Collaboration in Iranian Scientific Publications

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This study looks at international collaboration in Iranian scientific publications through the ISI Science Citation Index® (SCI) for the years 1995–1999, inclusive. These results are compared to and contrasted with the earlier findings for the periods covering 1985–1994 (Osareh & Wilson 2000). The results of Iran’s increasing productivity over a 15-year period are presented. Iran doubled its output in the first two five-year periods and increased 2.8-fold from the second to the third five-year period. The rise in Iran’s scientific publication output is due mainly to factors such as the ending of the war, better economic conditions, recent changes in the Iranian government’s policy, basic changes in the political environment brought about by the Reformers, expansion of the Iranian presses for national publications, and the recent return of a large number of students trained overseas through government scholarships. External changes also account for the increased productivity, e.g., the acceptance of three Iranian source journals by the SCI, increased access to international databases through the Internet and better electronic communication facilities for international collaboration. One of the most important and significant factors that caused this dramatic rise seems to be the government’s research policies in the last few years. Since 1999, the Iran Science, Research and Technology Ministry, has encouraged researchers to publish their articles in highly ranked international scientific journals, for example, by giving prizes to researchers who publish their articles in ISI-ranked journals.

Introduction

A notable feature of the recent scientific literature is that international cooperation is increasing even faster than that of publication output. For all countries, the number of publications in Science Citation Index® increased from about 1.6 million to nearly 2.1 million during the interval of ten years (from 1982–1984 to 1992–1994), indicating an average annual growth rate of 2.6%. On the other hand, the number of collaborative links increased from about 0.2 million to over 0.6 million, indicating an average annual growth rate of 11.1% (Nagpaul 1999). These results are evidence of the increasing role that international collaboration is playing in the generation of scientific publications. International scientific collaboration has been of increasing interest in recent years due, in part, to:

- the fruitful exchange of ideas, research techniques, methods and knowledge which can be potentially beneficial to all collaborative partners;
- the higher quality of collaborative papers as shown by higher average impacts when compared to solely national publications – even in the case of developed countries (Van Raan 1998);
- less expensive and faster communication systems (e.g., electronic mail) as well as remote access to electronic information, databases and facilities through the Web;
- the promotion of international scientific programs and the provision of government funding for travel to attend international scientific conferences;

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the fact that multi-country publications receive more citations than single country publications, hence, the assumption that multi-country publications are becoming a more important segment of the world literature (Narin & Whitlow 1990; Glänzel & Schubert 2001);

the fact that international cooperation in science is becoming more frequent and more extensive and is playing a far greater role today in the production of scientific knowledge than ever in the past (Wagner et al. 2001); [This is reflected in the ever-growing number of multi-authored papers, even though, according to a recent study multinational co-authorship is leveling off (Abdel-Kader et al. 1998).]

the benefits gained by peripheral countries from international collaboration for integrating their national publications into the international scientific network (Russell 1995);

and finally, the overall positive effects of increase in publication productivity, in international visibility and in the quality of research (Bordons & Gómez 2000).

**Aims and objectives**

This paper studies the extent of international collaboration in Iranian scientific publications through the Science Citation Index® (SCI) for the years 1995–1999, inclusive. The results of this study will be compared to and contrasted with the earlier findings in Osareh & Wilson (2000).

The study will attempt to answer the following questions:

- To what extent do Iranian scientists collaborate internationally with scientists from one or more countries?
- What is the rate (percentage) of international collaboration among Iranian scientists (1995–1999) and how does this compare to earlier publication periods, 1985–1989 and 1990–1994?
- What is the collaboration network among Iranian scientists with developed and developing countries?

We will also continue to investigate the growth and development of Iranian scientific publications in SCI for 1995–1999 versus the 1985–1989 and 1990–1994 periods. The following areas will be investigated:

- the emergence and departure of Iranian scientists with respect to productivity and influence or impact;
- the change in the ranking of journals in which Iranian scientists publish;
- the similarity or difference in the journals which Iranian scientists cite in their publications;

**Methodology**

As with the earlier study, the *SciSearch* file on the DIALOG information system was used to analyse the following fields, which addressed the aims and objectives above:

- the geographical location (GL) field to provide the initial set of documents of Iranian scientific and technical publications for the period 1995–1999;
- a further analysis of the GL field of the data set for Iranian publications to obtain information on international or cross-country collaboration;
- the publication year (PY) field to provide a 15-year growth profile of Iranian publications from 1985–1999;
- the author (AU) and corporate source (CS) fields to establish the most productive scientists and institutions/organizations;
- the journal (JN) and cited work (CW) fields to rank the journals in which Iranian scientists publish and from which they cite in their publications;
- and the subject categories (SC) of the journals in which Iranian scientists publish to establish the subject areas of Iran’s research efforts;

**Analysis of results**

Iran’s productivity in science and technology has increased dramatically during the 15-year period (1985 to 1999). Iran doubled its output in the first two five-year (from 1016 to 2045 publications),
and increased 2.8-fold from the second to the third five-period (from 2045 to 5549 publications). Figure 1 shows the growth of Iranian productivity in *Science Citation Index®* (SCI) during the years 1972 to 2000 in more detail. In 1972 only one Iranian paper was indexed in SCI. The number of Iranian papers increased from one in 1972 to 610 in 1978. By 1979, the Iraq-Iran war was underway and the number of publications authored or co-authored by Iranian scientists declined sharply until 1985. The war ended in 1986 and from 1987 to 1989 the numbers of publications remained considerably lower than in the earlier years. However, by 1990 until the present, Iranian scientific publications have increased significantly. The same trend can also be seen in the percentage of Iran’s publication vis-à-vis the rest of the world: from 0.019% in 1985 to 0.027% in 1990 and finally to 0.119% in 1999. This dramatic rise is due to a number of internal factors, such as: the ending of the war; better economic condition; the recent changes in the Iranian government’s policy, e.g., increase in research funding; basic changes in the political environment brought about by the Reformers; expansion of the Iranian presses for national publications; and the recent return of a large number of students trained overseas through government scholarships. External changes also account for the increased productivity, e.g., the acceptance of three Iranian source journals by SCI; increased access to international databases through the internet; and better electronic communication facilities for international collaboration. One of the most important and significant factors that caused this dramatic rise seems to be the government’s research policies in the last few years. In 1996, Iranian government announced the first national research call for papers and continued it for the next years. The researchers according to their areas selected topics and started working on large research grants. This can lead the researchers towards the research topics needed by the government. Related to the corporate source (CS) field is the geographical location (GL) field – that is, the country where the corporate source or address of the author is located. Table 1 shows the number of occurrences (papers) from each of the top 11 countries collaborating with Iran in each of the five-year periods. Iran, of course, appears at the top (765, 1410 and 4043) representing the total number of publications where at least one author is affiliated with an institution in Iran. It is the number of occurrences of the remaining geographical locations which gives a picture of Iran’s collaborations with other countries. The percentages in columns three, six and nine are calculated using the total number of GL occurrences after Iran has been removed. For example, for 1995 to 1999 there are 1502 occurrences of GLs (other than Iran) and of these, 324 or 21.6% are attributed to the US. Although the USA and England rank first and second in all the three five-year period, the overall percentages have decreased in the last two five-year periods. Collaboration with Australia has increased substantially, both absolutely
and relatively; likewise, India shows substantial increases in numbers, though lagging relatively. Germany on the other hand has increased in absolute numbers, but has decreased (relatively) in the last five-year period. Canada has remained constant percentage-wise, but has more than doubled in the numbers of occurrences (papers) in each of the five-year periods.

Comparing the most productive Iranian authors from 1985 to 1999 in SCI displays interesting results. As can be seen in Table 2, there were 28 authors during 1985–1994 (combined ten-year period) each with at least 10 papers, producing 506 papers (23.3%). However, in 1995–1999 (the third five-year period) there were 29 authors with at least 19 papers, producing 1042 papers (25.8%). Eleven bolded authors (Sohrabi, Shamsipur, Zar-rindast, Firouzabadi, Kumar, Safavi, Shafiee, Dehpour, Ensafi, Moosavi Movahedi, and Iranpoor) appear in each of the two lists. Of interest is the marked increase in the average number or papers per year for all of the authors appearing in both lists; for example, Shamsipur went from producing about 4 papers per year in the ten-year period to producing nearly 19 papers per year in the last five-year period. This increase could be attributed to increased collaboration with many authors within the same institution, other institutions in Iran or institutions in other countries. A further explanation could be a change in the publishing patterns of Iranian scientists – from either one or merely a few number of authors per paper to five or more authors per paper. An examination of Shamsipur’s publication in the two lists (using the post productive year in each list) reveals the following. In 1993, this author produced 12 papers with the following distribution of the number of co-authors: 9 papers with only one co-author, 1 paper with two co-authors, and 2 papers with four co-authors. However, in 1999, Shamsipur

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Total 506 Total 1042
produced 30 papers with the following distribution of the number of co-authors: 10 papers with only one co-author, 7 papers with two co-authors, 3 papers with three co-authors, and 10 papers with four co-authors. As to the extent of collaboration, a quick examination of the same two sets of papers by Shamsipur for 1993 and 1999 revealed the following. In the 1993 papers, collaboration occurred only with Iranian inter- and intra-institutions. For 1999, both Iranian inter- and intra-institutional collaboration occurred with one other country, Canada.

Table 3 shows the source authors as in Table 2 (with the eleven bolded authors in both lists), but in rank order by the number of citations received in two time periods: 1985 to 1997 and 1995 to 2001 (June) for 6.5 years. Obviously, this simple measure of influence or impact has limitations; however, the results show a first approximation of how influential the most productive Iranian authors are according to the number of citations received from authors publishing in journals indexed by SCI. The most cited author, Firouzabadi, was cited in 562 papers in SCI from 1974 to 2001 (June, Week2) and of these, 406 (72%) were by papers not authored by Iranian scientists. A more detailed examination of the other citations needs to be made; however, a preliminary comment can be made as to the impact (internationally) of Iranian scientists. In addition, papers by Iranian scientists appear to receive (on average) more citations in the last 6.5 years than in the earlier years.

Table 4 shows the top ranking journal titles in which Iranian authors published their papers from 1985 to 1994 versus 1995 to 1999. In 1985 to 1994, there are 21 journals with 11 to 39 papers in each. However, in 1995 to 1999, there are 22 journals with 23 to 105 papers. Only six of the journals, which are bolded, are the same journals in both
The journals cited (CW) by the papers in both periods. The major difference in the 1995 to 1999 period is the appearance of three Iranian journals (Iranian Journal of Science and Technology, Iranian Journal of Chemistry & Chemical Engineer, and Iranian Polymer Journal) in SCI. In these three Iranian journals 256 papers with at least one Iranian author in each have been published during 1995 to 1999. The remaining 61 papers in these three Iranian journals for the same period were papers by Indian and USA scientists. The USA, England and Australia were the major country collaborators of Iranian scientists for the 256 papers in the three Iranian journals from 1995 to 1999. Looking ahead, papers in these three journals for 2000 to June 2001 indicate India, Australia and Japan as Iran’s top three country collaborators.

The journals cited (CW) by the papers in both periods are nearly all journals with high impact factors. The top 21 cited journals in 1985 to 1994 were cited at least 50 times, while those in 1995 to 1999 were cited at least 123 times. Table 5 shows fourteen journals (bolded) which are the same in all the studied periods and have been cited by papers authored (or co-authored) by Iranian scientists. Nature, Science and Proceedings of the National Academy of Sciences are general science journals that are highly cited not only by authors from Iran during the studied periods but also by all scientists worldwide. Although the journals which influence Iranian scientists do not (necessarily) add to their collaborative research patterns, it is interesting to note that highly cited journals are known, read and used even though they are not those in which Iranian scientists publish. There are two journals, however, that is in common in both Table 4 and Table 5; the journals in which Iranian scientists publish and cite, Nature and Science. As it was mentioned, Iranian Scientists have been publishing in and citing to high impact factor journals. Yet it is expected that they publish in even more important journals, since from 1999, the Iran Science, Research and Technology Ministry encouraged researchers to publish their non-Farsi language articles in highly ranked international scientific journals.

The ranked distribution of the corporate source (or address) field yielded a list which required extensive “cleaning” and “collapsing” of institutions with variant forms of addresses. Therefore, exact figures for each of the top ranking institutions cannot be easily determined. After the editing process, the top five institutions and the number of affiliations indicated by Iranian author
Table 5: The top frequently cited journals by Iranian scientists from 1985 to 1994 versus 1995 to 1999

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Table 6: The top-ranked Iranian Institutions from 1985 to 1994 versus 1995 to 1999

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</tr>
<tr>
<td>Tehran</td>
<td>University</td>
<td>Sharif</td>
<td>318</td>
</tr>
<tr>
<td>Sharif</td>
<td>University</td>
<td>Tehran University of Medical Sciences</td>
<td>157</td>
</tr>
<tr>
<td>Atomic Energy</td>
<td>Organization Iran (AEOI)</td>
<td>INST Studies</td>
<td>262</td>
</tr>
<tr>
<td>(AEOI)</td>
<td>Theoretical Phys &amp; Math</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Collaboration in Iranian Scientific Publications

LCSH subjects for the three five-year periods in ranked order. What is readily apparent in the comparison of the three five-year periods is the substantial decrease in the Technology subject category in 1995–1999. The Medical Sciences decreased markedly in the early 1990s; however, the downward trend appears to have stopped in the mid to late 1990s. The basic sciences (including chemistry) have remained stable throughout the fifteen-year period and accounts for nearly 40% of Iran’s scientific publications; likewise the percentage output of papers in the Agricultural Sciences remained the same. As only the Science Citation Index was searched, not much can be said of Iran’s output in the Social Sciences; however, there was a substantial increase in the 1995 to 1999 period.

Small and Garfield’s (1985) subject categories

Besides using LCSH to group the Science Citation Index’s journal subject categories, we also looked at Small and Garfield’s (1985) groupings under seven major subject fields for the World’s publications in SCI and SSCI. This categorization of subject fields will offer a comparison with earlier studies of publication by authors in the Third World Countries (TWCs 1985–1989 in Osareh
Farideh Osareh, and Concepción S. Wilson

96

1996); for Iran in two five-year periods from 1985 to 1989 and 1990 to 1994 (Osareh & Wilson 1997, 2000) and with the results of this study for 1995 to 1999.

Table 9 shows that in the 1980’s the percentage of the TWC or Third World Countries’ (including Iran) publication output in Biomedicine & Biochemistry (57.6%) exceeded that of the World (38.5%). Considering Iran alone for the earlier five-year period, the percentage (41.6%) is still higher than that of the world; however, in 1990’s the research publications in areas related to medicine dropped substantially to about 25%. The drop in medical publications is offset by an increase in Physics & Engineering and more particularly, in Chemistry (Osareh & Wilson 2000). There is an apparent decrease in publication output in the three subject areas of Agricultural Sciences, the Geosciences and in Mathematics & Computer Sciences. Again, little can be said about the Social & Behavioural Sciences as the Social Sciences Citation Index was not searched for any of the Third World Countries’ (including Iran) studies.

<table>
<thead>
<tr>
<th>Small &amp; Garfield’s (1985) major subjects</th>
<th>World 1985 (%)</th>
<th>TWCs 1985 to 1989 (%)</th>
<th>Iran 1995 to 1999 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedicine &amp; Biochemistry</td>
<td>38.5</td>
<td>57.6</td>
<td>41.6</td>
</tr>
<tr>
<td>Physics &amp; Engineering</td>
<td>18.0</td>
<td>18.4</td>
<td>28.2</td>
</tr>
<tr>
<td>Chemistry</td>
<td>13.4</td>
<td>11.4</td>
<td>13.7</td>
</tr>
<tr>
<td>Agricultural Sciences</td>
<td>7.6</td>
<td>6.6</td>
<td>7.0</td>
</tr>
<tr>
<td>Geosciences</td>
<td>5.0</td>
<td>3.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Mathematics &amp; Computer Sciences</td>
<td>6.1</td>
<td>1.6</td>
<td>6.1</td>
</tr>
<tr>
<td>Social &amp; Behavioural Sciences</td>
<td>11.7</td>
<td>0.8</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Conclusions

Our study has shown that Iran’s publication output in science and technology has increased over the three five-year periods in the Science Citation Index®. Iran doubled its output in the two five-year and increased 2.8-fold from the second to the third five-year period. This marked increase is noticeable especially from 1991 to 2000. As has already been stated, this rise in the numbers of publications by Iranian scientists is due to many factors; among these are the ending of the war, better economic condition, the recent changes in the Iranian government’s research funding policy, basic changes in the political environment brought about by the Reformers, expansion of the Iranian presses for national journal publications, and the recent return of a large number of students trained overseas through government scholarships. External changes also account for the increased productivity, e.g., the acceptance of three Iranian source journals by the SCI; increased access to international databases through the internet; and better electronic communication facilities for international collaboration. One of the most important and significant factors that caused this dramatic rise seems to be the government’s research policies in the last few years. In 1996, Iranian government announced the first national research call for papers and continued it for the next years. The researchers according to their areas selected topics and started working on large research grants. This can lead the researchers towards the research topics needed by the government.

Iran’s main international collaborators for all three five-year periods are still authors with institutional affiliations in the US or the UK; however, it is obvious that Iran is looking more and more for collaborative partners elsewhere. Collaboration with authors in Canadian and Australian institutions has increased either in absolute numbers, relative percentages or both. This is not surprising as the period during the Iranian war saw many Iranian scholars sent to either Australia or Canada. Germany, Japan and India are also collaborative countries on the rise.

For authors publishing since 1985, the last five-year period has shown a two- to six-fold increase in the average number of papers published per year. Eleven of the 29 authors appear in both time
periods and all of the authors show increases in their productivity. An examination of the most productive author in the latest period revealed increased collaboration with researchers in the same institution, other institutions in Iran, as well as with researchers in other countries.

When the same lists of productive authors were ranked by the number of citations received in the two time periods, a slightly different picture emerges. For example, in the 1995 to 1999 period, the 11th ranked author (for productivity) received the most citation for 6.5 years (1995 to June 2001) and averaged nearly 45 citations per year. Again, the same eleven highly productive authors increased their average number of citations received per year in the later period. One can assume that increased collaboration (nationally and internationally) has brought greater visibility (or impact) to these authors.

The inclusion of three Iranian journals (in 1994, 1996 and 1997) by the Science Citation Index® accounts for a large number of papers by Iranian scientists in the later five-year period. However, a closer examination of papers (n=256) in these three journals authored by at least one Iranian scientist as compared to papers (n=61) authored only by non-Iranian scientists reveals an interesting picture. For those with at least one Iranian scientist, the top collaborating countries are (in ranked order) the USA, India, England and Australia. Authors from the same top two countries, USA and India, were also the major contributors of papers when there was no collaboration with Iran. A preliminary (and cautious) conclusion may be that co-country collaborators establish a publishing pattern which continues even without previous collaboration. Further studies into the co-authorship and publishing pattern (or behaviour) of scientists would be necessary to confirm (or otherwise) this conclusion. This study also found that, Iranian Scientists have been publishing in and citing to high impact factor journals. Yet it is expected that they publish in even more important journals, since from 1999, the Iran Science, Research and Technology Ministry, encouraged researchers to publish their non-Farsi language articles in high international scientific journals by giving prizes to researchers who publish their articles in ISI’s journals.

Wagner et al. (2001, 14) classified Iran as one of 24 ‘scientifically developing countries’ based on its investments made to participate in international Science and Technology (S&T). Countries in this category are seeking to invest further in science and in some cases have good capabilities that attract international partners. (The country categories are ‘scientifically advanced’, ‘scientifically proficient’, ‘scientifically developing’, and ‘scientifically lagging’.) The composite index constructed for grouping countries into one of the four categories of S&T capacity include, inter alia, ‘the number of S&T journal articles and patents produced by citizens of the nation to characterize S&T outputs’. One of the findings of this study is that 30 to 49% of the co-authorships of 12 countries in the Middle East and Africa (including Iran) were with the United States (2001, 29). Further, co-authorships between either Japan or Australia with Iran has increased over the 8% threshold from 1986–1988 to 1995–1997 (National Science Board 2000). The findings in our study appear to confirm those found in other (more detailed) studies on S&T indicators and collaboration.

References


Osareh, F. 1996. *Evaluation and measurement of Third World Countries’ research publications: A citation and...*