

The rationales and impact of open science

The particularities of open science provide the policy and economic rationales for supporting it. Open search tools increase the efficiency of research as well as of its diffusion. Greater access to scientific inputs and outputs can improve the effectiveness and productivity of the scientific and research system, by: reducing duplication costs in collecting, creating, transferring and reusing data and scientific material; allowing more research from the same data; and multiplying opportunities for domestic and global participation in the research process. Scientific advice can also benefit from the greater scrutiny offered by open science, as it allows a more accurate verification of research results. In addition, increased access to research results (in the forms of both publications and data) can foster spillovers not only to scientific systems but also innovation systems more broadly (Box 1.1). With increased access to publications and data, firms and individuals may use and reuse scientific outputs to produce new products and services. Open science also allows the closer involvement and participation of citizens.

There is growing evidence that open science has an impact on the research enterprise, business and innovation, and society more generally. Recent analysis reveals that enhanced public access to scientific publications and research data increases the visibility of, and spillovers arising from, science and research.

There has been debate in the academic literature as to whether open access publications receive more citations than non-open access publications, which has led to attempting to measure the so-called *open access citation advantage*. Most of the studies conducted on this question do find that open access increases citations. It has also been argued that the open access citation advantage is caused by a quality bias (i.e. researchers tend to publish via open access their best-quality works, and this is why they get more citations); however, there is also evidence that the citation advantage is not caused by the quality bias but by the advantage from users self-selecting what to use and cite, without any constraint related to selective accessibility to subscribers only.

Scientists and academics are not the only groups that can benefit from greater open science efforts. The demand from the business sector and individual citizens to access research results is significant. For example, usage data from PubMedCentral (the online repository of the US National Institutes of Health) show that 25% of the daily unique users are from universities, 17% from companies, 40% are individual citizens and the rest are from government or in other categories (UNESCO, 2012).

Calculating estimates of the economic value of research publications and data is challenging, but these have begun to emerge. Available estimates include those of Houghton and Sheehan (2009), who analyse the effects of increasing accessibility to public sector research outputs in Australia; they conclude that increased accessibility generates a return of approximately AUD 9 billion over 20 years. Houghton, Rasmussen and Sheehan (2010) estimated that a public access policy mandate for US federal research agencies over a transitional period of 30 years may be worth around USD 1.6 billion and up to USD 1.75 billion if no embargo period is in place. Around USD 1 billion would benefit the US economy directly and the remaining amount would translate in economic spillovers to other countries. These figures would be significantly higher than the estimated cost of implementing open access archiving. JISC (2014) conducted a study on the economic impact of three UK data centres (the Economic and Social Data Service, the Archaeology Data Service and the British Atmospheric Data Centre), and estimated that the returns to investment of each of these three centres could be between approximately twofold and tenfold over 30 years.

Additional evidence shows that firms and smaller research institutions face barriers to accessing public research results. A recent study on R&D-intensive small and medium-sized enterprises (SMEs) in Denmark (Houghton, Swan and Brown, 2011) found that 48% of those SMEs consider research outcomes very important for their business activities, and more than two-thirds reported difficulties in accessing research material. A survey on UK SMEs found evidence that the equivalent of 10% to 20% of articles were not easily accessible for the survey respondents (Ware, 2009). Finally, it has been argued that making research data publicly available may promote public understanding of

science, evidence-based practices, and citizen-science initiatives (Kowalczyk and Shankar, 2010).

For further reading

Houghton, J. and P. Sheehan (2009), “Estimating the potential impacts of open access to research findings”, *Economic Analysis and Policy*, Vol. 29, No. 1, pp. 127-42.

Houghton, J., B. Rasmussen and P. Sheehan (2010), “Economic and social returns on investment in open archiving publicly funded research outputs”, Report to the Scholarly Publishing and Academic Resources Coalition (SPARC), Center for Strategic Economic Studies, Victoria University.

Houghton, J., A. Swan and S. Brown (2011), “Access to research and technical information in Denmark”, Technical Report, School of Electronics and Computer Science, University of Southampton.

JISC (2014), “The value and impact of data sharing and curation: A synthesis of three recent studies of UK research data centres”, JISC, March, <http://www.cni.org/news/jisc-report-value-impact-of-data-curation-and-sharing/> [1], accessed 11 June 2015.

Kowalczyk, S. and K. Shankar (2010), “Data sharing in the sciences”, *Annual Review of Information Science and Technology*, No. 45, pp. 247-94.

UNESCO (2012), *Policy Guidelines for the Development and Promotion of Open Access*, UNESCO Publishing.

Ware, M. (2009), *Access by UK Small and Medium-sized Enterprises to Professional and Academic Literature*, Publishing Research Consortium, Bristol.

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[1] <http://www.cni.org/news/jisc-report-value-impact-of-data-curation-and-sharing/>