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Increasing polarization of global science

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Extended Abstract

The globalization of science is built on the open exchange of knowledge[3]. Yet, the modern scientific enterprise is subject to strong regional and national cultural biases that shape which discoveries, methods, and frameworks are recognized by the scientific community[2]. As a consequence, quantitative indicators of scientific recognition, especially citation counts, reflect a geographical bias.

Here, to capture the international variability in scientific citation and recognition, we focus on country specific citation rankings. The ranking of citation counts is arguably a more accurate indicator of institutional performance, and is regularly used as a measure of top performance despite temporal and field variations [1]. Specifically, we adapt a statistical test for rank over-representation or under-representation of a country's publications within the reference lists of publications from another country, empowering us to measure when one nationality over- or under- cites the work from another nationality. The resulting measure of citation bias is a value between 0 (preference against) and 1 (preference for), where a value of 0.5 captures no preference and can be interpreted as the probability that a randomly selected publication from one country has more citations than a randomly selected publication for anywhere-else in the world.

We confirm that scientists from all nationalities tend to over-cite work from the same country (Figure 1A), even when accounting for tendencies to self-cite their own publications, or cite other publications affiliated with the same institution. Extending the national self-citation bias over time reveals that the US has always had a strong tendency to overcite its own work, while China has seen a strong recent burst in bias towards its own publications.

The temporal evolution of the citation bias score between countries also reveals many interesting geopolitical trends. For example, throughout the 50 years for which we have enough publications to measure the citation bias, the US has had a strong tendency to under-cite publications from China (Figure 1B). This under-citation bias grew until the mid-90s and then has been decreasing since. On the other hand, for most of this time, China has either been agnostic to the US (citation bias statistically indistinguishable from 0.5) or even over-cited the US. That is, until 2010 when China established a statistically significant citation bias to under-cite publications from the US.

Next we map the network structure of international scientific recognition (Figure 1C). The international scientific recognition network is a signed, directed network in which each country is a node, and a source country is linked to a target country by a positive (negative) if the source country over-cites (under-cites) the target country's publications. We find that of the 2,450 international relationships in 2015, 558 (22.78%) are positive over-citations (forming the positive network shown in Figure 1), 887 (36.2%) are negative under-citations, and the remaining 1005 (41.02%) reflect random citation relationships

Stochastic block models reveal a tri-partition of the network. Two blocks strongly resemble a core-periphery structure, such that the elite western countries within the core tend to over-cite each-others work and under-cite countries in the periphery, while countries in the periphery are agnostic to each-other, but over-cite countries from the core (Figure 1D). The third block

captures an international community that is becoming increasing polarized away from the west. Analysis of the temporal scientific recognition network empowers further revelations about changing geopolitical recognition in science.

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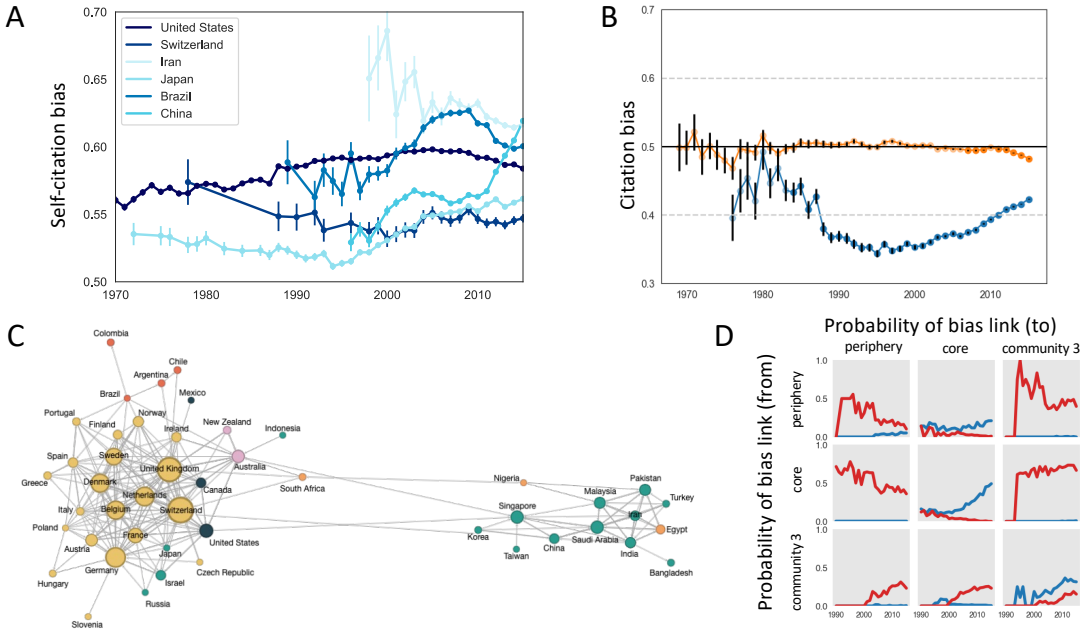

Figure 1: A) The self-citation bias for six representative countries. Error-bars capture one-standard deviation of the bias measure; a value of 0.5 captures no bias, while values above 0.5 reflect a tendency to over-cite. B) The citation bias from the US to China (blue) and from China to the US (orange). A biased value of 0.5 captures no bias, while values below 0.5 reflect a tendency to under-cite. C) The international network of scientific recognition over-citation relationships. Node size captures the in-degree, node color reflects the Continent: Europe (yellow), Asia (green), North America (dark blue), South America (orange) and Oceania (pink). D) The directed connection probabilities between each of the three communities ihe international network of scientific recognition for positive over-citation links (blue) and negative under-citation links (red).