Rethinking the evaluation of scientific research: beyond bibliometric indicators

Foreword

One of the most challenging unresolved issues in contemporary science is how to better assess the significance of research and its actual impact on scientific progress.

In an extensive article published in Italian in the November 4 issue of the *Scienza in Rete* Newsletter, Michele Ciavarella and Vito Cacucciolo, both from the Polytechnic University of Bari, comment on the recent reform of academic recruitment in Italy, introduced by *Law No. 129 of July 16, 2026, Revision of the procedures for access, evaluation, and recruitment of university researchers and faculty. Official Gazette No. 170, July 24, 2026* (the so-called Bernini Reform). This reform provides the Authors with an opportunity to revisit a fundamental question: How should we recognize and select outstanding scientists and their publications?[1]

The issues raised and the comments offered by the Authors are relevant not only to universities and research institutions, but also to scientific journals. For this reason, I would like to highlight below the arguments that appear to me to be of particular interest to our journal and to the scientific Societies that support it.

Scientific excellence, they write, cannot be confined to the number of papers published, the citations received, or the position of journals in which research appears. Yet academic careers, research funding, university recruitment and reputation of scientific journals have increasingly been influenced by precisely these indicators. The issue goes far beyond Italian legislation, as it concerns the values that guide scientific research, the incentives offered to young investigators, and the responsibility of universities and research centers to identify and support genuine intellectual talent.

Eminent scientists and the limitations of numerical indicators

Ciavarella and Cacucciolo recall that John Jumper, together with Demis Hassabis, was awarded the 2024 Nobel Prize in Chemistry for the development of *AlphaFold*, an artificial intelligence system that has profoundly transformed the prediction of protein structures. Jumper's scientific output was relatively limited in numerical terms, but included a landmark publication in *Nature* in 2021.[2] This illustrates that scientific productivity and scientific originality do not necessarily coincide. A single contribution can fundamentally change an entire research field, whereas a long list of publications does not automatically translate into comparable scientific progress. History offers other striking examples. Albert Einstein's scientific legacy cannot be adequately described by his publication rate or citation indices. Peter Higgs suggested that, under today's academic productivity requirements, he might have struggled to obtain a university position. Carlo Rubbia's early experience with academic recruitment in Italy also reminds us that conventional selection procedures may fail to recognize exceptional scientific potential. These examples should not be interpreted as arguments against productivity. Rather, they demonstrate that scientific excellence may be multifaceted and that quantitative indicators capture only part of its features.

The question remains as to how we can better assess the value of research and its actual impact on scientific progress today, when evaluating researchers who fall within the middle range of scientific performance, rather than at either extreme of the spectrum, characterized by outstanding excellence or particularly low levels of productivity and quality. Indeed, bibliometric indicators were initially introduced precisely to make more objective the evaluation of researchers in this intermediate range. Over time, however, their use has gradually evolved, and they have increasingly become tools for boosting researchers' *h-index* scores and the Impact Factors of scientific journals.

When bibliometric measurement becomes the objective

Bibliometric indicators have a legitimate role in research assessment. Publication numbers, citation counts, and the *h-index* provide useful information about scientific activity and visibility. Indeed, Hirsch originally proposed the *h-index* as a tool for characterizing individual research output.[3] The problem arises when these indicators become decisive criteria rather than supporting evidence. When a measure becomes a target, it may cease to be a reliable measure. A fundamental confusion arises between measurement and evaluation. The *h-index,* Journal Impact Factor, and citation counts measure certain aspects of scientific output and visibility, but they do not necessarily reflect the intrinsic quality, originality, or scientific significance of research. The *h-index* combines productivity and citation impact, but does not measure the actual quality of scientific contributions. Similarly, the Journal Impact Factor reflects the average citation performance of articles published in a journal, rather than the scientific merit of any individual paper.

The number of publications, meanwhile, provides little information about the originality of the findings or their contribution to advancing scientific knowledge. Researchers who are rewarded primarily for the number of their publications might be encouraged to divide results into different smaller papers, favor safer and more easily publishable topics, and pursue citation strategies rather than intellectually ambitious questions. Evidence from Italy is particularly relevant. Baccini and colleagues documented changes in national citation patterns following the introduction of bibliometric criteria into academic career evaluation, raising concerns about strategic citation behavior.[4] More broadly, the growing volume of scientific publications places increasing pressure on researchers, reviewers, and the scientific publishing system.[5] The alternative, however, is not to abandon quantitative assessment altogether. Bibliometric indicators can help inform decisions, provided they are interpreted in the context of scientific discipline, career stage, research opportunities, and the nature of individual contributions. In this regard, quantitative evaluation should support, rather than replace, expert judgment.

Fewer publications, more meaningful contributions

An important lesson emerges from the experience of distinguished scientists: research should be driven by the importance of the question, rather than by the need to produce another publication. Richard Hamming, in his lecture *You and Your Research*, encouraged young scientists to devote their efforts to significant problems rather than become absorbed in routine activities.[6] Peter Medawar similarly emphasized the importance of choosing meaningful and scientifically dealt questions.[7] This philosophy is increasingly reflected in the assessment practices of leading research institutions. The European Research Council, for example, asks applicants to identify a limited number of relevant research outputs rather than to provide an exhaustive publication list.[8]

Applicants should be invited to present a small selection of their most significant scientific contributions and explain their originality, their personal role, their influence on the field, and their potential for future development. Such an approach would encourage committees to read and critically evaluate scientific work instead of relying primarily on journal rankings, impact factors, or citation statistics.

Qualitative assessment must, of course, be transparent and rigorous, often a quite difficult task… Expert judgment can be influenced indeed by institutional affiliations, scientific schools, personal relationships, and reputational biases. The role of independent external reviewers, clearly defined criteria, and documentable decisions is essential for acceptance of scientific manuscripts too. The European Agreement on Reforming Research Assessment, which promotes qualitative evaluation centered on peer review and the responsible use of quantitative indicators, provides an appropriate framework for this transition.[9]

The widespread of predatory journals

Furthermore, we should not overlook the fact that the increasingly widespread use of bibliometric indicators encourages the proliferation of so-called *predatory* journals, that exploit this environment by offering rapid publication and often inadequate peer-review procedures. At the same time, the resulting inflation of scientific publications makes it increasingly difficult to distinguish genuinely significant contributions from papers that merely add to publication and citation statistics, while simultaneously having negative consequences for scientifically rigorous journals, such as *Bleeding*, *Thrombosis and Vascular Biology*, with consistent editorial traditions, that do not adopt strategies aimed primarily at maximizing citation rates. These journals may, in fact, be penalized by evaluation systems that are often inconsistent with one another and are developed outside the actual realities and needs of the scientific research community. Scientific journals should not be judged exclusively on the basis of their Impact Factors or their position in bibliometric rankings. A more balanced assessment should also consider the rigor of their peer-review processes, the methodological quality of the articles they publish, the originality of their contributions, their editorial consistency and reputation, and their overall contribution to the development of their respective scientific fields.

A cultural change, not simply an administrative reform

Ultimately, the challenge is not to find a better formula for counting publications. It is to restore the central role of scientific judgment in scientific life.

Young researchers should be encouraged to pursue important questions, develop original ideas, and bring their work to maturity, rather than organize their careers around numerical thresholds. Universities and Research Centers should be able to recognize excellence in all its forms, including fundamental discoveries, interdisciplinary research, technological innovation, clinical advances, and contributions with measurable societal impact. Simplifying procedures is not enough. Scientific excellence is not a matter of counting publications. It is a matter of understanding which contributions move science forward.

References

1. Ciavarella M, Cacucciolo V. Riforma Bernini: nella giusta direzione, ma senza una grande spinta? Scienza in rete Newsletter. November 4, 2026. Avallabile from: https://www.scienzainrete. it/articoli/reclutamento-universitario-bibliometria/. Accessed: November 2026.
2. Jumper J, Evans R, Pritzel A, et al. Highly accurate protein structure prediction with AlphaFold. Nature 2021;596:583-9.
3. Hirsch JE. An index to quantify an individual's scientific research output. Proc Natl Acad Sci USA 2005;102:16569-72.
4. Baccini A, De Nicolao G, Petrovich E. Citation gaming induced by bibliometric evaluation: A country-level comparative analysis. PLoS One 2019;14:e0221212.
5. Hanson MA, Gómez Barreiro P, Crosetto P, Brockington D. The strain on scientific publishing. Quant Sci Stud 2024; *5*:823-43.
6. Hamming RW. You and your research. Transcription of the Bell Communications Research Colloquium Seminar, 7 March 1986.
7. Medawar PB. The Art of the Soluble. London: Methuen; 1967.
8. European Research Council. ERC work programme 2026. European Commission; 2025.
9. Coalition for Advancing Research Assessment (CoARA). Agreement on Reforming Research Assessment; 2022.

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