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EDITORIAL

■ Three Years of ISSI Newsletter

Time is elapsing quickly. It was just three years ago when we started up this e-zine. Now, a dozen issues of our Newsletter has appeared and it is time to look behind. Our original intention when founding this e-zine was "to carefully select, bundle and present relevant information in an individual form along with contributions of common interest such as feature reports, facts and figures, literature reviews, conference reports, interviews, photos (with subtitles), cartoons and anecdotes."

I hope that we succeeded in accomplishing our ambitious aims and beyond providing the members of our Society and all those who are interested in our field with a mixture of (hopefully) useful information and entertainment, we were even able to publish a number of short research notes on topical questions in bibliometrics, informetrics and webometrics.

Six of those about twenty notes published during the last three years have been found worth of being cited in the current literature. Figure 1 presents the citation patterns of these papers in the mirror of three citation indices, the Web of Science (WoS) of Thomson Scientific, Elsevier's Scopus and Google Scholar (GS). Citations have been retrieved on 29 February 2008.

Although citation rates found in Scopus regularly exceeded those retrieved from the WoS, the correlation between the two citation patterns was very strong ($r = 0.996$). By contrast, correlation between citation rates found in Google Scholar and the two bibliographic databases was distinctly weaker

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Editorial Board

(r < 0.8). The bar representing the high citation rate (19 cites) of paper #6 is indicated by a dotted line because GS did not directly refer to the Newsletter but to the repository where a PDF version of the paper is stored. I just mention in passing that most citations were not self-citations and that the disciplinary spectrum of citing papers rages from LIS over physics to the life sciences.

An anniversary is not only a reason for looking back; it is also the time to look ahead. And it is certainly the time for some changes as well. We will use this occasion to change the constitution of the editorial board in order to give new members the opportunity to help and contribute with their inspiration and commitment. The Editors of this e-zine would like to express their sincere thanks and appreciation to those members departing of the board. We offer our thanks to Aparna Basu (India) and Liwen Vaughan (Canada)

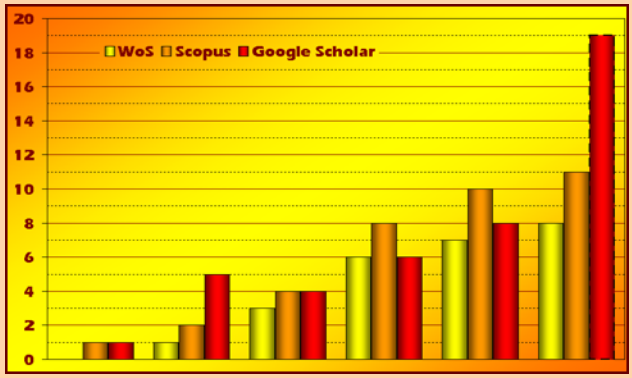

Figure 1 The ISSI Newsletter in the mirror of citation indices

for their contributions in the past. At the same time we warmly welcome two new members, Dietmar Wolfram (Canada) and Sujit Bhattacharya (India). Jointly with the members remaining in the board, we are looking forward to further years of fruitful co-operation.

Wolfgang Glänzel

Editor-in-Chief

CONFERENCE CALLS

NORSLIS PhD Course on Informetrics

Purpose of the course: Over the last decade or so, informetrics has become a 'hot topic', not the least in terms of applying informetric indicators for the purpose of research evaluation (and to some extent also, the allocation of research funds). This, together with e.g. an increased effort from the university libraries to build institutional repositories to gather data on local publication activities, has made informetrics a sought-after competency in both the library and research policy sector. Furthermore, informetrics has been one of the main research perspectives in LIS during the last 30 years. The course will present various perspectives on informetrics as research practice, in terms of its application for research evaluation and for mapping research fields, as well as the relation between informetric analyses and theories on the social and intellectual organization of research fields.

The course is primarily intended for PhD students within the NORSLIS network. Provided there is room for more participants, the course will also be open for PhD students from adjacent fields or other LIS departments, as well as senior researchers from NORSLIS and other departments. Research students are required to submit a five-page abstract (approx. 2500 words) of their PhD research topic, including research questions and the methodical issues of the research project. The application should also include a brief CV. This information will be used for selection purposes (where NORSLIS PhD students will be prioritized). Please, send the application as word or PDF file by e-mail to Fredrik Åström. NORSLIS recommends 5 ECTS (European Credit Transfer System) for our research courses.

Main responsible person: PhD Fredrik Åström, Lund University Libraries • **Local host:** Prof. Olle Persson, Umeå University • **Lecturers:** Assoc. Prof. Birger Larsen (Copenhagen) • Assoc. Prof. Lennart Björneborn (Copenhagen) • Assoc. Prof. Jesper W Schneider (Aalborg) • Asst. Prof. Rickard Danell (Umeå) • Dr Richard Klavans (SciTech Strategies, Inc., USA)

Location: Dept of Sociology, Umeå University, Sweden (http://www.umu.se/soc) • **Time:** June 15-19, 2008

Application deadline: April 1, 2008 • **Course webpage:** http://www.norslis.net/2008/norslisinformetrics.htm

10th International Conference on Science and Technology Indicators

Excellence and Emergence – A new Challenge for the Combination of Quantitative and Qualitative Approaches

Announcement & Call for Papers

The Austrian Research Centers GmbH – ARC and the University of Vienna are jointly organising the 10th International S&T Indicators Conference from 17 to 20 September 2008 at the University of Vienna, Vienna, Austria. There will be a welcoming reception on the evening of Wednesday 17 September.

Science and Technology (S&T) indicators have a long tradition as instruments for the quantitative measurement of S&T performance and development. New challenges appear in the S&T producing system: growing competition, efficiency and the call for excellence. On the other hand new dimensions in research are created through expanding electronic resources, research progress around the knowledge-based society and increasing importance of new concepts like network analysis or mapping of science.

The S&T Indicators 2008 conference in Vienna will be organised around the **following main themes:**

- *Theme 1* Quantitative and qualitative approaches: a special focus in evaluation of the academic performance;
- *Theme 2* S&T indicators for the identification of emerging fields;
- *Theme 3* Disciplinary relevance of bibliometric indicators: Science and Technology, Social Sciences and Humanities;
- *Theme 4* Interactions between Open Access initiatives and scientometrics;
- *Theme 5* Visualisation and Science Mapping: tools, methods and applications;
- *Theme 6* Accuracy and reliability of data sources for scientometric studies;
- *Theme 7* Management and measurement of bibliometric data within scientific organisations.

The language of the conference will be English.

■ The conference will be of interest to:

- Policy makers and politicians concerned with the design and implementation of national and international S&T policy;
- R&D managers in funding agencies, in universities and research institutes, and in the business sector;
- Information scientists and statisticians, especially those interested in S&T data;
- Researchers in the field of S&T studies;
- Science publishers and editors, writers and journalists and database vendors;
- Librarians

■ Important dates

25 Apr:	Deadline for extended abstracts
27 Jun:	Notification to the contributors
30 Jun:	Announcement of accepted contributions
01 Aug:	Publication of preliminary program
15 Aug:	Deadline for revised abstracts (to be published in book of abstracts)
01 Sep:	Deadline for slides in PowerPoint
17 Sep:	Registration and informal get-together
18-20 Sep:	Conference

■ Organisation

Programme Chair: Antony van Raan
Programme Co-Chair: Juan Gorraiz
Conference Chair: Edgar Schiebel
Local Committee: Marianne Hörlesberger, Michael Barber, Bernhard Dachs, Martin Fieder, Michael Greil, Barbara Heller-Schuh, Andrea Kasztler, Alexander Kaufmann, Karl-Heinz Leitner, Wolfgang Mayer, Manfred Paier, Ralph Reimann, Dorothea Sturn, Bernard Wallner, Lucas Zinner.

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■ Call for Papers

You are kindly invited to submit an extended abstract of 600–800 words. The abstract should be submitted by e-mail to STIConf2008@arcs.ac.at as Rich Text Format or MS Word attachment file. Your paper will only be accepted if it follows the extended abstract format:

a) The author(s) name(s),
b) Affiliation and complete mailing address of the contact person, with phone, fax and e-mail are to be shown at the top of the first page
c) Suggested primary and secondary conference theme (Theme 1 to 7)
d) Keywords: four to six terms which characterize the contribution.
e) Title
f) Abstract (600 to 800 words) should be structured as follows:

- background,
- problem/ application,
- methodology,
- outcome/findings/results,
- conclusion,
- references.

■ Conference website: http://www.sti2008.at/

■ Contact

Silvia Steinbrunner
Austrian Research Centers GmbH
– ARC systems research
Donau-City-Straße 1
A-1220 Wien, Austria
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4th UK Social Networks Conference

Friday 18th - Sunday 20th July 2008
University of Greenwich, London

The UK Social Network Conference offers an interdisciplinary venue for social and behavioral scientists, sociologists, educationalists, political scientists, mathematicians, computer scientists, physicists, practitioners and others to present their work in the area of social networks. The primary objective of the Conference is to facilitate interactions between the many different disciplines interested in network analysis. The Conference provides a unique opportunity for the dissemination and debate of recent advances in theoretical and experimental network research.

Keynote Speakers: • Ron Burt (University of Chicago) • Martin Everett (University of East London) • Tom Snijders (University of Oxford, University of Groningen)

Call for Papers: We invite submissions of extended abstracts on theories, methods, or applications of social network analysis. Submission of full papers is not required. Extended abstracts should be of no more than three pages and clearly indicate either the research purpose, methodology, and findings, or the discussion area and implications for the field.

Topics include, but are not limited to: • Policy, political and governance networks • Business and organisational networks • Knowledge, innovation and communication networks • Interlocking directors and elite networks • Economic and entrepreneurial networks • Citations and scientific networks • Social capital, brokerage and structural holes • Models of network analysis • Theory of relational sociology • Cross-sectional and longitudinal network datasets • Computational models and agent-based simulations of networks • Information diffusion and innovation through social networks • Online communities and social networking • Methods for interrupting clandestine and terrorist networks • Professional practice in network analysis

Location: This conference, hosted by the University of Greenwich Business School, is being held in the magnificent UNESCO World Heritage Site, Old Royal Naval College, Park Row, London, SE10 9LS.

Academic Committee: Dimitris Christopoulos (University of West of England and University of Bristol) • Bruce Cronin (University of Greenwich) • Federico Varese (University of Oxford) • Pietro Panzarasa (Queen Mary College, University of London)

Important dates: April 7: Abstract submission deadline; April 30: Provisional programme available; May 30: Registration deadline

For more information, booking details and paper submissions:
http://www.gre.ac.uk/schools/business/conferences-events/sna_conference

13th Nordic Workshop on Bibliometrics and Research Policy

11-12 September 2008; TaSTI, University of Tampere, Finland

Call for Presentations

The Unit for Science, Technology and Innovation Studies (TaSTI) organizes the 13th Nordic Workshop on Bibliometrics and Research Policy 11-12 September 2008 in University of Tampere, Finland Bibliometric researchers in the Nordic countries have arranged annual Nordic workshops on bibliometrics since 1996:

1996 in Helsinki	1999 in Copenhagen	2002 in Oslo	2005 in Stockholm
1997 in Stockholm	2000 in Oulu	2003 in Aalborg	2006 in Oslo
1998 in Oslo	2001 in Stockholm	2004 in Turku	2007 in Copenhagen

The general idea of the workshop is to present recent bibliometric research in the Nordic countries and to create better linkages between bibliometric research groups and their PhD students. The workshop language is English and the workshop is open to participants from any nation.

The participants who wish to present a research paper or a research idea are called for an abstract of their presentation no later than August 4th, 2008. The workshop is also open to participants without a presentation. Final date for registrations is August 11th, 2008.

There are no fees for participating in the workshop. Travel and accommodation have to be arranged and sponsored by the participants themselves.

More information on the workshop is available on the website: http://www.uta.fi/conference/nwb2008/

Workshop organizers: *Hanna-Mari Pasanen*, *Laura Himanen*, *Erkki Kaukonen* and *Otto Auranen*
Unit for Science, Technology and Innovation Studies (TaSTI), University of Tampere, Finland

TRIAD OR TETRAD: ANOTHER REPRESENTATION

Ronald Rousseau
KHBO
Ostend, Belgium

Introduction

In this year's first issue of *Scientometrics* Wolfgang Glänzel, Koenraad Debackere and Martin Meyer (Glänzel et al., 2008) present an article related to the US-EU race for world leadership in science and technology. Besides these two leaders a third, Japan, and recently a fourth (China) challenger have entered the fray.

I will not discuss this article, but, instead show how a visual representation that I introduced many years ago (Rousseau, 1989a,b) can be used to illustrate some of the findings of this article. This approach, called the barycentre method, has two variants: one represents results on an actual geographic map (Rousseau, 1989a), and has been used to study the publication centre of China (Jin & Rousseau, 2001), the other one represents data in a regular polygon (Rousseau, 1989b) and has been incorporated in (Egghe & Rousseau, 1990). I will apply the polygon approach to illustrate the publication relations between the Tetrad, and between the Tetrad and the rest of the world.

Standardised polygons

When studying a system with n components (n >= 3) quantitative relations between its components can be represented using a regular n-gon inscribed in a circle of radius one. Hence, each vertex of the regular n-gon lies at a distance one of the centre of the circumscribed circle. The actual orientation of this polygon is of no importance as only relative shares are represented. The order in which vertices are assigned to the different components does matter, but will not be discussed here.

The barycentre of the system is defined as the point $C = (C_1, C_2)$, where

$$C_1 = \frac{\sum_{j=1}^{n} m_j L_{j,1}}{M} \; ; \; C_2 = \frac{\sum_{j=1}^{n} m_j L_{j,2}}{M} \; ; \; M = \sum_{j=1}^{n} m_j$$

$L_j = (L_{j,1}, L_{j,2})$ is the location of the j-th element in the system (the place of the j^{th} vertex of the regular n-gon), m_j is the contribution of the j^{th} element, and m_j/M is the relative contribution of the j^{th} element.

As components are represented by vertices of a regular polygon the centre of the circumscribed circle is the equilibrium point of the whole system, i.e. the place where the barycentre is situated in case all components have an equal share. As the barycentre C belongs to the convex hull of the L_j, C is always a point belonging to the closed n-gon.

The movement of the barycentre over time visualizes changes in the system. In particular, it shows which component or components become relatively stronger and which become weaker.

Representations

Figure 1 shows the Tetrad and the relative change in publications as covered by the WoS (data taken from (Glänzel et al., 2008)). The barycentre of the Tetrad system is clearly situated on the US-EU side, more or less in the middle between the two regions. Yet, over time the barycentre is clearly moving upwards (towards Europe, and to the right, in the direction of China.

Including the 'rest of the world' as a fifth player, does not add a lot of information. Also here one sees a movement to the top (Europe) and to the right (China), and clearly away from Japan.

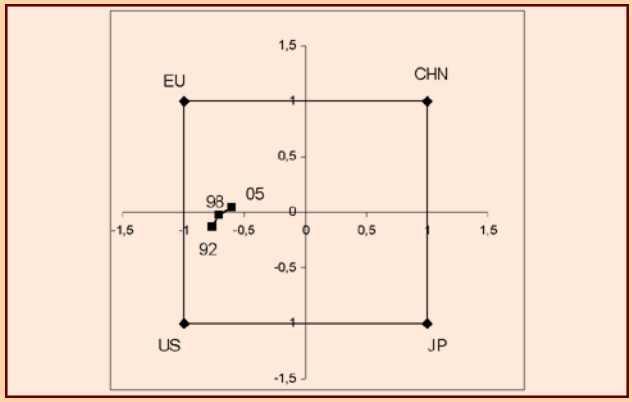

Figure 1 Representation of the Tetrad publication system

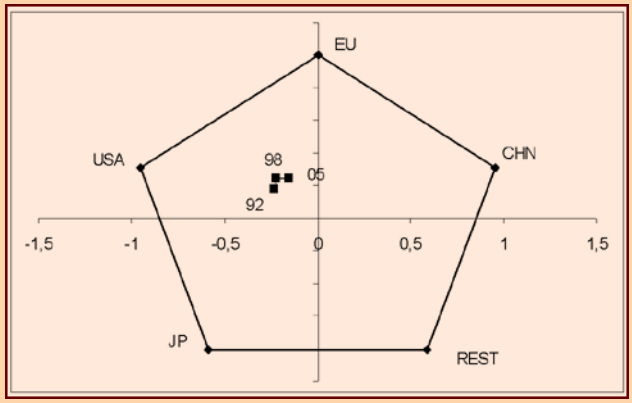

Figure 2 Representation of the publication system of the Tetrad and the Rest of the World

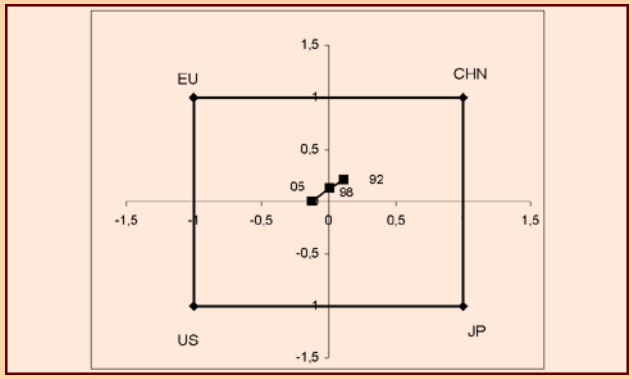

Figure 3 Representation of relative percentages of international publications

Finally, percentages of international publications are represented (data are again taken from the Glänzel et al. (2008) article. Here China's part decreases, while the United States' increases (see Figure 3), showing that the US published relatively more articles in collaboration with foreign partners, while China relaxed its dependence on foreign collaboration.

Conclusion

I am convinced that the barycentre method may yield a useful visualization of many relations between elements in a system. As such I hope it will be applied more than it has been in the past years.

References

Egghe L, Rousseau R (1990). *Introduction to Informetrics*. Amsterdam: Elsevier.

Glänzel W, Debackere K, and Meyer, M. (2008). ' Triad' or ' tetrad' ? On global changes in a dynamic world. *Scientometrics*, 74, 71-88.

Jin BH, Rousseau R (2001). An introduction to the barycentre method with an application to China's mean centre of publication. *Libri*, 51, 225-233.

Rousseau R (1989a). Kinematical statistics of scientific output. Part I: geographical approach. *Revue française de Bibliométrie*, 4, 50-64.

Rousseau R (1989b). Kinematical statistics of scientific output. Part II: standardized polygonal approach. *Revue française de Bibliométrie*, 4, 65-77.

CHINA RANKS SECOND IN SCIENTIFIC PUBLICATIONS SINCE 2006

Ping Zhou

Steunpunt O&O Indicatoren, Katholieke Universiteit Leuven, Belgium; & Institute of Scientific and Technical Information of China, Beijing, China

Loet Leydesdorff

Amsterdam School of Communications Research (ASCoR), University of Amsterdam The Netherlands

Abstract: With the fast development of its economy, China plays an increasingly important role in the world. China's performance in science is also impressive. The exponential growth of Chinese scientific publications provides evidence. However, statistical results about China's world share of scientific publications provided by different institutions and researchers have been in disagreement. With the data for 2007 being now available, we provide an update on this issue and conclude that China has become the second largest producer of scientific publications since 2006.

Keywords: China, SCIE, scientific publications, world share, rank

Various analyses of the growth of scientific literature showed that China became a leading nation in science (Zhou & Leydesdorff, 2006; Kostoff, 2007a). In high-tech fields, China's performance in nanotechnology and space technology is worth mentioning: China's share of publications in nanoscience and nanotechnology grows steadily and is closing the gap with that of the USA (Leydesdorff & Zhou, 2007; Kostoff, 2007b). The successful launch of the satellite Chang'e-1 for lunar probe in 2007 showed the Chinese strength in space technology.

Statistics about China's rank in terms of scientific publications have recently been somewhat confusing. Based on data from the *Science Citation Index Expanded* (*SCIE*), the Institute of Scientific and Technical Information of China (ISTIC) concluded that China ranked *fifth* in 2006 (ISTIC, 2007). The four countries ahead of China would be: the USA, the United Kingdom, Germany, and Japan. The producer of the *SCIE*, Thomson Scientific, obtained the same result

(Thomson Scientific, 2007). However, the results of these two institutions were based on different document types: the ISTIC counted all documents while Thomson Scientific included only four types of documents: articles, notes, reviews, and proceedings. The resulting figures about China's world share of publications were 5.9% (ISTIC) and 7.75% (Thomson Scientific).

Based on the same database (*SCIE*) but using different document types (articles, letters, notes, and reviews), Leydesdorff & Wagner (2007) had earlier concluded that China was the second country in the ranking already in 2006. Considering this ambiguity, we decided to repeat the measurement including 2007, when the *SCIE* data for the year 2007 was completed in January 2008. What is China's position in the world of science in terms of scientific publications? Did the exponential growth curve continue?

Figure 1 provides the evolutionary track of major countries and world regions in terms of percentages of world share of scientific publications based on the *SCIE*. In accordance with standard scientometric practice we used only four types of documents: articles, letters, notes, and reviews. Data was collected on January 14, 2008. This database allows for integer counting.

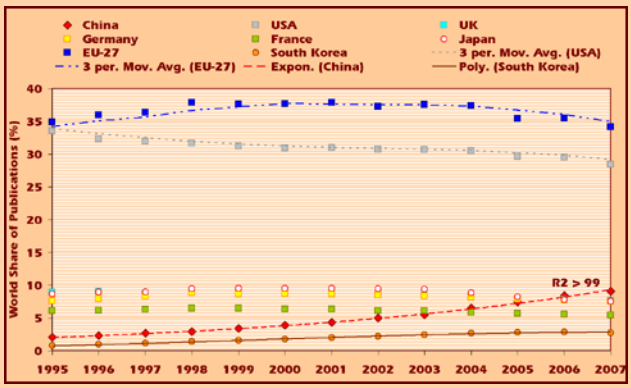

Figure 1 Percentages of world share of publications of selected countries/regions (1995-2007, *SCIE*)

In 2007, China ranks second beyond further doubt. Only the USA stands ahead of China. Using this indicator, China was already second in 2006, but the differences between China and the UK or Germany were so small that the use of different parameters could easily lead to different results. In 2006, China's percentage of world share of publications was 8.4%, while the corresponding percentages for the UK and Germany were 7.8% and 7.7%, respectively. In 2007, China's world share increased to 9.1% in 2007, leaving the UK (7.7%), Germany (7.5%), and Japan (7.6%) further behind. The differences are no longer marginal and the other large units are stable or relatively declining in terms of percentages.

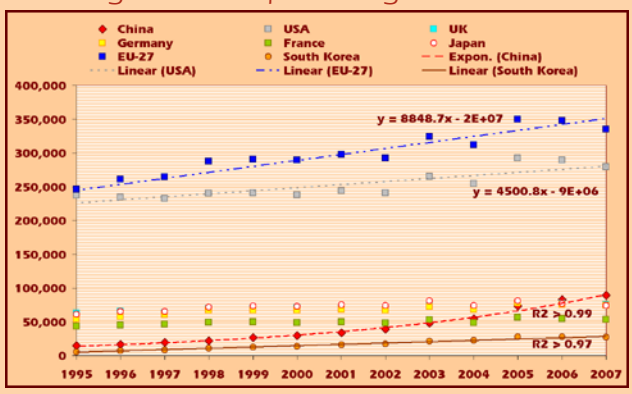

Figure 2 Numbers of publications of selected countries/regions (1995-2007, *SCIE*)

In terms of absolute numbers (Figure 2) and given this database, both the EU and the US have been increasing their numbers taking a longer-term perspective (Hill et al., 2007; NSB, 2008), but these absolute numbers declined during the last three years. The exponential curve provides an almost perfect fit for China's contributions using these figures, too. The UK, Germany, Japan, and France have been relatively stable using this indicator.

The Chinese path of development is unique among scientific nations: China's world share of publication has been growing exponentially both in absolute and relative terms. China is gaining and other major countries/regions are accordingly losing percentage world shares. Different countries/regions reached their production peak at different times. Based on figure 1, the USA has already been going down in relative terms since 1995. The EU reached its peak in 1998 and began to go down more recently. Only China is an exception: it is still on the way of climbing uphill.

The publication development of small countries is shown in Figure 3 using South Korea as the example. South Korea experienced a booming growth in the past ten years. In 1995, the world share of South Korea was the lowest among the countries included in Figure 2 for the comparison. However, it overtook Taiwan in 1997, left Switzerland behind in 2001, and passed the Netherlands in 2004. In 2006, the curve for South Korea seems to have reached its peak, and to bend off to its equilibrium level in the competition for scientific publications.

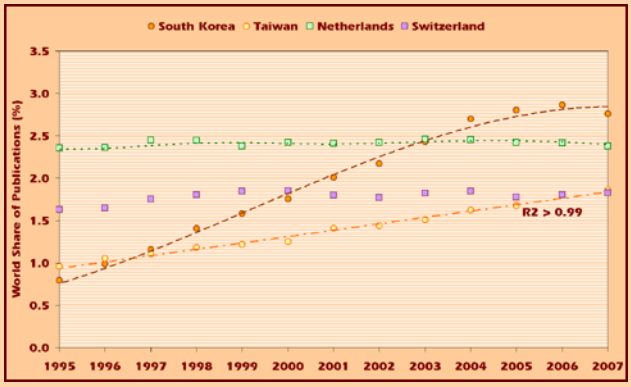

Figure 3 World share of publications of some small countries (1995-2007, *SCIE*)

Taiwan has also known linear growth for more than a decade. Linear growth is the normal pattern for a country which enters the world scene. For example, the figures for the Netherlands showed linear growth during the 1980s and the percentages for Italy and Spain grew linearly during the 1990s (Leydesdorff, 2000).

In summary, China has been the second largest country in terms of scientific publications during the last two years. Unlike most developed countries or regions which have reached their competitive potential in scientific publications, China is still growing. As an important Asian country in science, South Korea had experienced booming during the past ten years, but has reached its peak in scientific output. Taiwan has kept linear growth in the past ten years, and has not yet reached its full potential.

References

Hill, D., Rapoport, A. I., Leming, R. F., & Bell, R. K. (2007). Changing U.S. Output of Scientific Articles: 1988-2003 Washington, DC: National Science Foundation; available at http://www.nsf.gov/statistics/nsf07320/pdf/nsf07320.pdf (retrieved on Feb. 24, 2008).

ISTIC (2006), 2005 年度中国科技论文统计结果 (Statistics of Chinese publications in 2005). Beijing: Institute of Scientific and Technical Information of China.

ISTIC (2007), 2006 年度中国科技论文统计结果 (Statistics of Chinese publications in 2006). Beijing: Institute of Scientific and Technical Information of China.

Kostoff, R. N. (2007a). Chinese science and technology - Structure and infrastructure. Technological Forecasting & Social Change: 74 (2007) 1539-1573.

Kostoff, R. N. (2007b). Technical structure of the global nanoscience and nanotechnology literature. Journal of Nanoparticle Research, 9:701-724.

Leydesdorff, L. (2000). Is the European Union Becoming a Single Publication System? Scientometrics 47(2): 265-280.

Leydesdorff, L. & C. Wagner, Is the United States losing ground in science? A global perspective on the world science system, Proceedings of the 11th International Conference of Scientometrics and Informetrics, D. Torres-Salinas & H. Moed (Eds.), Vol. 1, 499-507, CSIC, Madrid, 21-25 June 2007.

Leydesdorff, L. & P. Zhou (2007). Nanotechnology as a Field of Science: Its Delineation in Terms of Journals and Patents. Scientometrics 70(3): 693-713.

National Science Board. (2008). Science and Engineering Indicators. Washington, DC: National Science Foundation; available at http://www.nsf.gov/statistics/seind08/ (retrieved on Feb. 24, 2008).

Thomson Scientific (2007). Scientific Output in China is Growing. Available at: http://scientific.thomson.com/press/2007/8423909/

Xinhua Net (2006). 国家中长期科学和技术发展规划纲要 2006-2020. (National Medium- and Long-term National Plan for Science and Technology Development 2006-2020). Available at: http://www.gov.cn/jrzg/2006-02/09/content_183787.htm.

Zhou, P. & L. Leydesdorff (2006). The emergence of China as a leading nation in science. Research Policy 35(1):83-104.

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TURKEY ON THE WAY TO THE EUROPEAN UNION? ON A SCIENTIFIC POWER RISING NEXT DOOR

Wolfgang Glänzel
Katholieke Universiteit Leuven, Steunpunt O&O Indicatoren, Dept. MSI, Leuven (Belgium) & Hungarian Academy of Sciences, Institute for Research Policy Studies, Budapest (Hungary)

Abstract: The spectacular increase of Turkey's research output in the sciences is studied on the basis of the Web of Science database. National publication profiles and citation impact are analysed in the context of the dynamic growth. A special focus is set on international collaboration of Turkish scientists.

Introduction

The spectacular rise of the emerging economies (e.g., *O'Neill*, 2005) has become a favourite topic of the recent literature on science and technology policy. The centre of gravity has actually moved away from the US and Japan, passing the European Union towards China, as has shown, e.g., by *Leydesdorff* and *Zhou* (2005), *Glänzel* et al., (2008) and *Rousseau* (2008). This development has already measurable effect on the balance of power as measured by scientific production. Somewhat overshadowed by the breathtaking growth of the economies in the Far East, countries of other world regions are undergoing dramatic growth and thus contributing to the global changes as well. In fact, scientific literature reports on the impressive developments in South America (e.g., *Zanotto*, 2002, *Glänzel* et al., 2006, *Leta* et al., 2006, *Zitt* et al., 2006), but also in the EU's direct neighbourhood. Recent literature on the rise of *Turkish* science embraces more than 15 papers alone in the journal *Scientometrics*. The articles deal with science and technology policy in Turkey in general and the overall trends of Turkey's publication output (*Yurtsever* and *Gulgoz*, 1999, *Uzun*, 2006), or are concerned with the evolution of output and performance Turkish research in selected science fields (earth science: *Gokceoglu* et al., 2008, physics and astronomy: *Uzun*, 1996, *Uzun* and *Ozel*, 1996, *Inonu* and *Kurnaz*, 2002, biomedical reseach: *Tonta*, 2000, *Tonta* and *Ilhan*, 2002, sports sciences: *Yaman* and *Atay*, 2007, and *Yurtsever* and *Gulgoz*, 1999, in the social sciences). If one keeps in mind that Turkey is aspirant to membership in the European Union, another question arises, particularly, the question of how this development relates to co-operation with and integration into the European science system. From earlier studies we know that the accession and integration process is accompa-

nied by increasing co-publication activity with the European Union and, to a certain extent, by convergence of the corresponding national science systems. This process has been studied for the East European accession countries by Schlemmer (see *Schlemmer* et al., 2004, and *Schlemmer* and *Glänzel*, 2004). Also the European association agreements with Israel on co-operation in trade (Euro-Mediterranean Agreement) and science and technology (Framework Programme for Research and Technical Development, RTD) have accelarated and deepened co-operation between Israel and Europe. In a recent paper, Israel's changing research landscape (*Zimmerman* et al., 2008) was studied in the light of intensifying co-operation with the European Union. Similarly, beyond analysing Turkey's changing national research patterns, we will also investigate to what extent these changes are accompanied by intensifying Turkish-European research collaboration.

Data sources and data processing

The results of this note are based on the bibliographic data extracted from the 1991-2007 annual updates of the *Web of Science* (WoS) of Thomson Scientific (Philadelphia, PA, USA). Only document types named as Articles, Letters, Notes and Reviews were taken into consideration. Publications are assigned to countries on the basis of their corporate addresses as indicated in the by-line of the publication. An integer counting scheme is applied, i.e., all countries appearing in the address field are considered and multiple occurrence of a country within the same publication is de-duplicated. This approach results in counting publications with (at least) one author with an affiliation in the corresponding country. This counting scheme is best suited for analysing both the countries' weight and their international co-publication links, but as a consequence of its application, publications cannot be summed up over countries to the world total (cf. *REIST-2*, 1997).

As for subject classification, the hierarchical classification scheme developed by *Glänzel* and *Schubert* (2003) on the basis of ISI's journal assignment to Subject Categories is applied: Agriculture & Environment (AGRI), Biology (BIOL), Biosciences (BIOS), Biomedical research, Clinical & Experimental Medicine I (CLI1), Clinical & Experimental Medicine II (CLI2), Neuroscience & Behaviour (NEUR), Chemistry (CHEM), Physics (PHYS), Geosciences & Space Sciences (GEOS), Engineering (ENGN) and Mathematics (MATH). The level in between these major fields and the ISI Subject Categories comprises further 60 subfields. A science field has five subfields on average and a subfield aggregates about three ISI Subject Categories each.

For the citation analysis, a three-year citation window beginning with the publication year is applied for selected sub-periods of the above-mentioned publication period. 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.

Methods and results

■ *Publication growth*

The evolution of Turkey's publication output has already been analysed in the context of economic growth and increasing R&D expenditure for the period 1983-2003 (*Uzun*, 2006). Indeed, the dynamic growth is steady and continues beyond this period as well. Taking into account the overall development of the underlying database (Persson et al. 2004), national publication growth is best analysed as the share in the world total. Although there is temporary down-leap in 2006 (cf. Figure 1), a quadratic regression describes the growth prettily well ($r = 0.990$). The average annual growth rate of the Turkish share in the world total amounts to 14.4% in 1991-2007. The absolute increase from about 1,300 papers in the sciences in 1991 to more then 16,000 in 2007 is even more impressing. This evolution mirrors the growth of

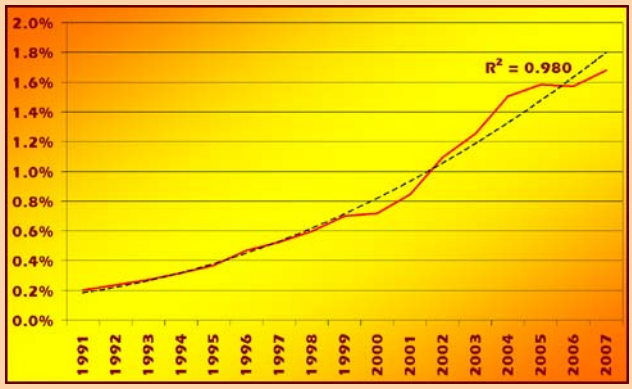


Figure 1 Evolution of Turkish publication output in the sciences in 1991-2007(all fields combined)

R&D expenditure on GDP which rose from 0.32% in 1992 to 0.67% in 2004, but does not yet reach the EU standard of about 1.9%. However, this trend roughly parallels the evolution of the R&D/GDP ratio of its neighbour country Greece where the publication growth did not keep pace with that of Turkey. While Greece moved from rank 30 in 1991 to rank 25 according to the publication output in the sciences and applied sciences, Turkey jumped from rank 38 to position 19 in the same period.

■ *Publication profile*

National publication profiles can preferably be measured and visualised using the *Relative Specialisation Index* (RSI). This measure indicates whether a country has a relatively higher or lower share in world publications in a particular science field than its overall share in the world total (see *REIST-2*, 1997), and is closely related to the *Activity Index* (AI) introduced by *Frame* (1977). Its definition and interpretation can be found in *Glänzel* (2001), therefore, a detailed description of these indicators is omitted here. RSI takes values in the interval [–1, +1]; RSI < 0 (RSI > 0) indicates a lower-than-average (higher-than-average) activity. RSI = 0 reflects a completely balanced situation. RSI is an indicator measuring the internal balance, therefore RSI > 0 for some fields implies RSI < 0 for others and RSI = 0 for all fields corresponds to the 'world standard'. National 'publication profiles' are determined on the basis of the twelve major science fields introduced in the *Data sources and data processing* section. Since subject classification on the basis of journal assignment does practically not result in disjoint subject areas, the classification scheme does not form a partition of the total. The twelve-component profile is therefore preferably visualised in 'clockwork diagrams', where each 'hour' represents one field. The graphical presentation of the 'world standard', i.e., RSI = 0 for all fields, is a regular dodecagon. Deviations from this standard result in to some extent characteristic deformations of the regular octagon. In earlier studies (e.g., *REIST-2*, 1997), four basic paradigmatic patterns in publication profiles could be distinguished, particularly,

I. the 'western model' with clinical medicine and biomedical research as dominating fields,
II. the characteristic pattern of the former socialist countries with prevailing activity in chemistry and physics,
III. the 'bio-environmental model' with biology and earth and space sciences in the main focus,
IV. the 'Japanese model' with engineering and chemistry being predominant.

Turkey's profile does not uniquely fit in any of the above categories (see Figure 2). It can rather be considered a mixture of Types I and III. The evolution is characterised by two general trends, particularly, by growing relative activity in Agriculture & Environment and the Life sciences and decreasing weight of natural and sciences and engineering.

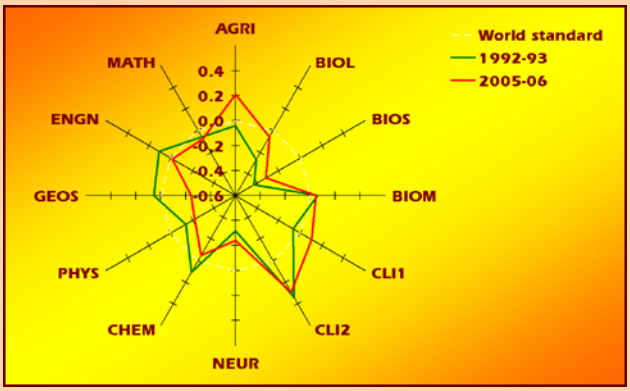


Figure 2 The change of Turkey's publication profile over time

■ *Citation impact*

In this section we will have a look at the evolution of citation impact of Turkish research in the life sciences, natural sciences and applied sciences. The following set of standard indicators is used for this analysis.

1. The *Mean Observed Citation Rate* (MOCR) is defined as the ratio of citation count to publication count.
2. *Mean Expected Citation Rate* (MECR). The expected citation rate of a single paper is defined as the average citation rate of all papers published in the same journal. MECR is defined as the average of these individual expectations over a given paper set.
3. *Relative Citation Rate* (RCR). RCR is defined as the ratio of the observed and journal-based expected citation impact. This indicator measures whether the publications of the unit under study attract more or less

citations than expected on the basis of the journal impact measures of the journals in which they appeared.

4. *Normalised Mean Citation Rate* (NMCR). The field-expected citation rate of a single paper is defined as the average citation rate of all papers published in the same subfield. Since subject assignment is often not unique a fractional counting scheme is applied. NMCR is defined as the ratio of the observed and field-based expected citation impact. This indicator gauges citation rates of the papers against the standards set by the specific subfields. This indicator is based on the 60 subfields according to the above-mentioned SOOI/ISSRU classification scheme.

A detailed description of definition, application and interpretation of these indicators can be found in earlier papers (e.g., *Glänzel* et al, 2003). We just mention here that MOCR = 0 implies RCR = 0 and NMCR = 0, and corresponds to uncitedness; RCR (NMCR) < 1 represents a lower-than-the-average, RCR (NMCR) > 1 a higher-than-the-average situation according to the corresponding reference standards. Finally RCR (NMCR) = 1 means that the papers received the number of citations expected on the basis of the average citation rate of the publishing journals (subfields). A large deviation of RCR from NMCR means that the journals in which authors of the country under study are on average publishing, do usually not conform to the corresponding subject standards. This deviation may be positive or negative.

As explained above, the two relative citation indicators (RCR and NMCR) are practically insensitive two structural changes in the underlying publication output such as described in Figure 2. This allows the direct comparison of the relative citation impact of different years or periods. The situation in 1992, 1996, 2000 and 2004 reflects the evolution by using gaps of four years each. As explained in the outset, a three-year citation window is applied (1992-1994, 1996-1998, 2000-2002 and 2004-2006, respectively). The results are presented in Figure 3. The RCR is steadily and strongly increasing from a quite low level in 1992 towards the standard of 1.0 in 2004. This trend is followed by the NMCR as well but the scissor between the two indices tends to more and more gape apart. The interpretation is obvious; Turkish publications nowadays tend on average to meet the standard of the journals where they are published, but the latter ones still fall behind the standard of the corresponding subject fields.

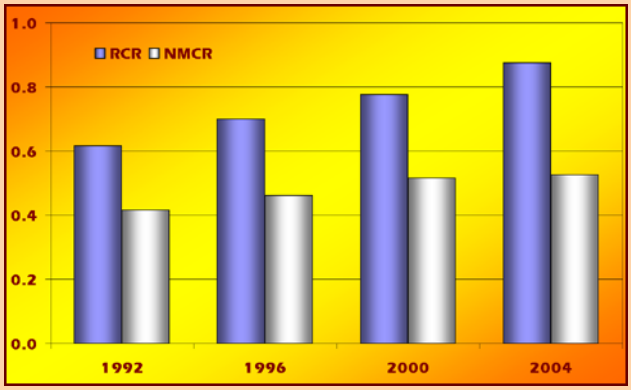


Figure 3 Evolution of citation impact of Turkish publications

The breakdown of citation indicators by major fields substantiates that the increase of relative citation impact has effect on all areas of the sciences. The effect is especially strong in Engineering, Chemistry and Agriculture & Environment (see Figure 4). These observations as well as the above observations concerning the two citation indices are in line with the results reported by Gokceoglu et al. (2008) on international earth science literature from Turkey.

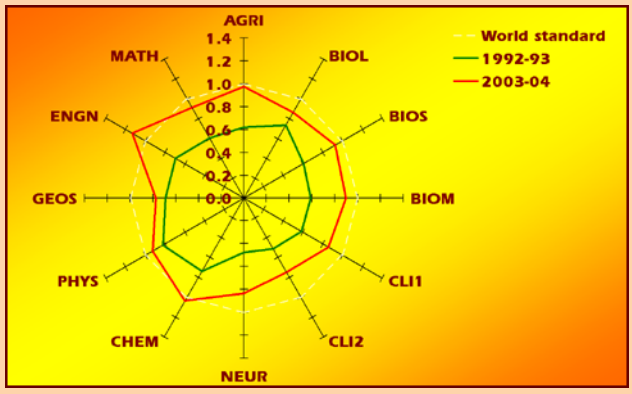


Figure 4 Change of Turkey's Relative Citation Rate over time

■ *International scientific collaboration*

The duality of the co-authorship/co-operation relationship has long been discussed in the bibliometric literature (e.g., Katz and Martin, 1997, Laudel, 2002). At the level of individual authorship (Laudel) or at the institutional level (Katz and Martin), co-authorship does not depict research collaboration entirely, or might be distorted by scientists' multiple affiliations. Nonetheless, co-authorship proved a good proxy for 'higher-level' research collaboration between institutions, regions, and countries. Above all,

international collaboration is usually well acknowledged in the published literature, and therefore a good indicator of co-operation at this level as well (*Glänzel* and *Schubert*, 2004).

Several aspects of international collaboration are of special interest; besides the extent and share of international co-publications, the geopolitical profile of co-publications and the impact of collaborative research are preferred topics of bibliometric analysis. The dramatic intensification of international co-operation at all levels and the structural changes in the collaboration network has repeatedly been reported by several studies. An overview of this literature can be found, among others, in a recent study by *Glänzel* and *Schubert* (2004).

A first look at the publication data reveals a strikingly low level of Turkey's international co-operativity. In contrast to the general trend of intensifying collaboration, Turkey's share of international co-publications in all papers has not changed. It ranged between 16% and 20% over the last 15 years. According to the regularity concerning the relation between foreign co-authorship ratio and the countries size found by Schubert and Braun (1990), one would expect a similar share of 'international papers' for Turkey as found for countries of like size. Table 1 presents the corresponding percentages for all countries with 30,000-72,000 papers in the period 2004-2006. Turkey has distinctly the lowest co-operativity among these countries. Only Taiwan has a similarly low level of international collaboration. The breakdown by partner countries, however, reveals some structural changes in collaboration pattern. Table 2 shows the weight of Turkey's ten most important partners in all papers with foreign partners in the two periods 1992-1994 and 2004-2006. The most impressing change concerns collaboration with the US and the EU[1]. While collaboration with the US considerably increased, co-operation with the 15 member countries of the EU weakened to practically the same extent. Collaboration with the UK and Germany was the most concerned. Another remarkable trend concerns Japan and Switzerland; the two countries have interchanged there position in the ranking of most important partners. A final interesting observation is Turkey's strong co-publication link with Azerbaijan. The overwhelming majority of joint papers of these two countries are result of bilateral co-operation; multinational collaboration remains the exception. Most papers were concerned with Physics, Engineering, Geosciences & Space sciences and Chemistry. The share of life sciences was small.

Table 1 Share of internationally co-authored papers in all papers of selected countries (2004-2006)

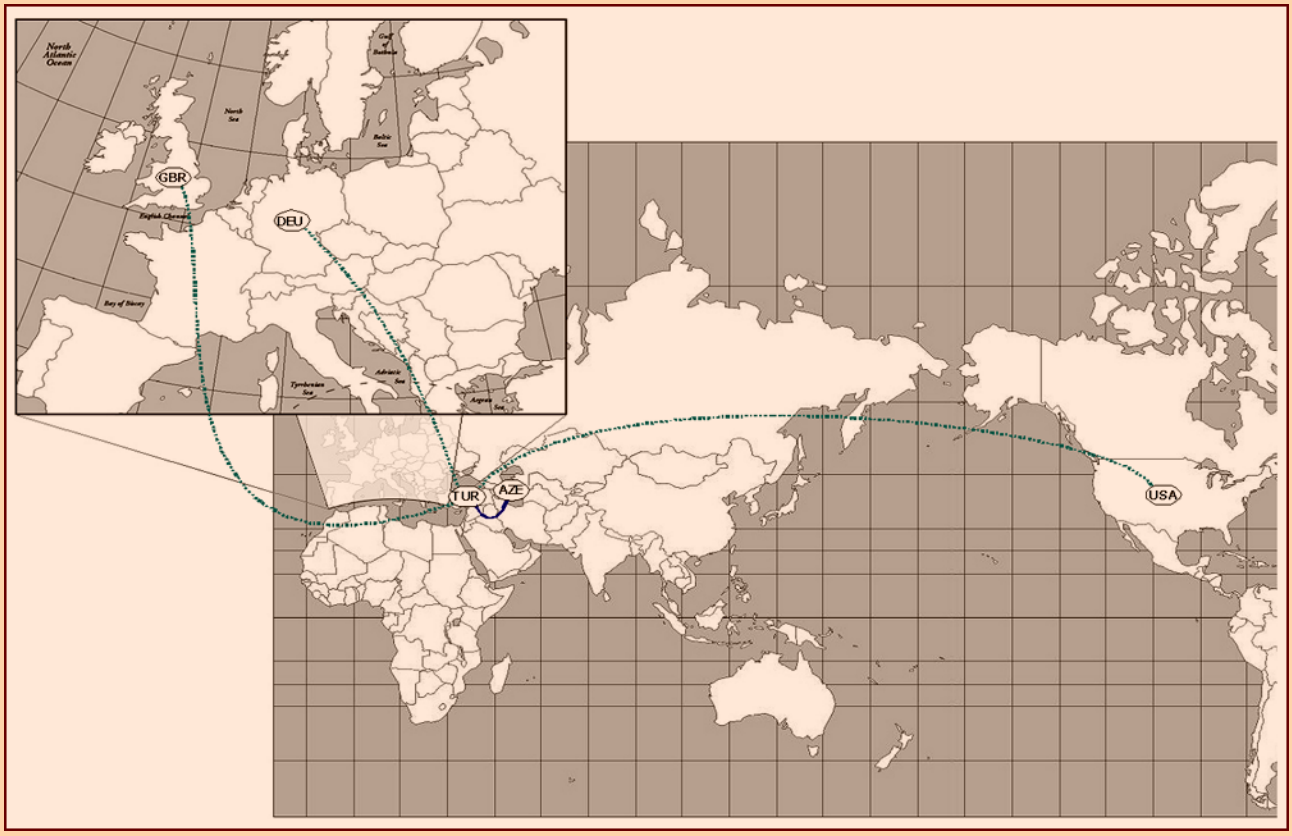
Country	Papers	Share
Switzerland	51,338	59.0%
Belgium	38,856	55.0%
Sweden	50,601	50.2%
Netherlands	70,516	48.3%
Israel	31,923	41.9%
Poland	42,843	39.4%
Russia	72,034	37.6%
Brazil	51,799	30.9%
Taiwan	48,144	18.9%
Turkey	43,784	16.2%

In order to measure Turkey's co-publication links with individual partners, Salton's (cosine) measure is used as an indicator of collaboration strength. In verbal terms, it can be expressed as the number of joint publications divided by the geometric mean of total publication outputs of the corresponding pair of countries (cf. *Glänzel*, 2001). Consequently, the strength of a bilateral co-operation is subject to the evolution of the partners' individual publication output, and might change even if the share of bilateral papers in the output of one of the countries is unchanged.

Table 2 Share of co-publications with Turkey's most important partners in all Turkish 'international papers' in the 1990's and in the new millennium

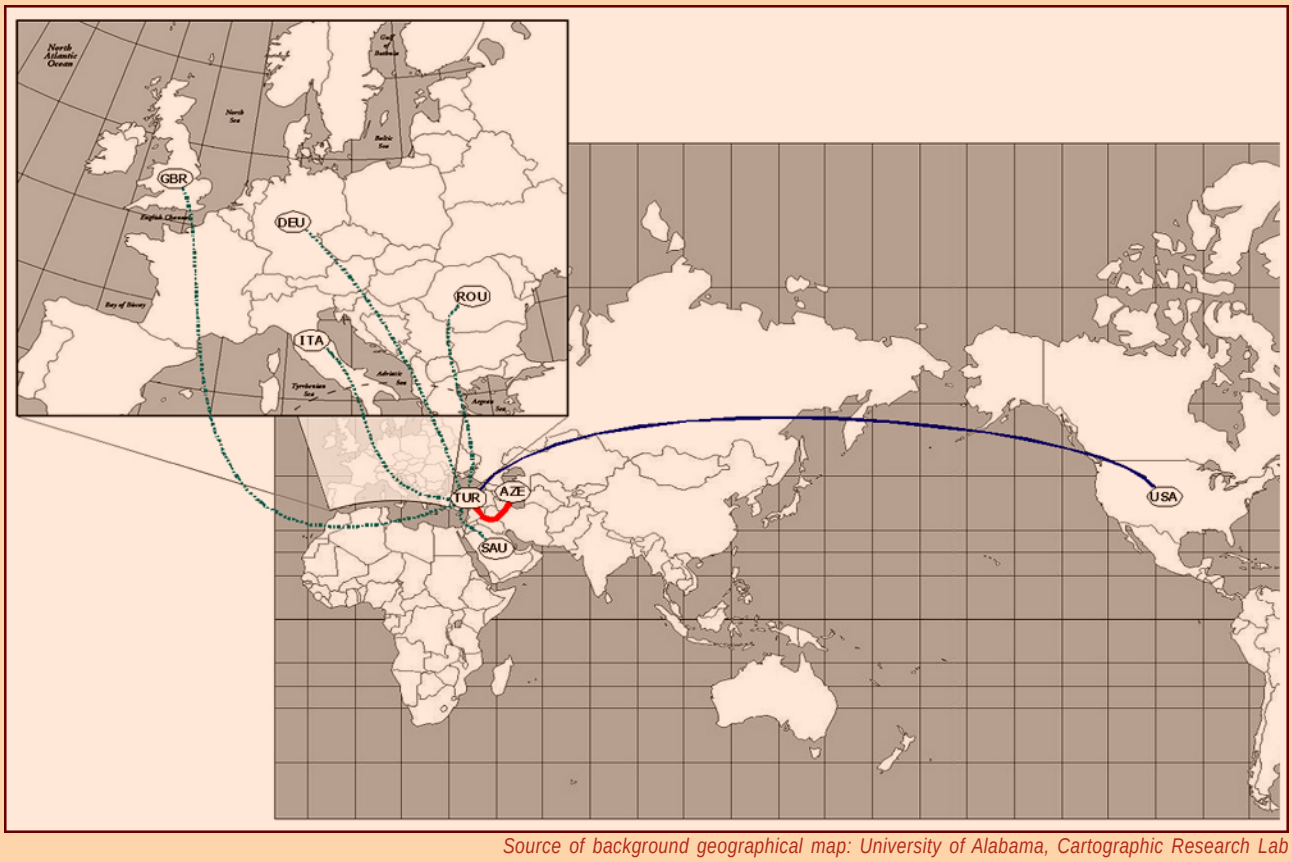
Rank	1992-1994		2004-2006	
	Country	Share	Country	Share
1	*EU15*	*49.6%*	USA	43.2%
2	USA	36.4%	*EU15*	*40.8%*
3	UK	18.4%	UK	12.9%
4	Germany	16.9%	Germany	12.3%
5	Italy	6.4%	Italy	6.2%
6	France	5.3%	France	5.5%
7	Switzerland	4.5%	Japan	5.1%
8	Canada	3.7%	Canada	4.1%
9	Netherlands	3.4%	Netherlands	3.3%
10	Belgium	3.1%	Russia	2.8%
11	Japan	2.9%	Switzerland	2.6%
12	Azerbaijan	2.6%	Belgium	2.5%
13	Russia	2.5%	Israel	2.4%
14	Israel	2.1%	Spain	2.4%
15	Spain	1.9%	Azerbaijan	2.1%

[1] In this study the constitution of the European Union till 2003 is used. The members of the EU15 are Austria, Belgium, Denmark, England, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and Sweden.



Source of background geographical map: University of Alabama, Cartographic Research Lab

Figure 5 Co-authorship map for Turkey's most important partners in all fields combined in 1992-1994 based on Salton's measure (dotted line >=0.005, solid line >=0.01, thick line >=0.025)



Source of background geographical map: University of Alabama, Cartographic Research Lab

Figure 6 Co-authorship map for Turkey's most important partners in all fields combined in 2004-2006 based on Salton's measure (dotted line >=0.005, solid line >=0.01, thick line >=0.025)

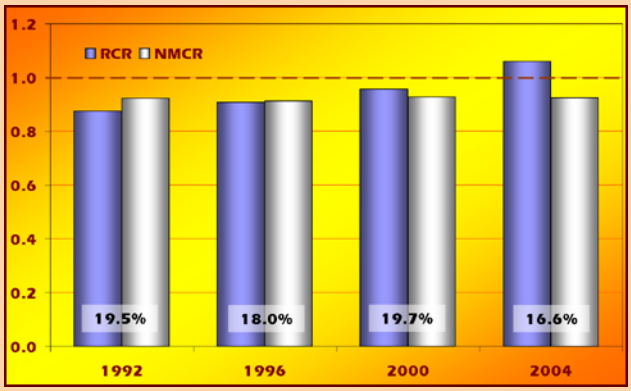


Figure 7 Evolution of citation impact of Turkish international co-publications (percentage of 'international papers' is indicated on the bars)

Figures 5 and 6 visualise the network of Turkish international co-publication links according to Salton's measure in so-called 'scientopographical' maps. The links are in general rather weak (cf. *Glänzel* and *Schubert*, 2004), only those with Azerbaijan and the USA (second period) can be considered medium-strong. Three different thresholds (0.005, 0.01 and 0.025) are used to visualise different intensities of co-operation. Although number and strength of co-operation links somewhat increased, local co-operation with Azerbaijan and scientific collaboration with the US prevails.

Finally, we have a look at the impact of collaborative research. The comparison of the citation impact attracted by international co-publications with that of the 'national standard' confirms the expectations. Because of the relatively low level of international collaboration the effect on the national total is limited. Figure 7 presents the two relative citation rates for international co-publications. The results can directly be compared with those presented in Figure 3. On average, Turkey benefits from foreign co-authorship. The relative citation impact has steadily increased over the period 1992-2004 and reached values around 1.0 during the last years. Nonetheless, the impact of the journals where the international co-publications appeared tends to remain below the corresponding field-expectations.

Conclusions

The dynamic growth of Turkish publication output in the sciences persists despite the downleap in 2006. This includes also a wider coverage of Turkish journals in the Web of Science. The relative growth with respect to the world total, which extends to all major fields of sciences, is accompanied by an increase of visibility and citation impact; however, the gap between journal and subfield standard still widens.

The relative low level of international co-authorship is somewhat striking. In contrast to the new EU members in Central and East Europe and unlike associate partners of the European Union (Israel), Turkey's co-authorship with the EU has lost weight in favour of collaboration with the USA.

Acknowledgement

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References

Frame JD (1977), Mainstream research in Latin America and the Caribbean, *Interciencia*, 2, 143-148.

Glänzel, W. (2001), National characteristics in international scientific co-authorship relations. *Scientometrics*, 51 (1), 69-115.

Glänzel, W., Danell, R., Persson, O. (2003), The decline of Swedish neuroscience - decomposing a bibliometric national science indicator, *Scientometrics*, 57 (2), 197-213.

Glänzel, W., Schubert, A. (2003), A new classification scheme of science fields and subfields designed for scientometric evaluation purposes, *Scientometrics*, 56 (3), 357–367.

Glänzel, W., Schubert, A. (2004), *Analyzing scientific networks through co-authorship*, In: H.F.M. Moed, W. Glänzel, U. Schmoch (Eds), Handbook of Quantitative science and Technology Research. The use of Publication and patent statistics in studies on S&T Systems. Kluwer Academic Publishers, Dordrecht, The Netherlands, 257-276.

Glänzel, W., Leta, J., Thijs, B. (2006), Science in Brazil. Part 1: A macro-level comparative study, *Scientometrics*, 67 (1), 67-85.

Gokceoglu, C., Okay, A.I., Sezer E., International earth science literature from Turkey - 1970-2005: Trends and possible causes, *Scientometrics*, 74 (3), 409-423.

Gulgoz, S., Yedekcioglu, O.A., Yurtsever, E. (2002), Turkey's output in social science publications: 1970-1999, *Scientometrics*, 55 (1), 103-121.

Inonu, E., Kurnaz, L. (2002), Observations on the growth characteristics of the research output of Turkish physicists based on a selective citation analysis, *Scientometrics*, 55 (3), 437-444.

Katz, J. S., Martin, B. R. (1997). What is research collaboration? *Research Policy*, 26, 1–18.
Laudel, G. (2002). What do we measure by co-authorships? *Research Evaluation*, 11, 3–15.
Leta, J., Glänzel, W., Thijs, B. (2006), Science in Brazil. Part 2: Sectoral and institutional research profiles. *Scientometrics*, 67 (1), 87-105.
Leydesdorff, L., Zhou, P., Are the contributions of China and Korea upsetting the world system of science? *Scientometrics*, 63 (3), 2005, 617-630.
OECD (2007), *OECD Factbook 2007: Economic, Environmental and Social Statistics*.
O'Neill, J. (2005), Attention Europe: The BRICs are coming! *Internationale Politik*, 60 (5), 78-79.
Persson, O., Glänzel, W., Danell, R. (2004), Inflationary bibliometric values: the role of scientific collaboration and the need for relative indicators in evaluative studies, *Scientometrics*, 60 (3), 421-432.
REIST-2 (1997), *The European Report on Science and Technology Indicators 1997*. EUR 17639. European Commission, Brussels.
Rousseau, R. (2008), Triad or Tetrad: another representation, *ISSI Newsletter*, 4 (1), 5-7.
Schlemmer, B., Glänzel, W., Radnóczi, J. (2004), A bibliometric analysis of national research profiles in the changing Europe (1983-2003), Poster presented at the 8th Science and Technology Indicators Conference 2004, Leiden (Netherlands), 23- 25 September 2004.
Schlemmer, B., Glänzel, W. (2004), National scientific profiles in a changing Europe. 9th Nordic Workshop on Bibliometrics, Informetrics and Research Policy, Turku (Finland), 7-8 October 2004.
Schubert, A., Braun, T. (1990), International collaboration in the sciences, 1981-1985, *Scientometrics*, 19 (1-2), 3-10.
Tonta, Y., Ilhan, M. (2002), Contribution of Hacettepe University Faculty of Medicine to the world's biomedical literature (1988-1997), *Scientometrics*, 55 (1), 123-136.
Tonta, Y. (2000), Contribution of Turkish researchers to the world's biomedical literature (1988-1997), *Scientometrics*, 48 (1), 71-84.
Uzun, A., Menard, A., Ozel, M.E. (1993), Citation status of Turkish physics publications in foreign-journals - a global analysis, *Scientometrics*, 28 (1), 79-87.
Uzun, A. (1996), A bibliometric analysis of physics publications from Middle Eastern Countries, *Scientometrics*, 36 (2), 259-269.
Uzun, A., Ozel, M.E. (1996), Publication patterns of Turkish astronomers, *Scientometrics*, 37 (1), 159-169.
Uzun, A. (2006), Science and technology policy in Turkey. National strategies for innovation and change during the 1983-2003 period and beyond, *Scientometrics*, 56 (3), 551-559.
Yaman, H., Atay, E. (2007), PhD theses in Turkish sports sciences: A study covering the years 1988-2002, *Scientometrics*, 71 (3), 415-421.
Yurtsever, E., Gulgoz, S. (1999), The increase in the rate of publications originating from Turkey, *Scientometrics*, 46 (2), 321-336.
Zanotto, E.D. (2002) Scientific and technological development in Brazil. The widening gap, *Scientometrics*, 55 (3), 411-419.
Zimmerman, E., Glänzel, W., Bar-Ilan, J. (2008), Scholarly Collaboration between Europe and Israel: A Scientometric Examination of a Changing Landscape, *Scientometrics*, forthcoming.
Zitt, M., Thèves, J., Laurens, P., Ramanana-Rahary, S., Bassecaulard, E., Filliatreau G. (2006), *Assessing international visibility of nations in science: citations performances of large emerging actors (BRIC)*. Poster presented at the 9th Science & Technology Indicators Conference, 7-9 September Leuven (Belgium).

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