NATURE NEWS BLOG

Global scientific output doubles every nine years

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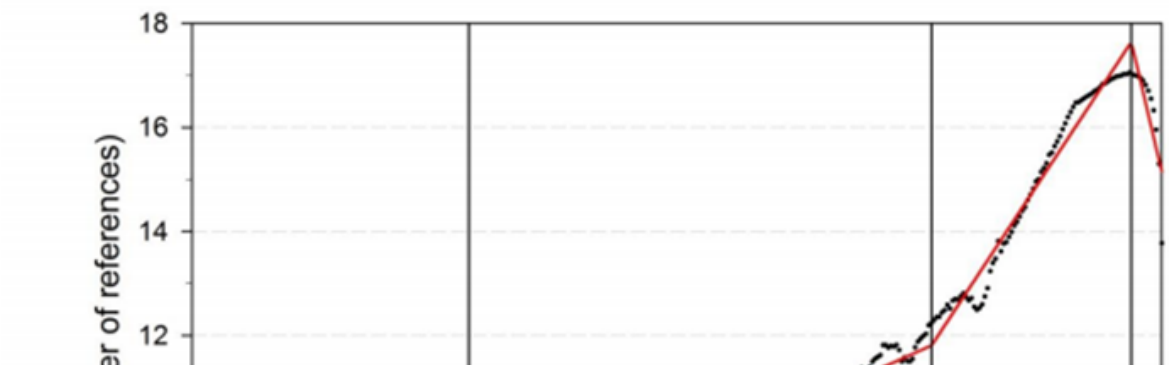
It's a common complaint among academics: today's researchers are publishing too much, too fast. But just how fast is the mass of scientific output actually growing?

Many would throw up their hands and declare the question impossible. It's clearly wrong to cite the growth of academic databases, such as Thomson Reuters Web of Science, which has increased its coverage by around 3% per year (barring occasions when the database incorporates a flood of new journals). That dramatically undercounts the true expansion: no database captures everything.

Bibliometric analysts Lutz Bornmann, at the Max Planck Society in Munich, Germany and Ruediger Mutz, at the Swiss Federal Institute of Technology in Zurich, think they have a better answer. It is impossible to know for sure, but the real rate is closer to 8-9% each year, they argue. That equates to a doubling of global scientific output roughly every nine years.

In a study to be published in the *Journal of the Association for Information Science and Technology*, and uploaded to the online server arXiv, Bornmann and Mutz find that global scientific output has probably kept up this dizzying rate of increase since the end of World War II. Other researchers say the study seems sound, although it is hedged with caveats.



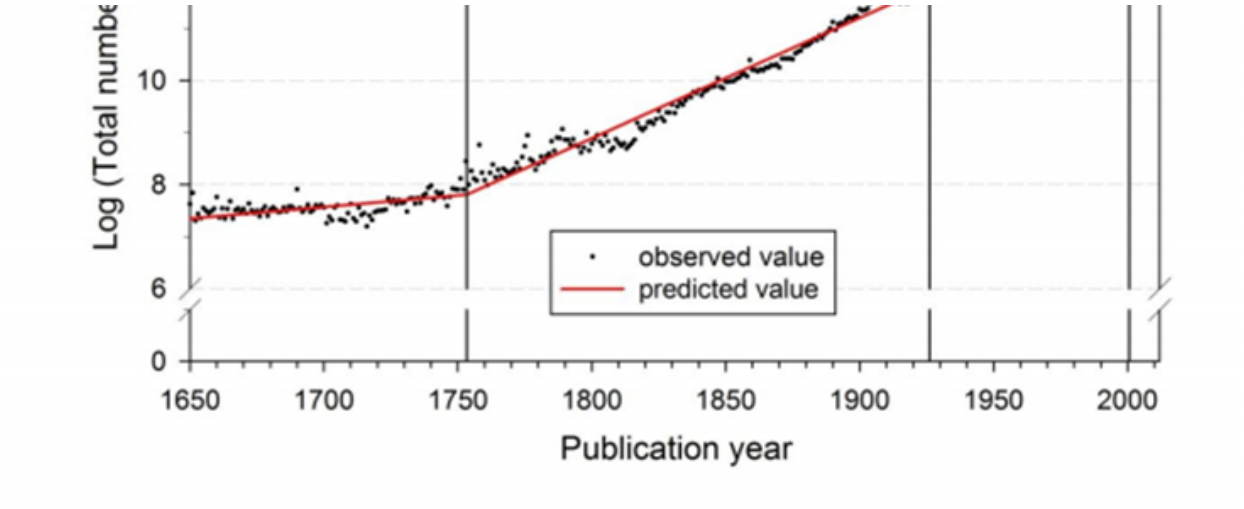


Figure 2. Segmented growth of the annual number of cited references from 1650 to 2012 (citing publications from 1980 to 2012)

“We identified three growth phases in the development of science, which each led to growth rates tripling in comparison with the previous phase: from less than 1% up to the middle of the 18th century, to 2 to 3% up to the period between the two world wars and 8 to 9% to 2012,” they write.

Bornmann and Mutz take an ingenious approach to estimating total scientific output: they define it as any reference – including not just papers, but books, datasets and websites – subsequently cited by another academic publication in the Web of Science database (including social sciences and arts and humanities disciplines). By analysing more than 755 million cited references in 38 million publications from 1980 to 2012, they totted up all publications from 1650 onwards that were ever cited (after 1980). The rates of increase are similar even if publications are limited to just the natural sciences, or just health and medicine.

Inevitably, the approach misses out publications that were never subsequently cited. But a publication that is never cited may be regarded as practically useless – and uncountable, unless it happens to appear in a selective database.

The estimate is extremely rough for other reasons: it is bedevilled by the ‘aging’ effect – which means that very old papers are less likely to be mentioned by academics publishing from the 1980s onwards – and because some of the literature will be multiply-counted, despite the researchers’ best efforts. By the year 2000, Bornmann and Mutz find 25 million separate references; or looking at natural sciences papers only, 9 million references.

The growth rates don’t look too different from earlier studies in the field, notes Anthony van Raan, at the Centre for Science and Technology Studies at Leiden University in the Netherlands. In particular, he points to his own 2000 study, which estimated 10% per-year growth by 1998.

Indeed, the basic argument goes all the way back to 1965, when the man widely regarded as a father of bibliometrics, Derek de Solla Price, analysed all the papers that had been referenced in the year 1961, and similarly found an exponential increase in growth (which he did not quantify). But analysing the block of papers from 1980 to 2012 gives a better picture, since taking the references of any one year, as van Raan and Price did,

greatly privileges the most recent papers.

Vincent Larivière, a researcher at the University of Montreal, Canada, says the figures look right in the long run, but points to an apparent slow-down in the growth rate after the 1970s. But Bornmann says this apparent slow-down is not reliable, and may partly be an artefact of the most recent papers having fewer years in which to have a chance of being cited.

Does this proliferation of papers represent real growth of knowledge? As far back as 1965, Price noted a now familiar observation: “I am tempted to conclude that a very large fraction of the alleged 35,000 journals now current must be reckoned as merely a distant background noise, and as very far from central or strategic in any of the knitted strips from which the cloth of science is woven”.

Today’s “salami slicing”, in which scientists may pursue additional publications for career advancement, only adds to this effect, says van Raan. “The behaviour of scientists to publish more, to split up papers, to publish first a short paper followed by a more detailed one, and so on, would imply an ‘extra’ growth which is not necessarily ‘real’ growth of science,” he points out. “It would be fascinating to develop a framework in which ‘sustainable’ contributions to scientific development can be identified and used as a kind of measure to see how our total scientific knowledge is growing.”

So non-real growth it may be – but for the beleaguered academic, it all counts as more stuff to keep track of.

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