C 6 SCIENTIFIC PUBLICATIONS AND PERFORMANCE

Overview

For many years already, "knowledge" has been a key competitive factor in the globalised economy. Many technologies and services are now knowledge-based. While the main aim of science is to produce new knowledge, in an economic context, training of a skilled workforce, and providing a scientific basis for future technological developments, are also key scientific tasks. One indication of the importance of "knowledge" in today's world is that assessments of countries' technological performance now also consider the aspect of scientific performance. And such additional assessments focus not mainly on immediate economic benefits but on medium-term and long-term orientation to additional technological developments.

At the same time, scientific performance is difficult to measure, because different scientific disciplines differ widely in terms of their basic structures and contexts. Scientific publications are used as indicators of research performance, for example, and yet publications reflect only the formal side of scientific communication in public research institutions. Differences between disciplines can lead analysts astray in their assessments, and thus assessments have to be carried out carefully, with solid methods. Fortunately, bibliometry – i.e. analysis of scientific publications – is now able to draw on a wealth of experience gained by a range of international research groups.

By themselves, numbers of scientific publications in internationally renowned journals can serve only as rough indicators of performance. Numbers are indicative of quantity, but they tell little about quality. For this reason, citations are also analysed. Citations are indicative of how publications are received by the scientific community, i.e. they give an idea of scientific impacts. In recent years, publications-based measurement of scientific performance has increasingly been used in assessment of institutions and individual researchers, leading both to modify their behaviour in connection with publications. Nonetheless, comparisons of countries remain possible, since that is an internationally widespread and consistently similar phenomenon.

In recent years, publication activity in China has been growing, obviously and continually. That growth reveals that China has been investing massively in training of highly skilled specialists, and that it will thus be able, in the coming years, to intensify its activities in technology-intensive areas.

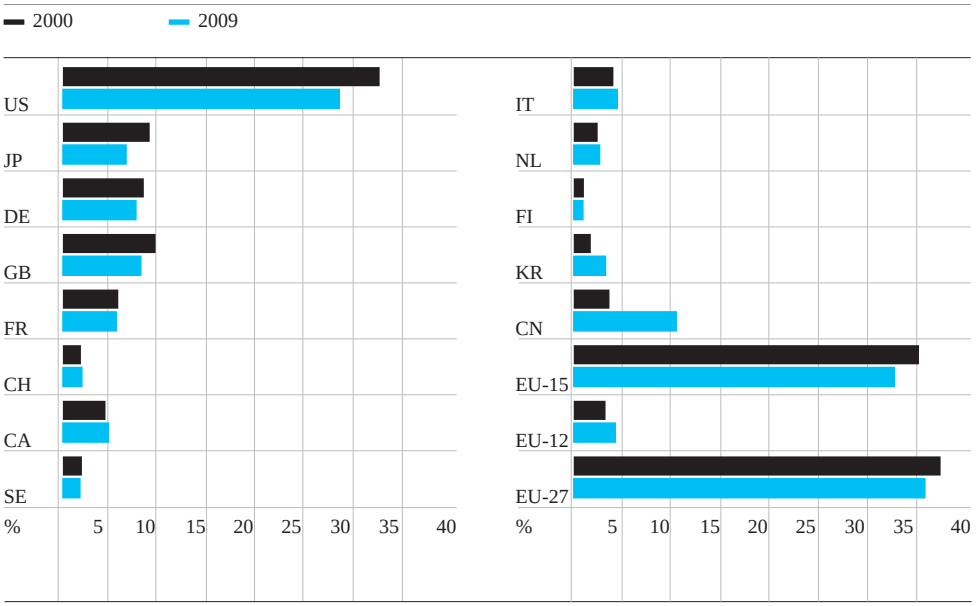
The following section is based on results of a study[374] of internationally renowed scientific publications. It includes the following areas: natural sciences, technology, medicine, life sciences and the humanities and social sciences.

Indicators studied:

- Shares of selected countries and regions for all WoS publications
- International alignment (IA) of selected countries and regions for WoS publications
  Scientific regard for WoS Publications from selected countries and regions

SHARES OF SELECTED COUNTRIES AND REGIONS FOR ALL WoS PUBLICATIONS 2000 AND 2009

C 6–1



Source: WoS. Research and calculations of Fraunhofer ISI.

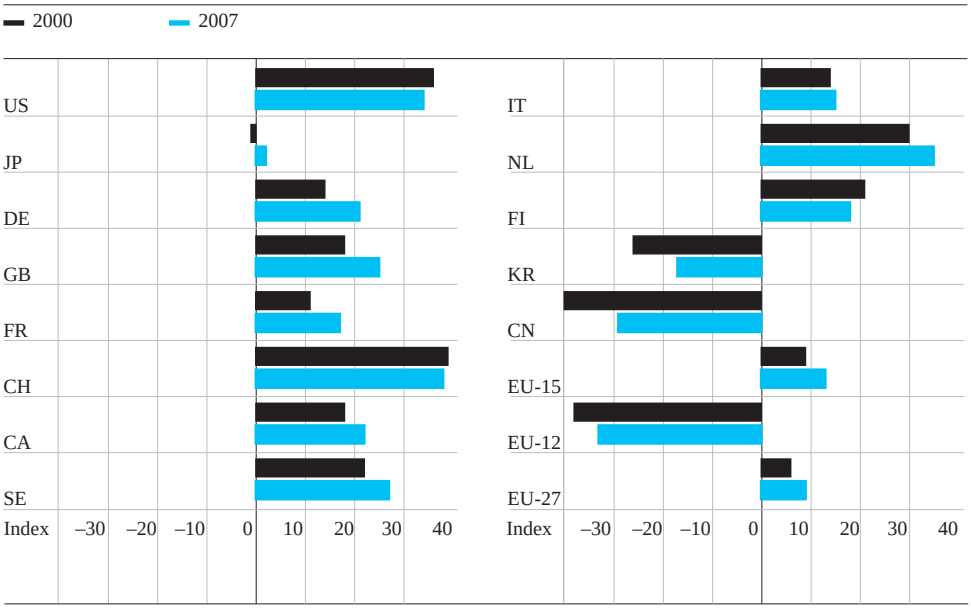
The database used for bibliometric analyses is the Web of Science (WoS) database.[375] In the present case, countries' shares of publications, and not absolute numbers of publications, are considered, in order to take account for changes – especially, continuous expansion – in relevant data collection.

Booming Asian countries are displacing major industrialised countries in the WoS

Since 2000, the WoS publication shares for Germany, the U.S., Japan, the UK and France have been continuously decreasing. British and Japanese authors have been affected even more strongly by this trend than German authors have. On the other hand, authors from Canada, Italy and the Netherlands have been able to maintain or even improve their positions. The decreases seen in the shares for many countries are due to the increasing shares of South Korea and, especially, China. And India, Russia and Brazil have been catching up as well. Since the WoS only covers a limited number of journals, growth in the shares of the countries that are catching up has been reducing the shares of the countries that have established themselves as leaders in this category. For example, in 1990, South Korea and China together had a share of 1.4 percent of all WoS publications. By 2009, their combined share had grown to 13.4 percent, i.e. had increased nearly tenfold. A regional consideration shows that the publication shares of the "old" EU Member States (EU-15) have been decreasing gradually. Those of the new EU Member States (EU-12) have been growing, on the other hand, although the pace of that growth has been slow. The new EU countries' growth in this area does not come close to that of South Korea and China.

For a qualitative assessment of publications, cf. the additional indices "international alignment" and "journal-specific scientific regard".

C 6–2 INTERNATIONAL ALIGNMENT OF SELECTED COUNTRIES AND REGIONS FOR WOS PUBLICATIONS 2000 AND 2007[376]



Source: WoS. Research and calculations of Fraunhofer ISI.

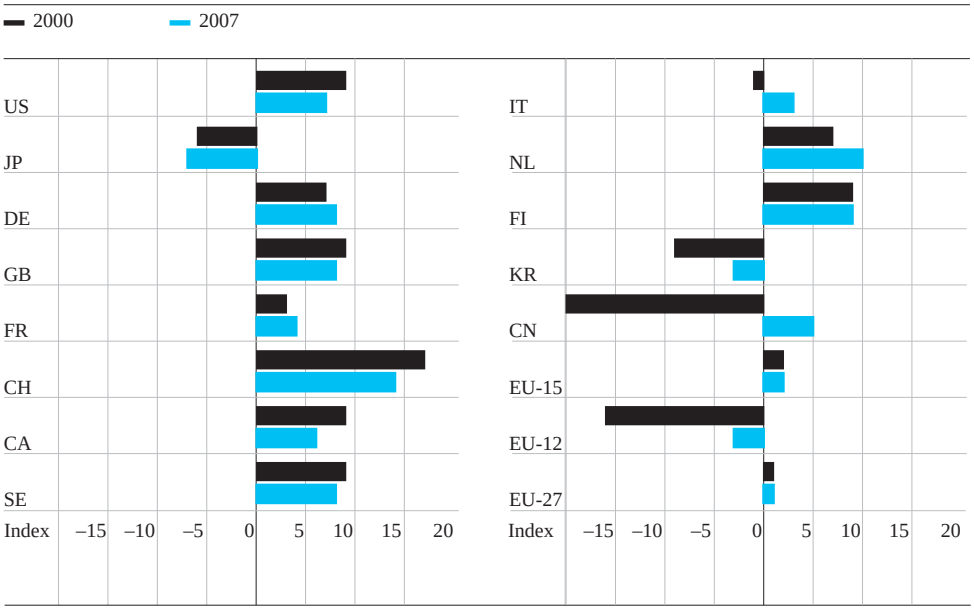
The IA index for a country shows the extent to which the country's authors, in comparison to the world average, are publishing in internationally noted journals and in less-noted journals. Positive values are indicative of above-average IA; negative values are indicative of below-average IA. Index calculations do not take account of self-citations.

Intensifying competition in science

The continuously growing IA values for Germany point to an increasingly international alignment for German authors. On the other hand, the significance of that conclusion is lessened somewhat in that nearly all countries studied have growing IA scores. Authors' own career motivations play a key role in this context, since publications in internationally noted journals lead to higher rates of citations, and citations are increasingly being used as a means of assessing scientific research achievements – for example, in connection with hiring of professors or awarding of third-party funding. While growing publication in internationally visible journals benefits the worldwide scientific dialogue, it means that specialised topics that reach smaller groups of readers, and thus garner fewer citations, are being neglected. Since U.S. journals have a predominant position worldwide, American scientists are at an advantage in calculation of citations in the WoS. That advantage is reflected in their high IA scores. At the same time, Switzerland and the Netherlands achieve comparably high scores. Since authors from those countries have few national options for publication, they have to publish internationally from the outset. On the other hand, authors from Asian countries are in a less favourable position in this regard. Nonetheless, Japanese authors have been able to connect somewhat more effectively with the international scientific discussion. The new EU Member States (EU-12) have especially poor scores; their IA is comparable to that of China.

SCIENTIFIC REGRAD FOR WOS PUBLICATIONS FROM SELECTED COUNTRIES AND REGIONS 2000 AND 2007[377]

C 6–3



Source: WoS. Research and calculations of Fraunhofer ISI.

The SR indicator for a country shows whether the country's scientific articles are cited more frequently, or less frequently, on average, than the articles in the journals in which the country's own articles appear. Positive values are indicative of above-average SR; negative values are indicative of below-average SR. Index calculations do not take account of self-citations.

Qualitative improvement in publications of China

The SR indicator for Germany indicates that assessment of German publications is stable: its authors have a growing – and suitably noted – presence in internationally respected journals. Countries with SR scores similar to that of Germany include the UK, the U.S., Canada and Sweden. With respect to English-speaking countries, Germany's SR indicator is considerably better than its simple citations rate, since the SR indicator eliminates any advantages of language. In light of their high SR scores, Switzerland and the Netherlands, in addition to maintaining their publication shares, are achieving high levels of recognition for their research achievements. The growing SR scores for South Korea and China point to qualitative improvements in publications of those countries. But since those countries' authors tend to publish in journals that are less well-noted (cf. their IA indicators), it may be concluded that the quality of their publications remains considerably below world standards. While China's SR score is somewhat better than South Korea's, its IA index is lower. That indicates that China's higher level of recognition is being achieved in journals that are not particularly well known. Japanese authors continue to score poorly in this category. Nonetheless, Japanese authors have increasingly been publishing in internationally noted journals, and thus have increasingly been competing with more widely known scientists. The new EU countries currently have a poor position within the scientific community: they have low SR scores, and their publications tend to appear in journals that are not particularly well-known (cf. their IA indicator).