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The science marketplace

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Abstract

The brilliant enterprise of a privately-run marketplace on a public service (science) and associated goods (body of knowledge) is currently challenged on the grounds of shared value.

1 Introduction

Science represents different realities for the various stakeholders — for instance, (a) *idealist academics* associate science with credibility and trustworthiness, or even prestige in the righteous pursuit of knowledge, (b) their *practical administrators* associate science with productivity (e.g. impact factors, rankings), patents, and grants for their institutions, while (c) *publishers* and *ancillary service providers* lock on to the opportunity for business profit — e.g. publishing, indexing, abstracting, rating, ranking (Perdicoúlis, 2014a,b,c). Despite their apparently different perceptions and interests, all of the stakeholders bank on the credibility of science and the knowledge it conveys — Figure 1.

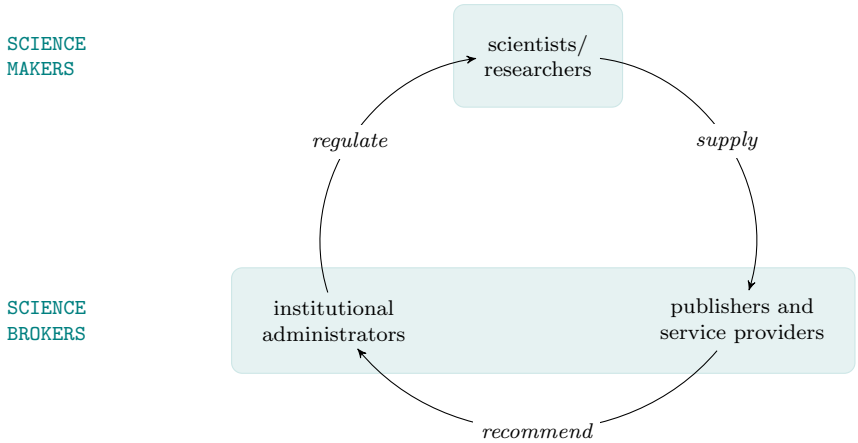

FIGURE 1 Science makers interact with science brokers

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2 Transactions and tokens

Science as a body of knowledge exists primarily in the minds of the learned individuals who follow a work protocol known as the 'scientific method' (Popper, 2002), while both the knowledge and the method continuously evolve (Kuhn, 1996). The 'live' transmission of science is typically handled in schools, from Plato's Academia to modern-day universities (Perdicoúlis, 2013d). *Verba volant, scripta manent*, though, so science partially depends on the recording and communication of knowledge in physical media, from papyrus and parchment to scholarly journals and textbooks. The comprehensive means for the recording and transmission of science, from universities to publications, create a *marketplace* for knowledge — e.g. schools charge fees for teaching, and publishers sell printed books — Figure 2.

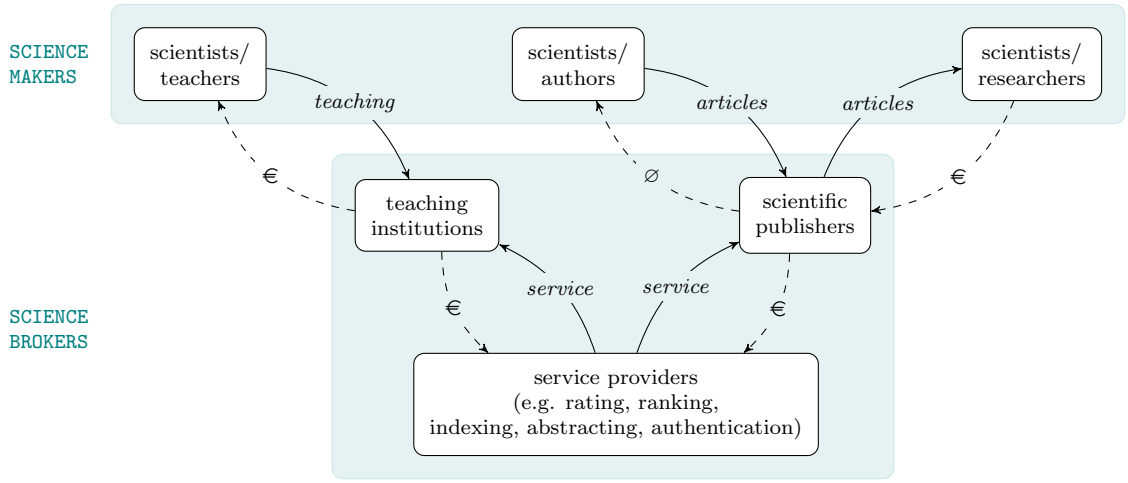

FIGURE 2 Key transactions of the science marketplace

Scientific knowledge is not the only facet of human culture or civilisation to develop a 'market version' that may become dominant at some point in history — cooking, for instance, starts at home, but then cooking schools and restaurants are created; the same with story-telling, garment making, or even courtship. Regardless of their origins, such markets are known to shape the original pursuit to the reality of the market — e.g. product image, market share, popularity, money. The capitalist character (Marx, 1867) of the science marketplace is evidenced in key relations — for instance, scientists regularly hand over their 'products' (e.g. scientific articles) for free, out of which publishers and ancillary service providers make a profit (Figure 2). While scientists esteem the 'metrics' they receive as tokens for their articles (Figure 3), they are being exploited with reference to the common token of exchange known as 'money'.

Science metrics are becoming increasingly popular as tokens in the scientific milieu: *articles* are the unit of 'scientific production', *citations* reflect the 'reach' of articles (Perdicoúlis, 2012c), and the *impact factor* is the 'worth'[1] of journals (Perdicoúlis, 2013a,c). These are routinely featured in the portfolios of scientists, representing their own 'worth' in the science market (Figure 3), often accompanied by more complex calculations such as the 'h-index' and the 'i10-index'[2]. In this trend, scientific work and its contribution (i.e. real impact to science and/ or the community)

[1] i.e. the level at which they deserve to be valued or rated.

[2] The wi(l)der dream of Garfield (2005, 1955) included 'scientometrics', 'bibliometrics', and 'journalology', to which science is but an object of measurements and calculations.

are effectively sidelined by surrogates such as their own 'shadows' (Perdicoúlis, 2012b, 2013b). Young academics, for instance, are led to think that their scientific duty is to publish in commercial journals, and anyone claiming to 'explore and understand' can be viewed as 'idealist' or 'romantic'.

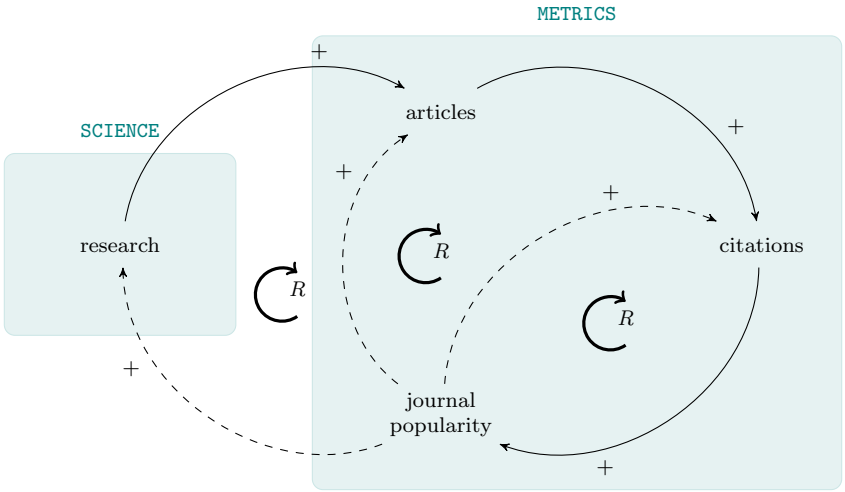

FIGURE 3 *Disclosed* journal popularity is a powerful token

While unbiased logic and stern conduct are professed traits of science, they may be somewhat altered by its association with the market. At large, the conditions created in the science marketplace by establishing special transactions (Figure 2) and accepting new tokens (Figure 3) are being driven by two human foibles: *bias* (§ 3) and *greed* (§ 4).

3 Bias

Personal interests to publish — whether formed by the pursuit of fame, or by administrative counsel — turn scientists *partial* (Figure 4), which 'polarises' their judgement capacity and reduces their suitability for participation in review panels of publications, career promotions, or idea contests. Nonetheless, 'peers'[3] are regularly asked to review and assess the work of others, with whom they compete directly or indirectly. While peer review may make sense in 'idealist' science, in the marketplace it is but a stakeholder act (*v.* end of § 3).

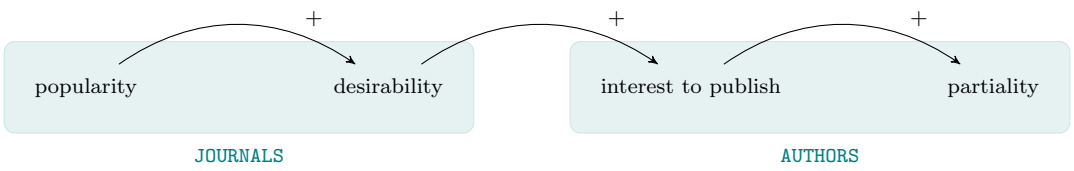

FIGURE 4 *Partiality*: authors attracted to 'good' journals develop a natural bias towards them

It is customary that academic metrics (i.e. tokens or 'points') can be exchanged for services such as publishing or grants, and benefits such as career promotions — and there *is* indeed preferential

[3]From *par* [L], equal — not as members of nobility, as the common use of the term may imply, but as *colleagues*.

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treatment or *vice*[4] (Figure 5), to the extent that issues of discrimination may be raised. The unfairness for some — and 'good business' for others — is due to reinforcing feedback loops (Figures 3 and 5) that function as *status quo* amplifiers for individual scientists, scholarly publications, and by extension for their parent or host institutions.

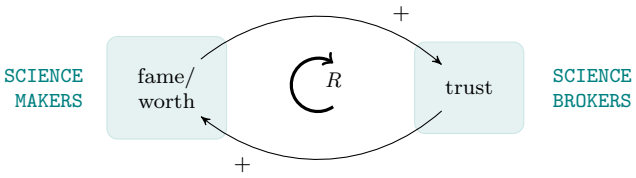

FIGURE 5 *Vice*: science publishers, investors, and administrators reserve their right to be preferential

These two forms of *bias*[5] — i.e. partiality (Figure 4) and vice (Figure 5) — interfere with the genuine concern of science: *trustworthiness*, *credibility*, or *validity* — for instance, that the method of the work is sound, the content is correct, and the transmission (e.g. the article *per se*) is error-free. Such *qualities* deserve high consideration and safeguarding, on a par with the contribution (i.e. true impact) of science to the community, but the marketplace is permissive to a variety of decision-making techniques that are not equally reliable — Figure 6.

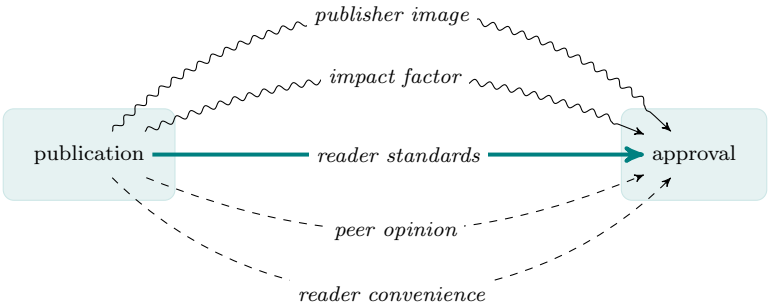

FIGURE 6 Vitiated (⇝), partial (- - -➤), and responsible (⟶) choice of publications

Direct appreciation of (quality in) published scientific articles implies diversity of perspectives and purposes, so the dimensions and scales of criteria, the benchmarks or cut-off points, as well as the measurement and assessment methods are distinguished by *non-uniformity*. It follows that scientists must be able (i.e. learn how) to judge scientific quality for themselves (Perdicoúlis, 2013a) — Figure 6, 'responsible' (⟶) pathway.

On the contrary, from the point of view of the science brokers, the science marketplace requires *uniformity* — encountered in the form of metrics — to share global-scale comparisons or to measure and announce market trends. Such metrics are fundamental for whetting the interest of participants, promoting contests, and inciting dynamism in the science marketplace — Figure 3. In what would gradually become a culture of tokens, proxies, or surrogates, technically known as indicators and indices, scientific articles would not have to be examined individually; conveniently, their 'quality' or value could be inferred from the prestige[6] of the host journal as reflected in its impact factor —

[4] In this sense, immoral or wicked behaviour.
[5] Inclination, partiality, or prejudice for or against, especially in a way considered unfair.
[6] Notwithstanding, *praestigium* ([L], illusion, conjuring trick) was originally depreciatory (Perdicoúlis, 2012a).

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or, somewhat more abstractly, the 'fame' of the publishing house. On this principle, publications made by old and famous publishers are to be trusted, while those made by newer or independent publishers (e.g. the authors themselves) are to be discarded on the grounds of their 'pedigree' (Figure 5), expressed practically in the fear of *deceit*[7].

By adopting tokens such as the impact factor as proxy metrics of quality, the issue of quality in science is bypassed altogether through a vast over-simplification: the proxy is so strong that quality is practically *substituted* by popularity — Figure 6, 'vitiated' ($\rightsquigarrow$) pathways. But while tokens may be handy for measuring simple objects (Perdicoúlis, 2013b), they are usually inappropriate for complex objects or situations such as science or its specific concern of quality (Perdicoúlis, 2012b). And while the shift of focus from quality to popularity on the plausible grounds of 'measurability' is being promoted by the publishers and the ancillary service providers, this appears to be done with the consent or connivance (or, it could be argued, with the active collaboration) of both the scientific administrators and the scientists — both in their generality as groups, of course, allowing for exceptions.

As a special case, the selection of submitted articles for publication in (commercial) scientific journals generally involves a combination of approaches. After passing the 'pedigree' screening for authors and institutions — Figure 6, 'vitiated' ($\rightsquigarrow$) pathways —, which is a proxy approach, the assessments are generally attributed to peers to perform their personal reviews — Figure 6, 'partial' ($\dashrightarrow$) pathways. The traditionally *pro bono* functions of the peer reviewers keep the production costs low for the publishers, but the peer review argument itself is vulnerable considering that (a) peers are not impartial due to personal interests (Figure 4), (b) only two peers are typically called to judge a scientific work, and (c) reviews are carried out only once[8]. It would be difficult to claim that scientific validity is sought by reviews in which the vast majority of peers have absolutely no say, and non-reviewers have the ethical obligation to remain silent for ever[9].

4 Greed

Assuming that fraudulent conduct is not condoned, it can be argued that the *recommended* scientific practice is in the 'idealist' sense: if scientists are to publish, then they should prepare their work with due care and thus make a valuable contribution to science and the wider community — Figure 7, 'recommended' ($\longrightarrow$) pathway. The verification of this practice should come from the antipodal point of view: the readers — in principle, scientists should be able to partake in (public) science as freely as they contribute; in practice, they should have full access to scientific articles of value (Figure 6, 'readers'). Hence, artificial obstacles (e.g. fees, embargo) placed by publishers (Figure 6) for their own financial profit are a manifestation of *greed*, against the interest of scientists and/ or science. A typical and direct consequence is the reaction of authors, who are tempted (or forced) to breach their copyright agreement with the publishers, handing out copyrighted material[10] because they 'need the citations'.

The perceived need (or greed) of authors invites an easy tactic to increase their own 'points', by replicating their own publications in whole or in part. For instance, a web page (Testa, 2004)

[7] The fear of deceit is actually valid only amidst an academic culture of greed, with scientists striving to accumulate 'academic points'; in healthy circumstances, scientists publish because they have something to communicate.

[8] This is the 'one-off, two-peer' review model.

[9] Contrary to opinion or journalistic publishing, the ethics of the scientific community do not encourage peers to question the works of their peers after their publication — save the exceptional cases of errors, or concerning the work of scientists of other generations.

[10] Technically they can only send pre-print versions of their articles, some of which may lack only the final formatting.

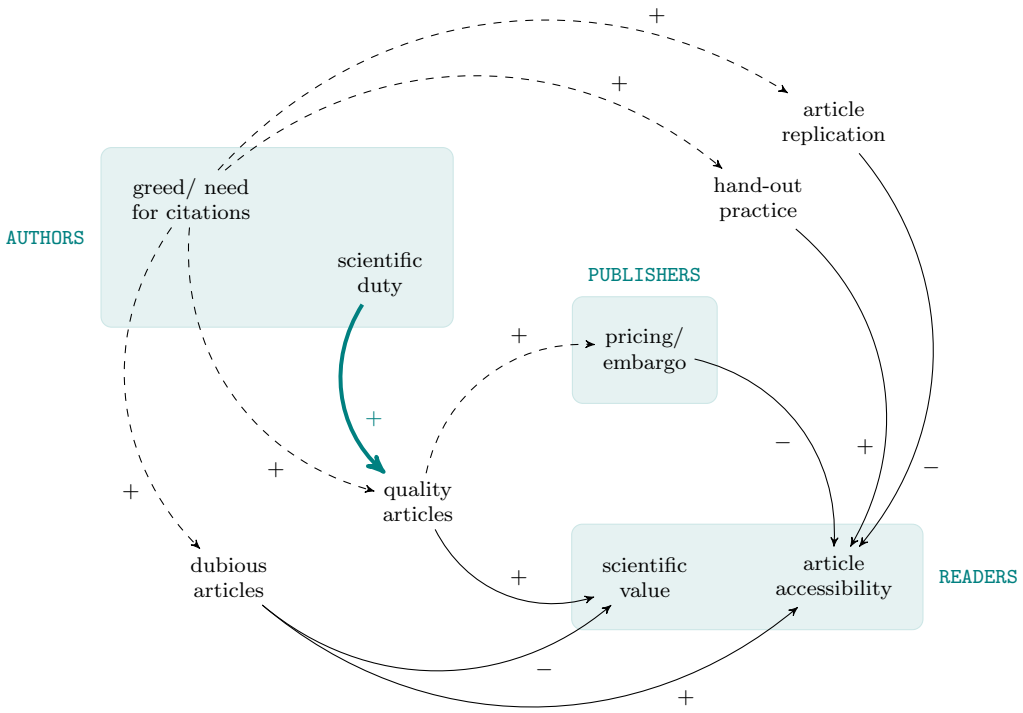

FIGURE 7 Typical (⟶), recommended (⟹), and questionable (- - -➤) pathways in publishing

can become a lecture (Testa, 2006a), which then can become a journal article (Testa, 2006b), yet another journal article (Testa, 2008), and then return to the web as an essay in PDF format, available in eleven (11) languages (Testa, 2004, v. footnote). While (some) journal editors are now restricting this replication as 'self-plagiarism', the grand concern is the misappropriation of intellectual property (i.e. true plagiarism[11]), which is borderline criminal[12].

Perhaps the most irresponsible and far-reaching side-effect of greed in the scientific marketplace is the littering or poisoning of the scientific body of knowledge. Law-abiding scientists and students who want a safe and trouble-free approach to finding 'printed knowledge' at no financial cost are risking *prime access to second-rate material*. As there is no mandatory quality screening and the technical means are widely accessible, anyone can 'publish' practically anything on the internet — and this includes 'desperado' scientists who cannot enter the commercial circuit, or fledgling authors with no experience in following the scientific protocol. As a result, publication quality lowers — but while research articles prepared with sub-standard sources may be rejected from the (commercial) publication circuit, the knowledge acquired by people who *learn* from such sources will remain forever impaired.

[11] From *plagium* [L], kidnapping; originally from πλάγιον [Gk], inclined, slanted, and its use as 'indirect means' of achieving an aim.

[12] There is a 'fair practice' exception that allows the verbatim and attributed republishing of material by other authors, although the exact number of words varies across countries and/ or publishers, and also along time.

5 Challenges

The creation of a privately-run marketplace on a public service (science) and associated goods (body of knowledge) may have arisen from the need to record and organise valuable knowledge in a professional manner — a need which the printing press and indexing services promptly fulfilled. But giving up the *(copy)rights* of the knowledge itself to the media owners was probably not a great idea, as now the marketplace runs at the cost of *accessibility* to valuable scientific knowledge — Figures 2 and 7. An eventual *de-privatisation* of the science marketplace (Figure 8) could empower scientists and release public knowledge for public use, but is also expected to *struggle for credibility* as it fights against new opportunism — e.g. 'predatory' publishers (Perdicoúlis, 2013a) — and perhaps 'old money' resistance — e.g. by commercial publishing houses and/ or ancillary service providers.

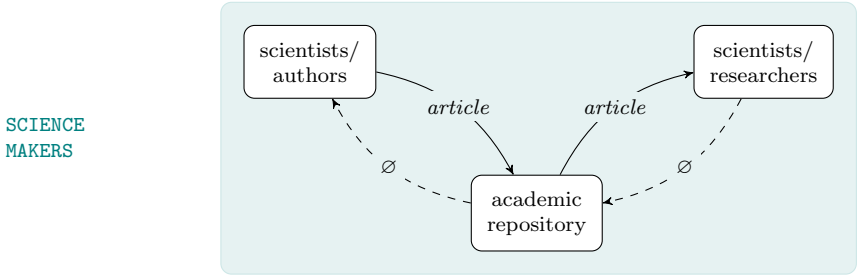

FIGURE 8 Creating 'shared value' (i.e. accessible *bona fide* knowledge) for public science is a formidable challenge (Perdicoúlis, 2014a)

Whereas the current situation may provoke sporadic *reactions* of independent scientists or interest groups, concerns at the institutional or national level have the capacity to develop *reforms*. For instance, the UK Research Excellence Framework (REF, 2012) turns its attention to (a) the originality, significance, and rigour of research output, which points to the 'slow and careful' production of research articles, in an old-fashioned way, resisting to the pressures or greed to accumulate 'academic points', and (b) to the reach and significance of the 'research impact' on the economy, society, and/ or culture through examples or evidence — not an impact that can be collected and accumulated as 'academic points'.

Meanwhile, scientists could demonstrate their integrity by (a) refusing to be misled by administrators who exchange 'token' criteria for job security or promotions instead of considering real impacts (e.g. the actual work of the scientists, its applications, and evidence of contribution), and (b) refusing to be exploited by commercial publishers at the promise of 'high impact' publications — for instance, they could ensure legal accessibility of their work to other scientists.

As for the commercial scientific publishers, they could redefine their role towards producing *exceptional value* (e.g. active involvement in editing and typesetting manuscripts, or producing high quality graphics) for which a price would be well justified — for instance, with 'deluxe' editions such as collector compendia. Many scientists do appreciate good print, whether physical or electronic, so the publishing art and associated market can upgrade instead of disappear. In the same way, an essence-focussed scientific community would need less of the ancillary (i.e. meta-information and mainly marketing) services, as public science re-takes its focus (and perhaps command) on *shared value* — Figure 7.

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[13] First version: 2004 (without 'Reuters' in the title); last update: 2012; PDF available in 11 languages.
[14] Based on Testa (2006a), according to a footnote on the first page of the article.