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The economics of creative research

Research can drive economic development, but only if it is shielded from political whims and capitalist ideas

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In these times of economic crisis and austerity, the public funding of scientific research has come under the spotlight. Whilst there is acceptance of the general value of scientific research itself, governments and funding agencies are increasingly interested in the performance and cost efficiency of specific research institutes, projects, teams and individuals. To make these 'value-for-money' assessments, many countries rely on agencies and define criteria to evaluate research and carry out academic benchmarking—for example, the Research Assessment Exercise and the future Excellence Research Framework in the UK, the Wissenschaftsrat and Akkreditierungsrat in Germany, the National Institution for Academic Degrees and University Education in Japan and the Agence d'Evaluation de la Recherche et de l'Enseignement Supérieur in France, which are organized in international networks, such as the European Network for Quality Assurance in Higher Education. These organizations often have common procedures and standards, such as applying economic principles of quality assurance to research and its institutions. Their wide-ranging evaluation of scientific research by panels of experts aims to create qualitative and quantitative measures for research output, influence, organization, education and strategy.

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A substantial part of the work of research assessment organizations involves some sort of meta-review of publications, grants, books, distinctions, awards and promotions by expert panels. But evaluation agencies do not merely quantify academic achievements, publication bibliometrics and publication records, they also generate new ratings, judgements, statements and recommendations, taking into account non-academic, technical and even subjective criteria. Expert panels re-evaluate projects and recommend that research activities and funds be redirected towards new goals. Some of these agencies and organizations also perform self-evaluation and are themselves the subject of evaluations and ratings by other agencies. Rating has become a worldwide business and academic-rating agencies profess to assess any and all types of research structure. Altogether, this expert super-review requires the investment of a great deal of manpower and money, both from the agencies themselves, and from the institutions, structures and people that are subject to evaluation and rating [1].

Given these costs, it is prudent to ask whether it is really necessary to perform these kinds of super- and meta-review of scientific research, especially during an economic crisis when the resources consumed in this way could be better spent. It is also prudent to ask whether, in general, the clout and influence of ratings and benchmarks is undermining or damaging the scientific enterprise itself. Ratings exercises increase organizational complexity and bureaucracy and, as a result, also increase the time scientists must devote to non-research activities. Perhaps worse still, such exercises can have an impact on the direction of research for all the wrong reasons, as they can force scientists to focus on quick results and publications, rather than risky but important long-term projects with uncertain outcomes. Finally, the

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entire premise of reviewing material that has already been examined through peer review and publication could undermine academia because it implies that traditional academic peer review might be defective or unable to assess the real value of a grant or publication.

Theodore W. Schultz (1902–1998), who won the Nobel Prize in Economics in 1979, concluded that economic progress depends crucially on scientific research, and that development is intrinsically linked to new knowledge. "Were it not for advances in knowledge, the economy would arrive at a stationary state and all economic activities would become essentially routine in nature," he wrote [2], suggesting a continuous flow between creativity, research and economic development. Schultz expanded this idea by integrating research activities into economics, as he considered research "an economic activity because it requires scarce resources and it produces something of value" [2].

Schultz related this "something of value" to "research entrepreneurship", which integrates individual qualities of "dynamic venture into the unknown", "risk and uncertainty", absence of routine and "creative research" [2]. The synthetic concept of research entrepreneurship is a change of paradigm in the debate on science policy in which "fundamental research" and "entrepreneurship" describe two different systems that should support and control each

other. Schultz turned this notion around by regarding creative research as the fundamental source of entrepreneurship and economic advancement [2].

The importance of creative and non-routine research, as opposed to controlled research, can be further extended from economics to human development, human welfare and the future of mankind [3]. Norman Borlaug, Nobel laureate and the father of the Green Revolution [4], was one of those scientists who used science to "construct a future that is worth living" [3]. In his personal recollection of 62 years of research to address hunger [5], Borlaug directly endorsed the views of Schultz on research entrepreneurship and lamented the onset of fashions and controls, "both generated from within the scientific community and imposed upon it by external forces" [5]. Both Borlaug and Schultz stressed that the independence of individual researchers and research teams must be encouraged to sustain the important role of creativity for economic and human progress.

The inevitable tension between individual creativity and organizational forces led Schultz to conclude that "a large organization that is tightly controlled is the death of creative research, regardless of whether it be the National Science Foundation, a government agency, a large private foundation or a large research-oriented university" [2]. Indeed, the science policies and the organization of research that have gained ground in most countries during the past years have intensified the pressure on researchers and threaten to stifle creativity. It is common that the 'research entrepreneur' is concomitantly accountable to his or her university, to government and private funding agencies, as well as other national and international agencies and organizations (Fig 1). Moreover, the increasing rating and benchmarking of research and its institutions and the super-review of peer-reviewed material have created new structures and complex bureaucracies that pile up on the individual research entrepreneur. Schultz warned us about this development 30 years ago: "There is the ever-present danger of over-organization, of directing research from the top, of requiring scientists to devote ever more time to preparing reports to 'justify' the work they are doing, and to treat research as if it was some routine activity" [2].

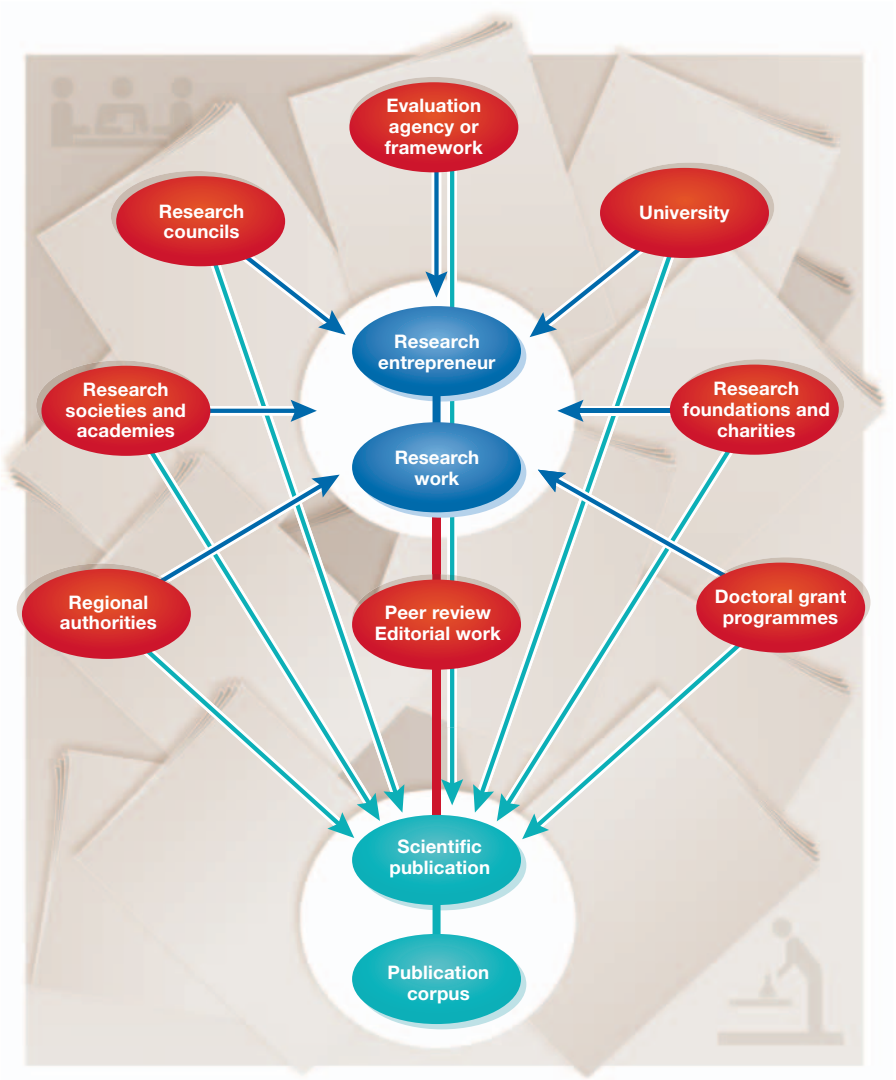

Fig 1 | Institutional and organizational networks surrounding the research entrepreneur at national level. The number of institutions and the complexity of their relationships vary between countries. The present scheme gives a partial view that might apply to many countries, in which evaluation agencies, universities, national research councils, foundations, charities, research societies and regional authorities interact with the individual researchers, their team and their laboratory. Arrows indicate relationships of evaluation-selection bearing on ideas, projects, expected results, pre-published results (dark blue arrows), publications and the corpus of publications (light blue arrows).

The present state of science organization and funding seems to be based on the assumption that expert evaluation and guidance, rather than traditional academic peer review, determines and quantifies the "something of value" [2] produced by scientific research. The dynamic process of traditional peer review seems to be regarded as too chaotic, too highbrow and too unpredictable for rational organization and economic efficiency. However, this chaotic and highbrow process reflects stochastic and dynamic processes that are an essential component of creative research. Schultz did not comment specifically on the role of peer review in the dynamics of creative research. However, his view was that "no research director can know the array of research options that the state of scientific knowledge and its frontier afford" [2]. Thus, scientists

> **"[…] a large organization that is tightly controlled is the death of creative research […]"**

themselves are the ones who are the most competent in assessing research results and hypotheses [6], and should accordingly be given freedom, responsibility and initiative [1,3]. This can be expanded to the community level, where the peer review of academic journals draws on the highly specialized expertise of researchers. Of course, academic peer review is neither perfect nor the ultimate measure of scientific value, which is why all scientists read and analyse published articles, both to discover new ideas and identify potential flaws. Through this process, they reproduce or expand experiments, scrutinize conclusions and push forward the boundaries of knowledge. Most importantly, their work is then itself subject to peer review, publication and peer scrutiny.

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Additional hierarchical layers of expert review of peer-reviewed achievements potentially undermine this ongoing, global and open process. Publications and peer review have already come under the influence of bibliometrics. Thus, even if a large part of research creativity remains outside the direct scope of evaluation agencies, the evaluation of researchers and laboratories can elicit opportunistic strategies in the planning of publications and the choice of journals to optimize subsequent success in evaluations.

Moreover, an increasing number of other research activities are subjected to increasing amounts of assessment. The scrutiny of evaluation agencies and organizations is not only pervasive and expanding, but also repetitive. The structures to which individual researchers belong—laboratories, institutes and research consortia—also develop their own evaluation processes and organizational systems that include self-evaluation, output analysis and project evaluation. In the long term, one fears that the repetition of such analyses and the constant update of bibliometric databases will probably influence scientists' psychological and behavioural processes.

The pressure to please the assessors can encourage unhealthy self-criticism and self-censorship, which leads to unambitious projects and a focus on short-term success. Declarations of independence such as "the funders had no role in study design, data collection and analysis, or preparation of the manuscript" might therefore not be true *in sensu stricto*, as funders have a significant role in streamlining research fields, defining research proposal calls, selecting projects and assessing previous work.

The philosophy behind evaluation agencies and the measures to which they hold research—competitiveness, excellence, productivity, quality assurance, human resources and benchmarking—are economic principles intended to maximize efficiency and profit, rather than scientific principles intended to maximize knowledge and understanding. In fact, in the weak economic climate, numerous stakeholders have stated explicitly that they want to profit from the research–innovation continuum. Their economic and political influence is increasing the impact of benchmarking and a strategic focus on innovation and the knowledge economy, both of which are threatening non-routine creative and independent thought. This 'normalization' of research might end, to use Schultz's words, in a "routine" and "stationary-state" economy [2].

This problem of how administrative and evaluation systems endanger research creativity is already a growing concern among the scientific community and analysts of science policy [1,3]. A few funding agencies, including the Alexander von Humboldt Foundation, the European Research Council and the Howard Hughes Medical Institute [1,3], have responded by developing funding schemes to support long-term and individual-oriented research, and to give researchers more freedom, independence and the means to "venture into the unknown" [2]. Scientific journals, societies and academies have also expressed opposition to research and knowledge-rating by evaluation agencies, whilst a range of articles [3,7–9] have criticized the non-specialized super-expertise relied on by ratings agencies, as well as the lack of critical and creative thought used in their activities and the deleterious effects of science metrics and benchmarking.

Criticism of the peer-review system, and examples of the deficiency of peer review, have already encouraged suggestions to move the system of assessing academic research away from peer review and towards direct community evaluation. The principles of quality assurance and the expanding activities of evaluation agencies might eventually include the rating of journals, societies and academies, or even, in the long term, the rating of research manuscripts. There are preliminary signs of this shift in values in the sense that the success of an academic or institution, in obtaining research grants and coordinating projects, is becoming more important to their evaluation than are peer-reviewed publications, suggesting that obtaining and managing money are becoming the objective of research. Thus, the already pervasive and nearly ubiquitous bureaucracy that has grown up around the assessment of research is poised to extend itself further to the standardization of scientific language, scientific style and scientific expression. Such a development would probably lead to academic writing agencies, professional article management and ghost-writing, which already pose a problem in biomedical research [10].

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Journals, societies and academies are therefore the first line of defence for traditional academic peer review against the superimposed review and constant surveillance of research productivity. Moreover, scientists themselves should resist these changes and speak out against the pervasive encroachment of business ideas in the management and funding of research and economic notions of the scientific enterprise. As Schultz and others [2] have shown, science is a highly creative activity that is stifled by too much regulation and money-oriented goal-setting. As such, viewing scientific research in terms of efficiency and return on investment will inevitably stifle creativity and backfire. If science is the basis for economic progress and development, such a situation would have the opposite effect to that which is desired by politicians, policy-makers and capitalists.

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CONFLICT OF INTEREST
The author declares that he has no conflict of interest.

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