 1999, Bordons and Zulueta, 2002). These developments are also mirrored by increasing interdisciplinarity which is required to reach the critical mass of knowledge to measure up to the complex tasks of present-day research (Klein, 2004, Bordons and Zulueta, 2002).

Our paper adds two approaches to the existing literature on cardiology in Spain. Firstly, by using an extended retrieval method which goes beyond the selection of journals but combines in a hybrid approach keyword searches and references we obtain a broader and more appropriate set of papers. And, secondly, by applying state-of-the-art citation indicators with standardisation with respect to journals and fields we enhance comparability between European countries.

2. Data sources, retrieval and processing

The data were extracted from the annual volumes from the *Web of Science* database of Thomson Reuters. For this study all documents indexed between 2000 and 2008 were examined and citations from all indexed years were taken.

A bibliometrics-aided hybrid retrieval method has been applied to delineate the subject of *cardiovascular research*. Unfortunately, a simple strategy based on keywords including terms such as *cardia** results in numerous false positive hits and thus in unacceptable noise. Therefore we decided to apply a hybrid methodology as introduced and described, for instance, by Glänzel et al. (2006b, 2009a) and Bolaños-Pizarro et al. (2000). The selection of relevant documents for the domain of cardiovascular research was actually done in four steps.

First a set of core journals was selected based on the JCR journal classification. All journals assigned the categories 'Cardiac & Cardiovascular System' were analysed in order to decide whether they could be regarded as real core journal. Only if almost all of their papers were relevant to the domain we considered them as being core. This resulted in a list of 72 journals for the complete 1991-2008 period.

In a second step a search strategy of keywords was created. This strategy was then applied on all documents indexed in our database by searching their title, keyword and abstract field. The lexical search strategy reads as follows.

(Arrhythm* OR Cardio* OR Cardia* OR Coronar* OR Echocard* OR Kardi* OR Myocard* OR ventric* OR angina) NOT (Chrysanthe* coronar* OR Intestin* angin* OR Velo cardi* faci* OR gastri* cardi* OR Cardiocond* bate* OR Hedysar* coronar*)

Thirdly, both sets were joined and a set of core documents were selected as follows. The selected documents were published in core journals *and* their title, keywords or abstract comply with our search strategy. As the noise ratio in the set retrieved at the second step proved still too large, an additional requirement was entered in the fourth step. Only those papers obtained from the lexical search with a strong citation link with the above defined core documents are retained. A share of 10 percent is used as a threshold to define this strong link. This actually means that at least one out of ten of all references to indexed documents must refer to a paper from the set of core documents. The final set of document assumed to be relevant is obtained as the union of the papers published in the core journals *and* obtained according the combined lexical-links strategy described above. Furthermore, only documents of the following types are taken into account: *article*, *proceedings paper*, *letter* and *review*.

3. Methodological rudiments

In addition to the standard measures of publication activity such as number and share of publications in the world total, the extent of international collaboration in the field of cardiology has been analysed. A link between two countries is established, whenever the two given countries co-occurred in the corporate address field of a publication. At the

macro level, the analysis of international co-authorship patterns by country pairs is the most intelligible approach to the analysis of a given country's collaboration links with other countries (Glänzel and Schubert, 2004).

To measure the strength of co-authorship links, we have used Salton's measure which is defined as *the number of joint publications* divided by the geometrical of the two countries publication output, i.e., *the square root of the product of the number of total publications* of the corresponding countries.

In order to get statistically reliable results, we have chosen only countries that have at least 25 joint publications with Spain in the period 2000–2008. The strength of collaboration linkage among Spain and the partner countries is classified as: strong links (Salton's measure ≥ 0.025), medium links (Salton's measure ≥ 0.01 and < 0.025) or weak links (Salton's measure < 0.01).

Analogously to earlier studies (e.g., Glänzel et al., 2006a), a set of advanced indicators is used to study the (citation) impact of cardiovascular research. For the citation analysis, a three-year citation window was applied for each of the relevant papers published in 2000–2006. Papers published in 2007 and 2008 are not included in the citation analysis because the corresponding citation window were not sufficiently large enough for building reliable citation-impact statistics. Citations received by these publications have been determined on the basis of an item-by-item procedure, using special identification keys, made up of bibliographic data elements. Author self-citations were identified in the same way as described, e.g., by Snyder and Bonzi (1998) and Glänzel et al. (2004). According to the definition applied in those papers, a self-citation occurs whenever the set of co-authors of the citing paper and that of the cited one are not disjoint, that is, if these sets share at least one author. In this context we have to mention that the reliability of this methodology is affected by homonyms and synonyms (i.e., spelling variances and/or misspelling of author names).

In the present study, the following set of indicators is used. The detailed description of these indicators can be found in earlier methodological studies by the authors, above all, in Glänzel et al., (2006a, 2009b).

- *Mean Observed Citation Rate* (MOCR) is defined as the ratio of citation count to publication count, here in a three-year citation window.

- *Mean Expected Citation Rate* (MECR) is a journal-based expected citation indicator. It is defined as the average citation rate of all papers published in the same journal, in the same year, here in a three-year citation window.
- *Field Expected Citation Rate* (FECR) is a subject-based expected citation indicator. The field-expected citation rate of a paper is defined as the average citation rate of all papers published in the same subject in the same year, here again in a three-year citation window.
- The ratio of the two previous indicators (MECR/FECR) expresses whether the unit under study publishes on average in higher (lower) impact journals than expected on the basis of the underlying subject fields.
- *Normalised Mean Citation Rate* (NMCR)¹. This indicator is defined as the ratio of the observed and field-based expected citation impact, that is, MOCR to FECR.
- *Relative Citation Rate* (RCR)¹ is the ratio of MOCR to MECR.

The following indicator is the counterparts of the previous one excluding author self-citations with analogous definition.

- *Relative Citation Ratio excluding self-citations* (RCRX). Author self-citations are removed from both the expected and the observed citation rate.

The above indicators will be applied to all papers as well as to the 'domestic' and internationally co-authored papers in order to measure the effect of international collaboration.

4. Spanish cardiovascular in an international context

4.1 Publication activity and citation impact

The changes in the global production in cardiovascular diseases research have been studied by Rosmarakis et al. (2005) for the period 1995–2002. These important changes also continued in the more recent past. The trends in publication activity and in the share of publication output in the world total in the period 2000–2008 are presented in Table 1.

The most dynamic growth in terms of publication activity outside Europe has been found in China, Brazil, Turkey, Korea, Taiwan and other upcoming economies in Asia and Latin America

Rank	2000-2002		2003-2005		2006-2008	
	Country	Papers %Share	Country	Papers %Share	Country	Papers %Share
1	USA	20257 37.6	USA	24313 37.5	USA	27390 35.6
2	DEU	5555 10.3	DEU	6528 10.1	DEU	7144 9.3
3	JPN	5329 9.9	JPN	5614 8.7	GBR	6229 8.1
4	GBR	4762 8.8	GBR	5431 8.4	JPN	5647 7.3
5	ITA	3153 5.9	ITA	3987 6.2	ITA	5497 7.1
6	CAN	2784 5.2	CAN	3600 5.6	CAN	4193 5.4
7	FRA	2643 4.9	FRA	3068 4.7	NLD	3463 4.5
8	NLD	1996 3.7	NLD	2809 4.3	FRA	3354 4.4
9	ESP	1541 2.9	ESP	1735 2.7	CHN	2821 3.7
10	SWE	1248 2.3	TUR	1593 2.5	ESP	2453 3.2
11	AUS	1186 2.2	AUS	1496 2.3	TUR	2354 3.1
12	CHE	936 1.7	SWE	1453 2.2	AUS	1933 2.5
13	BEL	832 1.5	CHN	1286 2.0	SWE	1595 2.1
14	ISR	761 1.4	CHE	1216 1.9	CHE	1505 2.0
15	TUR	735 1.4	BEL	1020 1.6	GRC	1333 1.7
16	RUS	733 1.4	ISR	931 1.4	BEL	1280 1.7
17	AUT	708 1.3	AUT	899 1.4	BRA	1230 1.6
18	FIN	700 1.3	RUS	833 1.3	TWN	1129 1.5
19	CHN	662 1.2	GRC	820 1.3	KOR	1119 1.5
20	TWN	564 1.0	TWN	802 1.2	POL	1112 1.4
21	DNK	544 1.0	FIN	781 1.2	ISR	973 1.3
22	GRC	498 0.9	DNK	762 1.2	AUT	967 1.3
23	NOR	460 0.9	BRA	705 1.1	RUS	941 1.2
24	BRA	454 0.8	KOR	632 1.0	DNK	896 1.2
25	KOR	385 0.7	POL	594 0.9	FIN	886 1.2
	Total	53875 100.0	Total	64801 100.0	Total	76937 100.0

Table 1 Ranked list of the world's 25 leading countries according to scientific output and their share in the world total for three sub-periods²

(see Glänzel et al., 2008). At present, Spain holds rank 10 according to its scientific output in cardiovascular research in the list of the world's most active countries. And Spain is the sixth most active country in Europe.

Publication activity is certainly an important scientometric indicator of national research output in a given research field. Citation-based indicators extend this through measuring the reception of these results by the international scientific community. In order to obtain an objective picture of reality, we normalise the observed impact and supplement the results by measures that reflect the extent of self-citations and foreign citations. These measures are built according to the rules described in the methodological section.

For the first exercise, the 15 most active European countries including Spain have been selected. Selected citation-based indicators for these countries are presented in Table 2. The citation window for each publication is three years, that is, 2000-2002 for papers published in 2000 and 2006-2008 for papers indexed in the 2006 volume of the WoS. The last row of the table contains the data of the world total as reference standard. On average, 22.3% of all papers worldwide remain uncited in an initial period of three years. Above all, in Scandinavia the share of uncited papers is distinctly lower than this reference value. The same applies to the

Netherlands, Switzerland and the UK. The highest share could be observed for Spain followed by France, Poland and Greece. The comparison of the mean citation rate (MOCR) and the share of uncited papers substantiate anew that the correlation between these citation indicators is far from being perfect (cf. van Leeuwen et al, 2005, Glänzel, 2009). Uncitedness of France and Greece in cardiology of about 25% is contrasted by a large deviation of the MOCR values of the two countries (8.0 vs. 5.0). Scandinavia has the highest impact, closely caught up by the Netherlands, Belgium and the UK. Spain and Greece are the only countries in the selection the MOCR values of which are below the reference standard.

The exceptionally high values of Norway, Denmark and Sweden reveal a combination of excellent impact and successful publication strategy. Greece, is according to the indicator values, in the least favourable situation. Although Spain's RCR exceed the reference standard of RCR=1.12, its relatively low mean citation rate points out that Spanish scientists do on the average not publish their research results in high-impact journals.

The share of self-citations of all European countries (except for Greece and, to a certain extent, Austria) are in the same range of about 18%. This, and the fact that the two relative citation rates including and excluding self-citation are obviously well-correlated substantiates that the achieved impact is due to the reception of the research results by the international scientific community.

Code	%Uncited	%Self-cites	MOCR	RCR	RCRX
AUT	21.2	21.4	6.82	1.10	1.06
BEL	19.1	19.2	9.47	1.39	1.36
CHE	17.5	17.6	9.74	1.39	1.39
DEU	21.6	18.4	8.03	1.34	1.34
DNK	16.2	17.5	10.45	1.55	1.56
ESP	28.5	19.8	5.65	1.17	1.15
FIN	12.3	17.7	9.54	1.38	1.40
FRA	25.1	18.1	8.00	1.38	1.39
GBR	17.6	17.1	9.16	1.38	1.39
GRC	25.0	24.9	4.97	1.04	0.95
ITA	18.7	19.0	8.16	1.24	1.22
NLD	13.7	19.5	9.72	1.28	1.26
NOR	15.0	15.5	11.88	1.86	1.92
POL	25.0	17.9	7.06	1.33	1.34
SWE	14.7	17.0	9.59	1.55	1.57
World	22.3	17.2	6.72	1.12	1.13

Table 2 Citation-based indicators for 15 selected European countries (publication period: 2000-2006, citation window: 3 years each; indicators for Spain are highlighted).

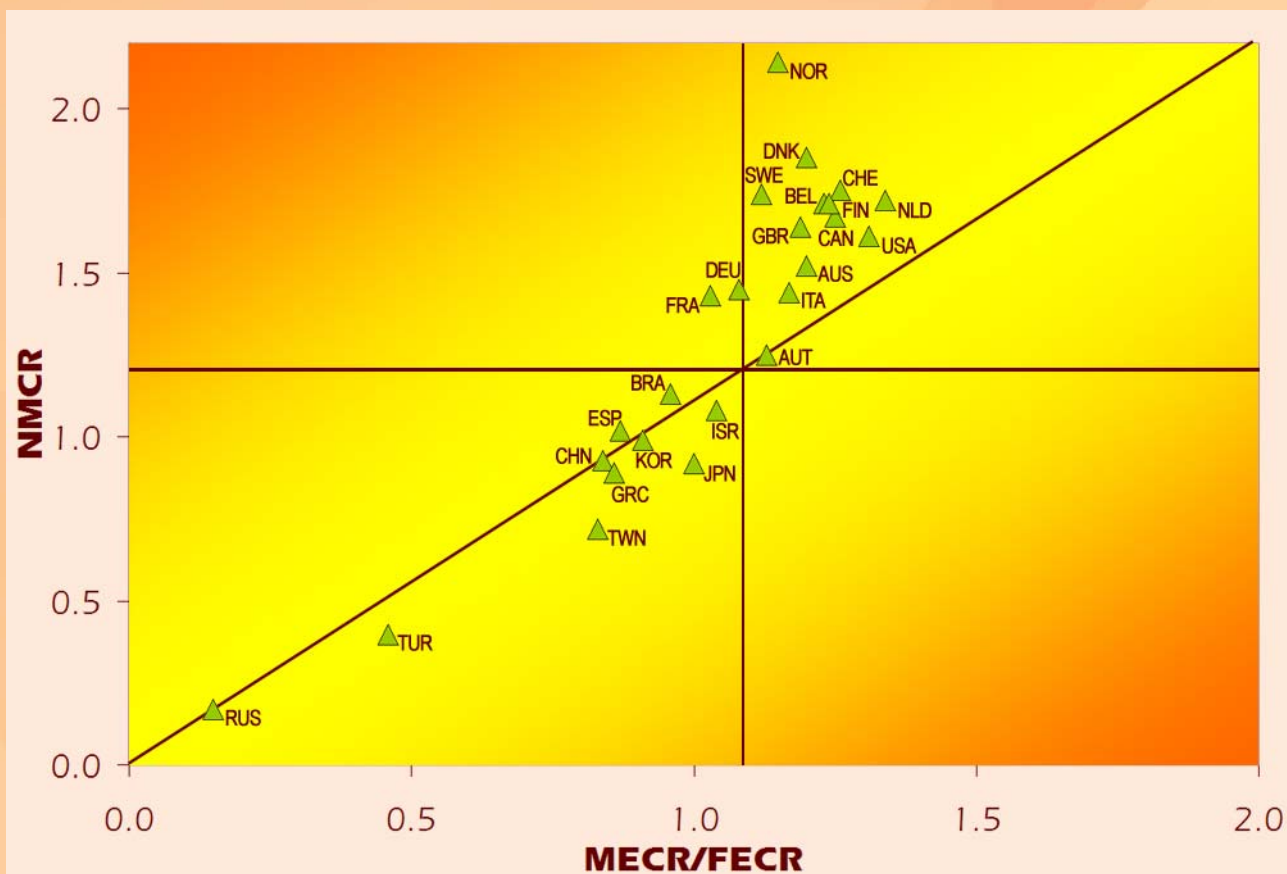


Figure 1 Citation-impact relational chart for the 25 most active countries in cardiology

In order to gain some more inside into the citation impact and the publication strategy of Spanish researchers in cardiology in comparison with their colleagues in the most active countries in the field, the subject-normalised indicators described in the methodological section are presented in relational charts (cf. Glänzel et al., 2009b). The six sections of these relational charts defined by the corresponding reference standard of the underlying indicators stand for characteristic situations of citation impact. The NMCR vs. MECR/FECD values of the most active countries in cardiology in the period 2000-2006 are presented in Figure 1. In this context we have to mention that in the present case NMCR is not equal to 1 by the same reason as for the RCR indicator above. Therefore the relational chart has been adjusted by setting the lines according to the reference standards in cardiology, particularly, $MECD/FECD = 1.08$, $NMCR = 1.21$ and $RCR = 1.12$. The chart confirms the results shown in Table 3. The Scandinavian countries jointly with the US, the UK, the Netherlands and Canada form a strong cluster in the most favourable section of the chart. Spain, Brazil, Israel, Korea and Japan form a cluster around the chart's centre somewhat below the world standard in the field. Finally, Turkey

and Russia are located away from the latter one in the least advantageous sector.

4.2 International Collaboration

Scientific collaboration is, of course, not always 'consummated' in co-authored papers as was shown, among others, by Katz and Martin (1997) and Laudel (2002). Above all if collaboration of individual scientists is concerned, co-authorship is no more than a partial indicator of this type of collaboration. This phenomenon rather applies to so-called intramural collaboration, that is, to collaboration within one research group, department or institute. Nevertheless, intensifying collaboration goes with growing co-authorship (cf. Patel, 1973). On the other hand, so-called extramural collaboration and notably international collaboration is usually well acknowledged by sub- or co-authorship. Scientific collaboration has thus been studied through co-authorship at different levels of aggregation. Above all the spectacular increase of international collaboration during the last decades has aroused science policy interest (e.g., Luukkonen et al., 1992, 1993, Glänzel, 2001, Glänzel and Schubert, 2004).

2000-2002			2003-2005			2006-2008		
Country	Papers	%Share	Country	Papers	%Share	Country	Papers	%Share
AUS	1186	35.2	AUS	1496	39.5	AUS	1933	43.5
AUT	708	29.0	AUT	899	35.7	AUT	967	45.9
BEL	832	49.9	BEL	1020	52.8	BEL	1280	53.2
BRA	454	33.0	BRA	705	34.9	BRA	1230	25.1
CAN	2784	36.4	CAN	3600	39.8	CAN	4193	44.7
CHE	936	45.0	CHE	1216	50.7	CHE	1505	53.1
CHN	662	37.9	CHN	1286	37.8	CHN	2821	32.9
DEU	5555	26.2	DEU	6528	33.1	DEU	7144	35.9
DNK	544	42.1	DNK	762	44.6	DNK	896	48.0
ESP	1541	18.6	ESP	1735	23.0	ESP	2453	25.4
FIN	700	36.0	FIN	781	41.2	FIN	886	43.2
FRA	2643	27.1	FRA	3068	32.5	FRA	3354	37.7
GBR	4762	30.3	GBR	5431	36.6	GBR	6229	42.4
GRC	498	26.9	GRC	820	27.4	GRC	1333	31.1
ISR	761	32.9	ISR	931	30.2	ISR	973	32.3
ITA	3153	27.7	ITA	3987	29.5	ITA	5497	32.6
JPN	5329	12.3	JPN	5614	13.2	JPN	5647	16.7
KOR	385	23.1	KOR	632	21.2	KOR	1119	22.5
NLD	1996	39.9	NLD	2809	40.5	NLD	3463	43.5
POL	350	35.1	POL	594	36.2	POL	1112	29.0
RUS	733	10.2	RUS	833	13.7	RUS	941	14.0
SWE	1248	34.9	SWE	1453	43.9	SWE	1595	50.0
TUR	735	6.0	TUR	1593	7.0	TUR	2354	7.3
TWN	564	14.4	TWN	802	14.7	TWN	1129	18.9
USA	20257	21.0	USA	24313	23.6	USA	27390	26.7

Table 3 Evolution of share of international collaboration of the 25 most active countries cardiology in 2000-2008 (indicators for Spain are highlighted).

Several factors, such as cost-savings, the growing importance of interdisciplinary fields and geographical, economic or cultural interests and intra-scientific factors are pointed out to contribute for the establishment of international collaboration (Beaver and Rosen 1978, 1979, Luukkonen et al., 1992, 1993, Beaver,

2001). Apart from global patterns (cf. Schubert and Braun, 1990), collaboration patterns of selected countries and world regions have been studied as well. Examples are Spain (Gómez et al., 1995), Scandinavia (Glänzel, 2000), and Brazil and Latin-America (Glänzel et al., 2006a).

In the following we will analyse co-authorship links and networks in cardiology with special focus on Spain.

Table 3 presents the evolution of the international collaboration of the 25 most active countries in cardiology in 2000-2008. With the exception of China, Brazil, Korea, Poland and Israel the share of scientific co-publications increased significantly in all selected countries. Belgium,

Switzerland and Sweden are the ones with the largest shares, amounting to or even exceeding 50% in the last subperiod 2006-2008. Turkey had the lowest share which lies distinctly below 10% in all three-year subperiods. Japan, Russia and Taiwan are the other three countries in the selection

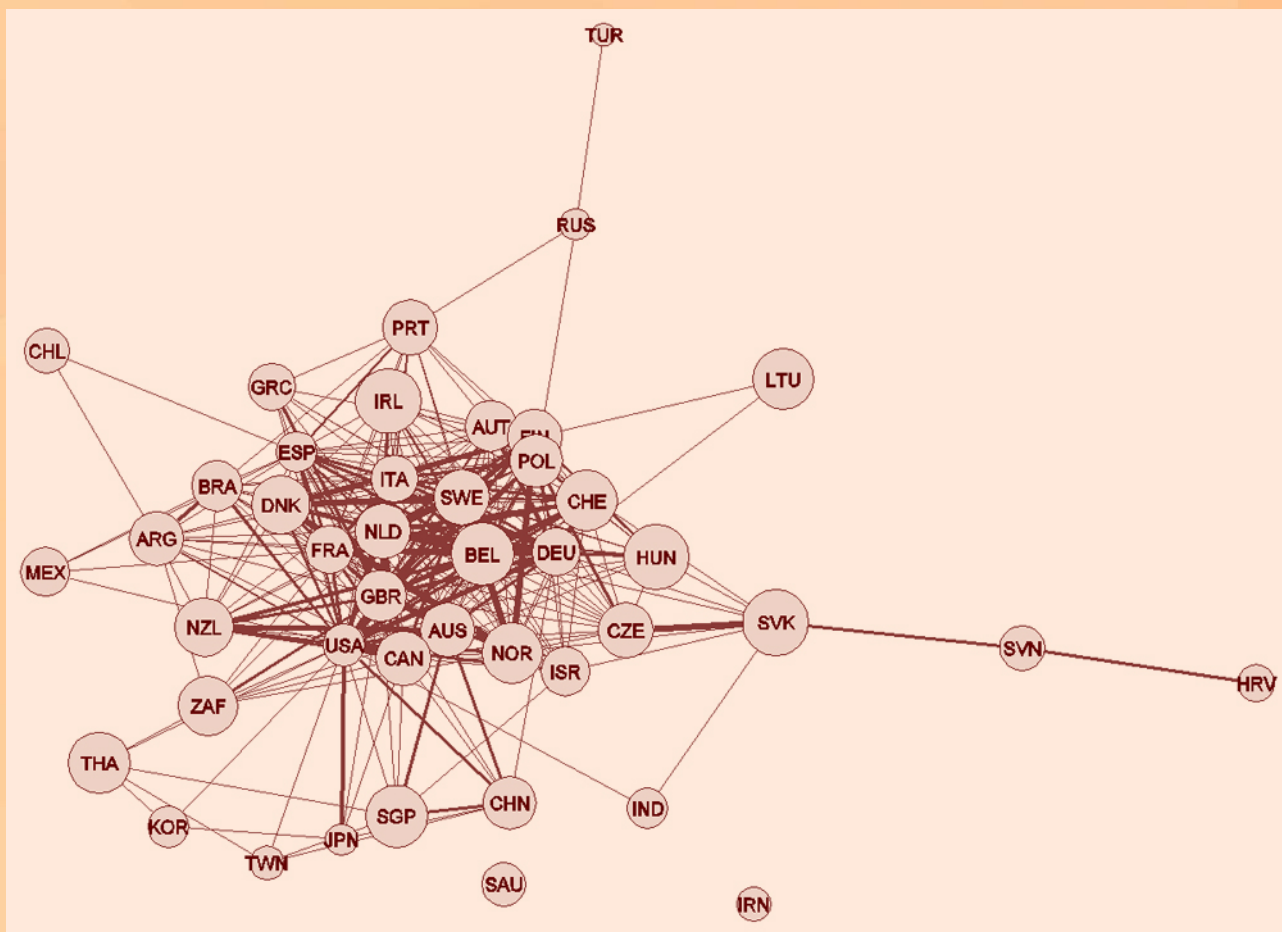


Figure 2 Visualisation of the international collaboration network in cardiology using Pajek [Batagelj and Mrvar, 2002].

with relatively low international co-operativity (<20% each). Spain's share of international publication increased considerably but lies in the lower mid-table.

In order to shed some light of the network of international collaboration in the field, the set of countries has been extended to those 44 countries which proved most active in cardiology in 2000-2006. The network is shown in Figure 2. The size of circles representing the countries are proportional to the share of their international 'co-publications'; the thickness of edges connecting country pairs are proportional to the strength of co-authorship links among these countries. Weak links with Salton measure < 0.01 have been neglected (cf. Saudi Arabia and Iran). Although the dense network reflects intense international collaboration in cardiology, some striking affinities can be detected in the map. The Scandinavian cluster, the strong link between USA and Canada as well as the West-European cluster is in line with general patterns pointed to by earlier studies (cf. Schubert and Braun, 1980, Glänzel, 2001, Glänzel and Schubert, 2004) are supplemented by other, rather local affinities such as the strong link between Belgium and the Netherlands, the Czech Republic and Slovakia, Germany and Austria and a special phenomenon in East/South Europe. Turkey is connected with the triangle Russia-Poland-Portugal through a relatively weak collaboration link with Russia.

The quite strong collaboration link between Spain and Portugal developed gradually (cf. REIST-2, 1997, Glänzel, 2001, Glänzel and Schubert, 2004). The earlier observed affinity of Spain and Portugal with Latin America (Schubert and Glänzel, 2006) could, however, only partially be confirmed in our study because of the minute size of cardiology co-publications among the corresponding countries.

In order to conclude the analysis of international co-authorship in cardiology, we compare the citation impact of 'international' papers, that is, of internationally co-authored publications with that of 'domestic' ones, that is, of publications without any co-authors with affiliation in a different country. The results for the 15 most active European countries are presented in Table 4.

The share of citations received by 'international' papers in all citations considerably exceed the corresponding share of 'international' papers in all publications for all selected countries. This result is not unexpected since international collaboration usual-

Country	% international		Domestic		International	
	Papers	Citations	MECR	RCR	MECR	RCR
AUT	34.2	57.1	5.18	0.86	8.07	1.41
BEL	51.6	69.0	5.29	1.15	8.28	1.53
CHE	48.2	70.0	5.72	0.99	8.39	1.69
DEU	30.5	50.4	5.02	1.14	8.17	1.62
DNK	44.2	70.2	5.87	0.95	7.88	2.11
ESP	21.8	54.1	4.03	0.82	7.59	1.85
FIN	39.3	64.4	6.04	0.93	8.21	1.90
FRA	30.5	57.3	4.70	1.05	8.26	1.82
GBR	34.7	52.6	5.98	1.11	7.88	1.77
GRC	28.2	45.5	4.45	0.85	5.57	1.44
ITA	29.2	52.6	5.80	0.94	8.55	1.72
NLD	40.3	55.7	6.99	1.03	8.45	1.59
NOR	47.5	73.7	5.00	1.19	7.95	2.32
POL	37.0	74.7	3.61	0.79	8.22	1.73
SWE	41.1	66.9	4.97	1.08	7.94	1.97

Table 4 Citation-based indicators for 'domestic' and 'international' publications of 15 selected European countries (publication period: 2000-2006, citation window: 3 years each; indicators for Spain are highlighted). ly results in higher mean citation rates than the national standard, however exceptions to this rule are also known (cf. Glänzel, 2001). The comparison of the journal-based expected citation impact and the relative citation rates substantiate the effect of international collaboration on both visibility (MECR) and observed citation impact (RCR) for all selected countries. The Spanish RCR value of domestic papers in cardiology (0.82) lies distinctly below the neutral value of 1.0. International collaboration raises relative citation impact (1.85) to one of the highest in the country set. Remarkably, a similar trend can be observed for two "leading" European countries in the field, Denmark and Finland; their domestic impact (RCR) does not reach the standard value but the relative citation rate of their international papers belongs to the highest ones in the group.

5. Conclusions

This study has confirmed and deepened the results of earlier related studies. In particular, Spanish cardiovascular research showed an increasing international visibility as reflected by the growing number of publications indexed in the Web of Science database. Spain holds a stable leading position in the world ranking of most productive countries in the field. Intensifying collaboration has certainly contributed to the increasing visibility. Nonetheless, In terms of citation impact Spain still needs to catch up with the leading countries, above all, with Scandinavia and Central Europe. Spanish scientists have already established medium and strong collaboration links with their colleagues from these countries. The divide between the impact of domestic papers and internationally co-authored publications is still big. The domestic research

landscape in Spain is characterised by a large extent of polarisation between the citation impact and visibility of research at the different institutes as has shown in an extended study on Spanish cardiology research by Bolaños-Pizarro et al. (0000).

Notes

- ¹ If subjects are defined on the basis of the ISI Subject Categories, and journals as entities are assigned to those categories are aggregations, the NMCR and RCR values calculated for the world total, are by definition equal to the neutral value one. In the present case, several journals and ISI subject categories are due to the hybrid search strategy only partially covered, that is, NMCR (RCR) is not equal to 1.
- ² The country assignment of the three-letter ISO codes countries can be found in the Appendix (Table A1).

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Code	Country	Code	Country	Code	Country	Code	Country
ARG	ARGENTINA	DNK	DENMARK	ISR	ISRAEL	RUS	RUSSIAN FEDERATION
AUS	AUSTRALIA	ESP	SPAIN	ITA	ITALY	SAU	SAUDI ARABIA
AUT	AUSTRIA	FIN	FINLAND	JPN	JAPAN	SGP	SINGAPORE
BEL	BELGIUM	FRA	FRANCE	KOR	KOREA	SVK	SLOVAKIA
BRA	BRAZIL	GBR	UNITED KINGDOM	LTU	LITHUANIA	SVN	SLOVENIA
CAN	CANADA	GRC	GREECE	MEX	MEXICO	SWE	SWEDEN
CHE	SWITZERLAND	HRV	CROATIA	NLD	NETHERLANDS	THA	THAILAND
CHL	CHILE	HUN	HUNGARY	NOR	NORWAY	TUR	TURKEY
CHN	CHINA	IND	INDIA	NZL	NEW ZEALAND	TWN	TAIWAN
CZE	CZECH REPUBLIC	IRL	IRELAND	POL	POLAND	USA	USA
DEU	GERMANY	IRN	IRAN	PRT	PORTUGAL	ZAF	SOUTH AFRICA

Appendix Country codes of 44 selected countries according to the ISO standard



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