evgeny klochikhin **view from the top**

New numbers for old questions

Data can inform science policy like never before—and researchers must make sure they get involved, says **Evgeny Klochikhin**.

Last month, life sciences minister George Freeman told the Conservative party conference that his colleagues were demanding evidence that the science budget merited its ring fence. Was this spending worthwhile in economic and societal terms? "I really want a scientific answer," said Freeman.

Any researcher tempted to provide that answer has no shortage of data sources to turn to. Huge amounts of science-related information have become available in the past decade. Publishers sell databases of their publications. Researchers scrape websites for CV and research data, and work to digitise and disseminate patent data. Administrative data from universities and research institutes detail spending on people and equipment.

These data have great potential to generate science metrics for policy. But using them in policy is challenging—they will yield good decisions only if the process is grounded in an understanding of how science operates.

What if, for example, the policy goal is to maximise publications? If one team has produced a decade's worth of high-impact papers, should we sponsor only that team and not junior scholars? Or if nanotechnology researchers generate the most patents, should we fund nanotechnology at the expense of other disciplines?

Academics' reluctance to answer these questions has led to government agencies doing it for them. As a result, research accountability has been moving towards metrics based on advancing measurable societal goals such as for the environment and health and safety.

But this is starting to change. In the United States, the Starmetrics and Umetrics initiatives to measure the impact of research on innovation and competitiveness are led by academics. European and Australian researchers are beginning to set the agenda for the 'science of science policy', and researchers everywhere are organising these data sets into an infrastructure designed to improve understanding of scientific impact.

In this researcher-led approach, the focus is on people rather than documents. Science is not an industrial process driven by machines; instead, labour is the main driver of productivity. People produce ideas, manifested not just in publications, patents, technologies and products, but in an educated workforce beyond academia.

One question that data sets and metrics are helping to address is that of workforce development: research spending does not only advance science; it also builds skills in the wider workforce. There is abundant evidence that academics produce multiple knowledge spillovers to the local economy. Following the pathways to work of students and postdocs can capture the supply-side effect of the flow of ideas from the bench to industry.

Researchers are consequently beginning to work with university records to examine where students go to work after graduation, what businesses they start and what innovations they develop. The findings will help inform public debate—and could have influenced, for example, the recent argument about job cuts at King's College London, by highlighting the value of research and ideas.

Another major question is the effect that universities have on regional economies from the demand side. Research affects industry not only as a collaborator but also as a customer, buying equipment and services. Researchers are developing ways to capture this impact, tracing the purchases of high-end scientific equipment.

A third goal is to describe the scientific enterprise in a way that makes sense to taxpayers and policymakers. Our old categories—physics, chemistry, biology and economics—no longer reflect the diverse structures of research. Researchers are using computational linguistic techniques to develop a taxonomy of science similar to industrial classifications, which now describe how things are produced rather than what is made. This will help distinguish between different types of scientific activity, and show the trends and productivity of science funding.

Academics, aware that it can take decades for scientific work to lead to a product or service, often resist measures of impact. But none of these analyses will undermine academic freedom or accepted measures of scholarly productivity. Rather, they will add to our understanding and help to address the imbalance between the valuation of publications and the valuation of training.

The study of demand-side and supply-side impacts will also provide more evidence to policymakers trying to explain the value of research to an impatient public. Proactive, data-driven research will be necessary if new science metrics are to be made relevant to policy. We can only hope that governments, seeking to boost economic growth while holding down public spending, will be responsive listeners.

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