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Wavering impact-factor trajectories

Established reasoning behind yearly changes in impact factors is mostly flawed.

Editors are acknowledged — and sometimes praised and rewarded — when the impact factor (IF) of their journal increases. Publishers may also wish to increase the perceived prestige and the rates of submitted manuscripts for the journals in their portfolios by incentivizing editors to boost IFs or to at least avoid big drops in the metric as they seek to increase publication output to mitigate any expected declines in revenue (a particularly acute worry for open-access journals and hybrid journals affected by changing funder policies[1]). The underlying thinking is that the knowledge and hands-on work of editorial teams, when put to work under a suitable strategy, can control the yearly trajectory of journal IFs. This is likely to be a fallacy.

A journal's IF is the average number of citations that the journal receives in one calendar year for the content it published during the previous two years. If most content published by a journal were to receive about the same number of citations — that is, if the shape of the citation distribution to the journal's content

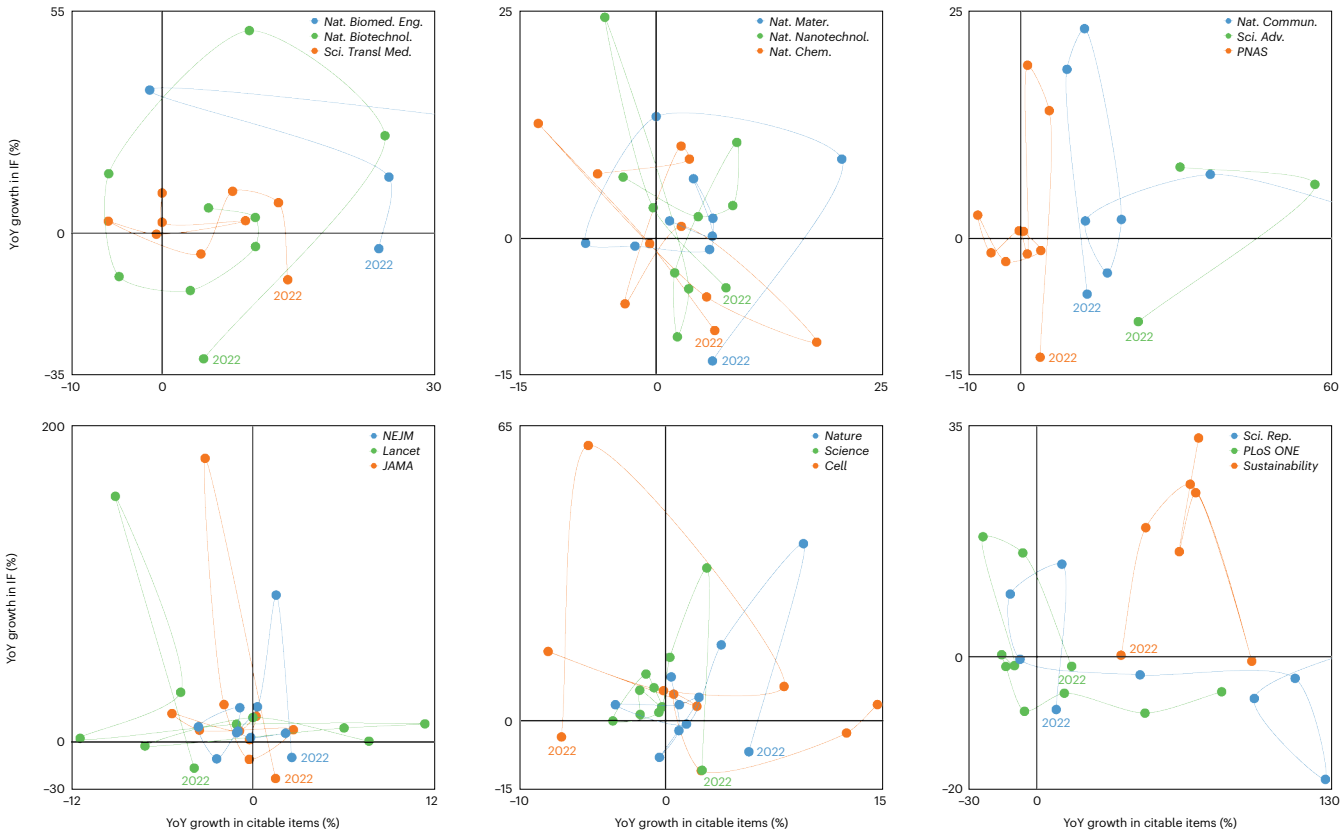

Fig. 1 | Year-over-year growth in the IFs and citable items of 18 selected research journals. Citable items are the number of articles (mostly research papers and scholarly reviews) that contributed to the IF's denominator (for example, for the 2022 IF, citable items were published in 2020 and 2021). The curved lines join successive yearly data points, from 2013 (or later, for the newest journals) until the most-recent numbers (the 2022 IFs, unveiled on 28 June 2023). The scales of the vertical and horizontal axes vary across graphs, so that patterns in the data can be better appreciated. For some of the newer journals (*Nature Biomedical Engineering* (*Nat. Biomed. Eng.*), *Sci. Rep.* and *Nature Communications* (*Nat. Commun.*), large numbers in YoY growth in citable items during the journals' first few years fall outside of the range of the graphs so that data points in later years can be better visualized. The journals included are general journals (*Cell*, *Nature*, *Nat. Commun.*, *PLoS ONE*, *PNAS*, *Science*, *Science Advances* (*Sci. Adv.*) and *Sci. Rep.*), megajournals (*PLoS ONE*, *Sci. Rep.* and *Sustainability*), area-specific multidisciplinary journals (*Nat. Biomed. Eng.*, *Nature Biotechnology* (*Nat. Biotechnol.*), *Nat. Chem.*, *Nature Materials* (*Nat. Mater.*), *Nature Nanotechnology* (*Nat. Nanotechnol.*), *Sci. Transl Med.* and *Sustainability*), medical journals (*Journal of the American Medical Association* (*JAMA*), *Lancet* and *New England Journal of Medicine* (*NEJM*)), gold-open-access journals (*Nat. Commun.*, *PLoS ONE*, *Sci. Adv.*, *Sci. Rep.* and *Sustainability*), subscription journals (*JAMA*, *NEJM*, *Science* and *Sci. Transl Med.*) and hybrid journals (*Cell*, *Lancet*, *PNAS* and the Nature-branded journals). The data points were calculated from IF and citable-items data in Clarivate's Journal Citation Reports (which from the 2021 release included early-access content as citable items; that is, it incorporated content that had yet to be included in a journal issue).

were normal and centred around the IF — journal output would be largely disentangled from the journal's IF (in this unrealistic situation, every paper would bring in roughly the same number of citations). Yet because the distribution of citations approximately follows a power law with a long tail of increasingly fewer papers each capturing more citations[2,3], and because increasing the quality of submissions is a protracted and laborious task, editors rightly expect that they can boost the journal's IF earlier by increasing the journal's selectivity — that is, by publishing fewer of the low-cited manuscripts and hence increasing the relative weight of the distribution's long tail. Are they right?

Maps of year-over-year (YoY) growth in IF and in citable items for 18 selected research journals (Fig. 1; curved lines join successive figures for YoY growth, from 2013 to 2022) are not on their side. First, IFs gradually go up, largely because of increasingly longer reference lists[4]; indeed, for most of the 18 journals in the figure, there are more years with positive YoY growth in IF, and such positive values are typically larger than the negative values for YoY growth in IF. Hence, editorial boards may overestimate the influence of their efforts on changes in the IF.

Second, systemic changes in academic publishing can shake IFs. Most recently, lockdowns during the early stages of the COVID-19 pandemic shook the patterns of academic publishing and thus the 2021 and 2022 IFs. For many journals, especially those publishing substantial content in (bio)medicine and health (Fig. 1, bottom left and bottom middle), 2021 IFs shot up and 2022 IFs wavered closer to historical levels. In fact, for nearly all journals in Fig. 1, the 2022 YoY growth in IF is negative.

Third, if decreasing output would be generally followed by increases in IFs, and vice versa (indeed, established reasoning portrays that rapid journal growth depresses the IF and portends lower average quality of the citable output), then in Fig. 1 most data points would fall on the upper-left and lower-right quadrants. Yet largely the opposite has occurred in the past 10 years: for most journals and most years, the figure shows that more papers published are followed by increases in IF, and that substantial reductions in citable output (that are either deliberate or because of reductions in submissions owing to strong competition) may not lead to a boost in IF and can even cause it to drop (as occurred for *PLoS ONE* in 2016–2019; Fig. 1, bottom right, green dots in the lower-left quadrant). And for the top medical journals (Fig. 1, bottom left), which publish as much as they did 10 years ago, IFs have increased nearly every year, regardless of fluctuations in output. There may be multiple explanations for these general trends: highly selective journals with full-time editors can more easily attract higher-quality papers and benefit more quickly from pivoting towards burgeoning research topics, larger publishers benefit from manuscript-transfer pathways across their journals, and larger journals can better leverage guest-editor collections to attract quality manuscripts and more citations. Moreover, massive growth in a topical subject area doesn't imply a forthcoming crash in IF, as the now megajournal *Sustainability* (published by MDPI) illustrates (Fig. 1, bottom right).

Fourth, yearly changes in citable output and IF do not correlate at all for established journals with rather stable IFs. In Fig. 1, this is the case for the selective journals *Nature Chemistry* (*Nat. Chem.*; IF approximately equals (≈) 24), *Science Translational Medicine* (*Sci. Transl Med.*; IF ≈ 17) and *Proceedings of the National Academy of Sciences of the United States of America* (*PNAS*; IF ≈ 10), and for *PLoS ONE* (IF ≈ 3.2) and *Scientific Reports* (*Sci. Rep.*; IF ≈ 4.3) since publishing more than ten thousand papers per year; indeed, their data are seemingly randomly distributed around 0% in YoY growth. Furthermore, for journals with an IF lower than approximately 10, IF and the journal's share of the top 1% most-cited papers in the journal's research area — a metric of selectivity — do not correlate[5].

The misuse of IFs and of other overvalued journal metrics have been widely criticized[5–8], and this journal has argued that the impacts of academic work matter far beyond what can be counted and that they should be systematically collected and analysed[9]. Also, The San Francisco Declaration on Research Assessment, which most publishers have signed, including Springer Nature, aims to halt the practice of correlating the IF to the merits of the contributions of a scientist, and states that editorial policies can be used to manipulate the IF. Indeed, but in the short term it may be a wavering game.

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