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Abstract

In the last decade Iranian academia has witnessed a glaring growth in scientific output, as can be seen in the relevant international rankings. However, there are serious doubts, among Iranian researchers themselves, as to the true meaning of Iran's status in such rankings. To see whether such ranks have any serious indication of development in scientific research, one needs a view on what scientific practice is. In this paper I make an attempt to show how Iran's improved rank would look like when seen in the light of a social-epistemological account of scientific research. I first propose an account of that kind based on which I then analyze Iran's rank in scientific output. My analyses shows that, as far as science is viewed as a practice of social-epistemological nature, Iran's status in such rankings cannot be taken at face value.

Keywords: scientific practice, social epistemology, international rankings of scientific outputs, Iran.

JEL Classifications: I23, O3

1. Introduction

In the last decade Iranian academia has witnessed a glaring growth in scientific production. According to the most credited international rankings, Iran's global rank in scientific output has for some time been very promising. However, there are serious doubts as to whether such ranks should be taken at face value. Many of Iranian prominent academics believe that Iran's global rank speaks of no corresponding substantial development in scientific research in the country. In my paper I intend to investigate whether such doubts are plausible.

In section 1 I spell out what the problem is, and why the elevated status of Iran in global rankings is looked at with suspicion. In section 2 I very briefly outline my methodology which is, most roughly, to propose a framework required for evaluating international rankings of scientific outputs. In section 3 I introduce the required framework which is a philosophical vision, brought about through a social-epistemological approach, on what science is, how scientific knowledge is produced, and how (true) scientific practice is demarcated. Based on the introduced framework, in section 4 I make an effort to analyze Iran's global status in international rankings for scientific output. Finally, in the last section I draw general conclusions regarding Iran's global rank in scientific output in particular, and proper policy-making for scientific research development in general.

2. The Problem

According to the most credited global rankings, such as ISI Web of Science, Scopus, and Google Scholar, Iran ranks very good in scientific output both in the world, in the Middle East region as well as the Islamic world, and among the so-called developing countries. According to the Scimago ranking powered by Scopus, in the year 2017, and when all disciplines are considered, Iran ranks 1st in the region and throughout the Islamic world, with a considerable distance from the second best; 4th among the so-called developing countries, after china, India, and Brazil; and 16th globally. When the consideration is narrowed down to certain disciplines, e.g. within the engineering field, Iran's rank is even more noticeable. For example, according to the same ranking, in chemical engineering Iran ranks 8th in the world.

Impressively, Iran holds a rank higher than a number of the so-called developed countries, such as Switzerland, Sweden, Norway, Denmark, Belgium, and Austria. Iran's rank sounds even more impressive when seen in the light of the country's spending on research and development (R&D). According to the latest report on R&D spending by UNESCO, Iran spends only 0.03% of its GDP for R&D ($3,317.2M in PPP$), while Switzerland, which falls beneath Iran in the ranking, spends 3.2% of its GDP for R&D ($14,744.9M in PPP$). A more or less same difference can be seen between Iran and other developed countries mentioned above. Even in the region Iran's R&D spending is by no means outstanding; Turkey's R&D spending is 0.9% of its GDP ($15,324.2M in PPP$), Saudi Arabia's is 0.8% of its GDP ($12,513.6M in PPP$), and Egypt's is 0.6% of its GDP ($6,081.8M in PPP$).[2]

[2] The data are taken from UNESCO official website (accessed 7 November 2018): http://uis.unesco.org/apps/visualisations/research-and-development-spending/

Moreover, while during the last decade the number of researchers in Iran (university professors, and especially postgraduate students) raised noticeably, which could have contributed to the growth in the scientific output, the number of researchers in the country is not comparatively high. According to the same UNESCO report, the number of Iran-based researchers per million inhabitants is 671. The corresponding number is 6.877 for Sweden, 7.311 for Denmark, 4.455 for Switzerland, 4.529 for Belgium, and 4.937 for Austria. When the whole population of each country is considered, the number of Iran-based researchers is either lower or not meaningfully higher than these countries. Let's make the same comparison between Iran and two of its regional rivals. The number of researchers per million inhabitants in Turkey is 1.163 and in Egypt is 667. So, when the whole population is taken into account, each of these countries accommodates more researchers than Iran. Therefore, the rise in the number of researchers cannot solely account for Iran's improved global rank.

It should also be noticed that the improved status in scientific output is gained by Iran in the face of the international restrictions on the country which affect scientific research in different ways, for example by hampering the collaboration of Iran-based researchers with their international counterparts.

One main concern is that the Iran's improved rank may, to a large extent, have been gained through academic exploitation, for the evaluation system based on refereed publication is now quite entrenched in the Iranian academia, and there are rigid regulations demanding publication in international journals.[3] The rigid regulations are widely criticized as a numbers-game approach to policy-making regarding scientific research, an approach which seems to be prominent in the Middle East region.

A lot of Iran-based academics are themselves critical of the academic evaluation system in the country. Some criticize its being too demanding and not suited with the way researchers are supported. Others criticize it as inadequate. Some in the latter group point to the fact that the products of Iranian academia are, to a large extent, irrelevant to the practical issues in the country. Others in the same group believe that the scientific outputs of Iran-based researchers are largely void of scientific value, pointing to such phenomena as predatory journals, low-ranked journals, the lack of genuine collaborations among Iranian researchers, and research misconducts like guest/ghost/gift authorship, citation rings, etc.

None of the above critics deny that there can be valuable works among such scientific outputs, works that are related to practical issues of the country, thus of practical benefit anyway, or/and that are of originality thus contributing to human knowledge. The concern is rather about the general meaning of Iran's good status in the global rankings of scientific outputs, about whether it means a real development in scientific research. It seems, therefore, that we require a

[3] For the regulations as to international publication see the following official documents (accessed 10 November 2018):
https://prog.msrt.ir/fa/regulation/30
https://irandoc.ac.ir/sites/fa/files/attach/page/faculty-recruitment-regulations.pdf
https://hohm.msrt.ir/file/download/download/1485266452-.-.pdf

framework by which to assess how indicative a country's global rank in scientific outputs is of the country's scientific research development. The framework is required to differentiate between merely quantitative growth and qualitative growth indicating substantial and enduring development. Such a framework is supposed to guide us not only in assessing academic products but also in policy-making regarding academic research.

3. Methodology

A framework for the assessment of the quantitative growth in academic publication is offered in section 3. The framework is based on a philosophical view, gained through a social-epistemological approach, on what scientific knowledge is and how it is produced. A study of development in scientific research requires to rely on a view about what scientific knowledge is and how it is produced. For such study requires to differentiate between good and bad instances of research. There are a variety of different sorts of practices under the guise of scientific research, not all of which can be (equally) taken as genuine scientific practices. For example, corrupt practices and misconducts, such as fabrication, falsification, guest/ghost/gift authorship, and citation rings, cannot be aptly considered scientific research.[4] Therefore, we require to characterize genuine scientific practice. We need a framework within which to differentiate between genuine scientific work and corrupt worthless practices under the guise of scientific work. It is only within such a framework that we can properly evaluate development in scientific research, and see if quantitative rankings of scientific productions indicate a corresponding qualitative development in scientific research.

Touching on some recent views in epistemology and philosophy of science, I suggest a framework of that kind, based on which I then will evaluate scientific outputs of Iran-based researchers. Within my proposed framework I analyze the global rank, global collaboration rate, self-citation and external citation rates of the documents produced by Iran-based researchers in the year 2017. All the relevant data are taken from Scopus's Scimago Journal & Country Rank (SJR). Scopus's coverage is greater than that of ISI Web of Knowledge. At the same time, unlike a fully open database as Google Scholar, Scopus is not unregulated but covers only peer-reviewed journals that satisfy some minimal conditions. That is why Scopus is chosen over ISI Web of Knowledge and Google Scholar.

4. A Framework for Evaluation and Policy-Making

Some recent views in social epistemology suggest that knowledge is social in a substantial way. The norms that govern knowledge acquisition, such views suggest, are essentially social. That claim is not the same as the one known as social constructivist theory of knowledge. Indeed, the two are in sharp contrast to each other. When it comes to scientific knowledge, for example, while the latter harshly refuses scientific objectivity, the former grounds scientific objectivity in a social way. Therefore, while the latter disvalues science as merely a form of opinion next

[4] Here are some recent examples of such research misconducts (accessed 11 November 2018):
http://retractionwatch.com/2017/12/21/elsevier-retracting-26-papers-accepted-fake-reviews/
https://www.nature.com/news/publisher-pulls-58-articles-by-iranian-scientists-over-authorship-manipulation-1.20916

to all other forms of opinion, the former assumes that scientific knowledge is different from and privileged over non-scientific opinions.

A good example of the social-epistemological approach is Helen Longino's philosophy of science, which I believe can provide us with the framework we require. She takes science to be a *social practice* and considers scientific method to be "something practiced not primarily by individuals but by social groups" (Longino 1990, 66–7). Longino argues that knowledge is the outcome of such social practices (Longino 1994, 142), and that such practices ground the objectivity of science (Longino 1994, 144), or that the objectivity of science "is secured by the social character of inquiry" (Longino 1990, 62).

Longino argues that through such social practices a kind of transformation takes place from the subjective to the objective, a transformation occurring through what she calls *transformative criticism*. So, for Longino, scientific knowledge is inevitably produced through scientific communities within which scientists interact and criticize one another. According to her account, to be able to produce scientific knowledge a scientific community should be characterized by (1) public forums for criticism, (2) uptake of criticism, (3) publicly recognized standards of argumentation, and (4) the equality of intellectual authority (Longino 2002, 129–134). It is only at the presence of a community with such features that subjective opinions can transform into objective science, because what can, in the first place, be taken as an appropriate reason is "determined and stabilized through discursive interaction" and "every assumption upon which it is permissible to rely is a function of consensus among the scientific community" (Longino 1994, 142).[5]

Longino's view on scientific knowledge, as I see it, gives us a framework within which to assess the development of scientific research based on the quantitative growth of scientific outputs. Scientific research is more of a social rather than individual practice. So, in order to credit what is claimed to be scientific research, we need to see whether they satisfy the conditions a social practice should satisfy in order to result in scientific knowledge. And Longino proposes a plausible view on what such conditions are.

Among other things, Longino's view suggests that the following factors contribute to the production of scientific knowledge: whether there exists a scientific community; how big such community is; how active it is; whether it is shaped by critical interactions; and how open it is to other scientific communities. Therefore, to see whether a piece of work qualifies as genuine scientific research and scientific practice we have to see whether it can be taken as resulting from a scientific community shaped by critical interactions, and open to critical reactions.

Based on the framework just outlined, the next section I makes an assessment of the scientific outputs of Iran-based researchers. I examine to what extent the quantitative growth of academic papers written by Iran-based researchers are the result of critical interactions between scientists,

[5] One objection to Longino's view is that it is a form of relativism. For an example of this objection see (Philip Kitcher 19991 and 1994). Another objection is that it does not do justice to the social character of knowledge. For example, Miriam Solomon argues that Longino's view is yet too individualistic (Solomon 1994). (Wray 1999) defends Longino's view against these and other objections.

to what extent they can be taken as originated from an Iranian scientific community, and to what extent they can be taken as open to critical reactions from other scientific communities.

5. An assessment of Iran's International Scientific Status

There are serious doubts about the existence of a scientific community in Iran. Such doubts raise despite the fact that the number of higher-education academics and institutions are presently quite high. Obviously, scientific community is not merely about the number of people and institutions affiliated with science but, more importantly, about interactions between them.

In a classic characterization of scientific community, Robert K. Merton highlights such features of scientific community as *disinterestedness*, *universalism*, *communalism* and *organized skepticism* (Morton 1973). Morton's characterization shows similarities with Longino's conditions. The social character of transformative criticism in Longino's view is clearly about satisfying such features as universalism, organized skepticism, communalism, and disinterestedness.

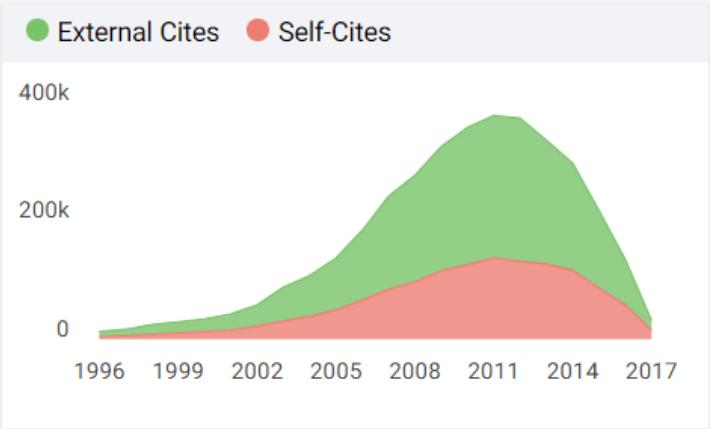
We can make a distinction between the global scientific community and the national ones, in terms of how a scientific community functions. The distinction can be crucial for the so-called developing countries which, as periphery countries, are often faced with obstacles in their way to join the global scientific community, compared to the countries that are already there in the core of scientific developments. Krishna et al. (2000) and Gaillard et al. (1997) suggest that the distinction is in fact the case for developing countries: two scientific communities of which one's main function is to sustain scientific practices in the national framework, while the other defines itself as part of the global scientific community. Khosrokhavar et al. (2007) suggest that the distinction is the case for Iran too.

A number of studies, such as (Khosrokhavar et al, 2004, 2006, and 2007; Rafipour 2003; Mansouri 2001; Ghaneirad 2002; Etemad et al 2004, 2002–03; Saburi 2002, 2003; E'temad 1999–2000), suggest that there is at best a preliminary and fragile scientific community in Iran. Despite quantitative growth during more than a decade since those studies were conducted, there is no evidence to show a remarkable development in the scientific community in Iran.

Let's now examine how international, or otherwise how isolated from the global scientific community, the supposed Iranian scientific community is. This can be done by analyzing the Scimago data on citation and international collaboration.

In 2017, almost half of all citations to the documents produced by Iran-based researchers are self-citations, namely they are from Iran-based researchers. This is shown in the figure 1.

Figure 1. External- and self-citation of Iran-based researchers



That self-citation ratio is rather high and thus suspicious. Let's make a comparison with the self-citation ratio of some of the above-mentioned countries. In the same year, for Switzerland, Sweden, Belgium, and Austria the ratio of self-citation to all citations are less than one-fourth, for some about one-fifth. And for Turkey it is less than one-third. So, while Iran ranks better than those countries in the number of documents, the number of citable documents, and the number of citations, it falls beneath them in the ratio of external citation to all citations.

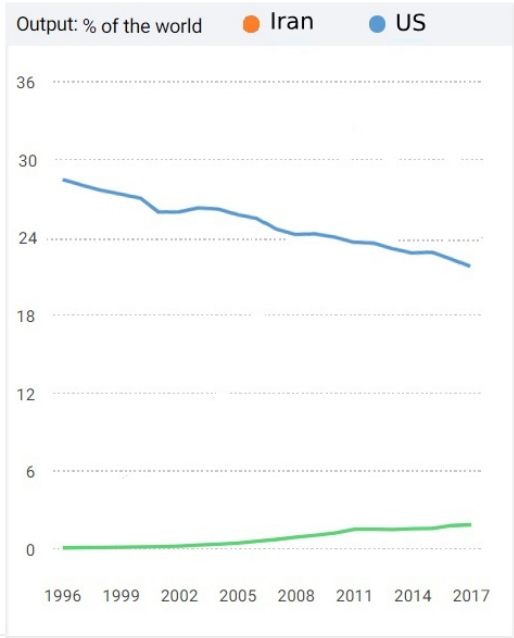
Clearly, the ratio of external citation to all citations has something to do with such features as how introverted a supposed scientific community is, how isolated it is from the global scientific community, and how seriously it is taken by international researchers. Therefore, a plausible explanation for the difference between Iran and the other countries in external citation ratio is that the Iran-based researchers form at best a rather closed community largely isolated from the global scientific community, unlike the scientific communities in those countries.

One factor contributing to the rise of self-citation ratio is co-authorship: the more authors a paper has, the more self-citations it gets. According to a study by Aksnes, papers with one author receive 1.15 self-citations on average, but those with 10 authors receive 6.7 (Aksnes 2003). Therefore, co-authorship can be taken as one explanation for the high ratio of self-citation to the documents of Iran-based researchers. Indeed, since the number of Iran-based researches, as we saw, are not meaningfully higher compared with the other mentioned countries, it is plausible to think that the high ratio of self-citation is a sign of co-authorship. But co-authorship can in turn be interpreted in two different ways. On the one hand, co-authorship clearly bears some indication of collaboration. On the other hand, co-authorship can be taken as a sign of academic misconduct in the forms of guest/gift/ghost authorship, citation rings, and alike. The ratio of author's self-citation would more clarify the likelihood of citation circles, but the above figure is country-based and so is silent on what ratio of the self-citations consists of authors' citing themselves.

As mentioned, the country-based self-citation gives an idea of how open the country's supposed scientific community is to the global scientific community, or, otherwise, how introverted and isolated it is. One may say, the greater the ratio of self-citation is for the outputs of the researchers of a particular country, the more introverted the country's supposed scientific

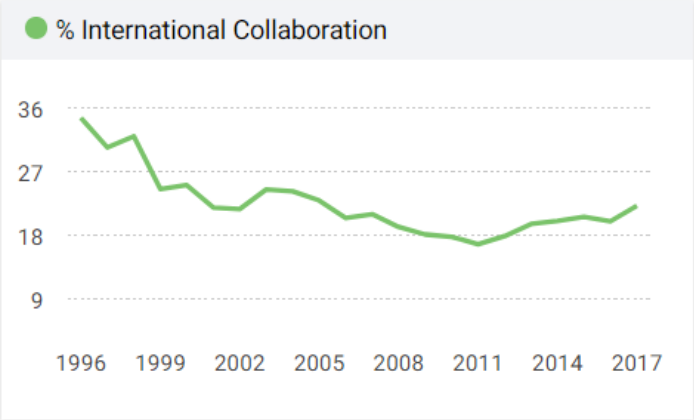
community is. It should be noticed, however, that a country's ratio of self-citation does not *by itself* indicate how introverted or extroverted the scientific community in the country is. To acquire that result, the country's self-citation should be considered with regard to the country's share of the whole global output. As an example, about half of citations to documents produced by the US-based researchers are by the US-based researchers. That means that the country self-citation ratio of the United States is almost as high as that of Iran. But here a relevant fact is that the outputs of the US-based researchers constitute 21.3 percent of the entire global output, while the outputs of Iran-based researchers constitute only 1.85 percent of the whole global output. So, while Iran-based researchers can be ignored by more than 98 percent of all international researchers, the US-based researchers can be ignored by less than 80 percent of all international researchers. Figure 2 compares Iran and US in their respective shares of the global scientific output.

Figure 2. Iran and US in their share of global output



So the meaning of a country's self-citation should be understood only with regard to the country's share of the global output. Since Iran's share of the global output is very low, we can plausibly say that the high ratio of self-citation to external citation for the documents of Iran-based researchers indicates that the supposed scientific community in the country is highly isolated from the global scientific community. The above figure, therefore, has some indication that the supposed scientific community in Iran is largely introverted and isolated from the global scientific community. This point gets clearer when we analyze the ratio of international collaboration of Iran-based researchers. Figure 3 shows the ratio of documents whose affiliations include more than one country address.

Figure 3. International collaboration of Iran-based researchers



According to this figure, only 22.23 percent of the documents produced by Iran-based researchers in the year 2017 includes more than one country address. Again, the meaning of this ratio is clearer when compared to that of other countries that fall beneath Iran in the ranking. The corresponding ratio of international collaboration for Switzerland is 68.05, meaning that the 68.05 percent of the documents produced by Switzerland-based researchers is the result of international collaboration. The corresponding ratios are 63.22% for Sweden, 66.02% for Belgium, 61.91% for Demark, and 63.81% for Austria. Thus, while Iran-based researchers have produced more documents and more citable documents than researchers based in those countries, and while the documents produced by Iran-based researchers have been cited more than ones produced by researchers based in those countries, Iran's international collaboration rate is about one-third of those countries' corresponding rate. It follows, again, that the supposed scientific community in Iran is largely introverted and isolated from the global scientific scene.

Here again it should be noticed that international collaboration ratio for a country does not *by itself* indicate how introverted or extroverted the scientific community in the country is, but the latter also depends on the country's share of the entire global output. As an example, the international collaboration ratio for the US-based researchers in the year 2017 is 35.4%, which is not much higher than the corresponding ratio for Iran in the same year. But, as mentioned before, a relevant fact here is that the outputs of the US-based researchers constitute 21.3 percent of the whole global output, whereas only 1.85 percent of the global output is of Iran-based researchers. Therefore, while Iran-based researchers have more than 98 percent of the entire international researchers to collaborate with, less than 80 percent of the whole international researchers are available for the US-based researchers to collaborate with. As Iran's share of the whole global scientific scene is very low, therefore, it is plausible to say that the low international collaboration ratio for Iran-based researchers indicates that the scientific community in Iran is highly introverted and isolated from the international scientific community.

6. Conclusion

When seen through a social-epistemological account of scientific research, the above analyses show that Iran's global rank in scientific output does not indicate a corresponding development in scientific research in the country. But how could Iran's improved rank be explained then, if

it is not brought about by proper scientific practices in the sense defined in this paper? To a large extent, the outputs of Iran-based researcher are brought about through individual works, rather than social practices, of researchers who are obligated, by rigid regulations, to publish internationally.

I only intended to see how Iran's improved rank would look like when seen through a social-epistemological viewpoint. But my analyses has plain implications for policy-making regarding academic research. Wise policy-making for academic research is required to rely on a philosophical view about what scientific research is. That is what seems to be lacking in the case of Iran. Iran's improved rank in scientific output is widely criticized as the result of a numbers-game approach to policy-making for academic research. My analyses suggests, instead, that research policy-making be aimed at developing an active and outgoing scientific community.

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