Review of: "Science desperately needs disruptive innovation"

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This paper addresses an important issue and does this in an engaging style. It is convincing in conveying the point that science is in need of more “disruptive” (radical, breakthrough) innovations. I agree with the general characterization of the science landscape, dominated by incremental research and only rarely shaken by major breakthroughs. The way science is pictured in this paper corresponds well with the epistemological model of Olsson (2005) and Growiec and Schumacher (2013), on which I worked several years back.

Specifically I agree that science naturally tends to specialize and operate in “silos”, with little communication across disciplines or even sub-disciplines. Furthermore, existing grant systems – even if declaratively focusing on “breakthrough” ideas – by construction must favor safe, predictable research plans. Finally, the conjunction of the peer-review model of publication with strong incentives to “publish or perish” indeed pushes scientists to engage in low-risk projects of incremental nature.

However, I am much less convinced by the empirical analysis carried out in the paper. It seems to me that the paper strongly over-advertises the Disruption Index (DI), which simply rescales any given base parameter (BP), putting it on a scale from 0 to 1 as long as BP is always positive. There is no added information in computing DI as compared to using BP directly. Therefore DI can only measure disruption if BP measures disruption.

The current paper uses the following variables for BP: (i) the number of investments (in selected hi-tech industries), (ii) citations of the top 10 000 papers (in selected fields of science), (iii) the number of published papers (in selected other fields of science). By doing so, the paper does not seem to measure disruption, but rather just frequency. Disruption and frequency are quite distinct concepts, though: for example, publication frequency can also increase in “fashionable” scientific topics, without representing any sort of technological or scientific disruption.

What makes matters worse, despite claiming that this approach allows for “seamless comparison” between science and the hi-tech industry, because of using different base variables (BP) for different fields, the paper is actually comparing apples to oranges to watermelons, big time.

This is particularly clear when citations are used. I am skeptical about the validity of claim that “the highly synchronized behavior of the distant disciplines suggests they represent the state of science in general”. Rather, I expect this synchronicity to be largely driven by the used metric: citations among “the top 10,000 cited papers between 1984-2020, (…) distributed by years”. Note that citations are gradually accumulated over time, and typically bulk of the citations are

acquired within the first ca. 5 years from publication. Next – particularly for the best papers – one can expect a steady flow of additional citations accumulating for many years on. This means that the sharp drop in the number of citations for publications in 2015-20 and its decline in the several years prior is most likely a statistical artifact: these papers simply have not accumulated their citations yet. In contrast, no such effect is present for publication or investment event numbers.

All in all, why I partly agree with the narrative of the paper – indeed there are mechanisms in science that discourage radical, “disruptive” innovation, and quite possibly science would benefit from more disruption – I think that unfortunately the paper does not provide convincing empirical support for these claims. I expect that there should be a better way to measure disruption in science.

References

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