

Big discoveries have small origins

In a rather belated official admission that scientific and technological innovations underpin economic prosperity, the Economic Survey, released ahead of the Budget, carries an entire chapter on transforming science and technology in India. It calls for doubling research and development expenditure from its current level of about 1 lakh crore, amounting to 0.8% of the gross domestic product (GDP). Even if instantly doubled through a miraculous diktat, it would still lag behind China, Israel, Japan and the U.S., each spending more than 2% of their GDP on research. For long, attaining the 2% GDP level had remained elusive for Indian science, but this is only a part of the story.

The other critical part, diminishing funds for exploratory small-scale science research, escapes attention in the din of the debate based on comparative GDP figures. Seminal innovations often result from the efforts of scientists working alone or in small groups with a tight budget rather than in well-funded mega projects. In 2012, the discovery of Higgs boson ('God particle' in popular media) at CERN, the European Organisation for Nuclear Research in Geneva, hit the world's headlines. With \$1 billion annual expenditure, CERN's work is big science by any yardstick. Yet, Higgs boson had its humble origins in seminal theoretical works of several scientists, including Peter Higgs, working independently. Even the \$100 billion enterprise Google began as an innovative mathematical idea of Larry Page and Sergey Brin, funded by modest grants from the National Science Foundation (NSF), at Stanford University.

Today, the global market for Raman spectrometers is about \$1.2 billion. In 1928, C.V. Raman spent about 200 on his laboratory-built spectrometer that heralded the era of Raman spectroscopy as an analytical tool and also brought to India its first science Nobel prize. Through the 1960s, Vikram Sarabhai was experimenting with simple sounding rockets that ultimately grew into the Indian Space Research Organisation of today, that we can justifiably be proud of. Time and again, small science projects have demonstrated the potential to emerge as harbingers of technological changes. Debates based on gross budget figures and GDP benchmarks miss the fact that over the years, funding for smaller, as opposed to large-scale big ticket, projects are dwindling.

Consider the fine print in this year's Budget. Of the 27,910 crore allotted to science ministries, 900 crore, or 3.22%, is earmarked for basic science projects to be disbursed as competitive research grants by the statutory body, Science and Engineering Research Board (SERB). In comparison, the apex body for medical research in the U.S., the National Institutes of Health, alone disbursed \$25 billion as research grants in 2017, representing 36% of the country's non-defence science budget. This figure can be higher if combined with the contribution of other agencies such as the NSF. The U.K.'s Engineering and Physical Sciences Research Council distributes nearly 10% of the research budget as grants. Clearly, India's provision for competitive research grants needs upward revision.

In India, as elsewhere, a significant fraction of the science budget goes to mission-oriented projects in the areas of defence, space, nuclear and environmental sciences. The mission-oriented work in these areas need not be diluted to favour small research grants. The operational missions are important but so is the research ecosystem that provides human resources and feeds the innovation pipelines connected to these missions. Throttling smaller-scale research is akin to cutting off the innovation pipelines. Enhanced competitive research grants for the Indian Institutes of Technology, the Indian Institutes of Science Education and Research, and universities will help address the needs of a larger pool of scientific talent outside national labs and bring in returns by way of publications, patents and innovations that can meet immediate needs.

Remarkably, the Economic Survey too has flagged this issue and recommends that India

“gradually move to have a greater share of an investigator-driven model for funding science research”. It also talks of the “need to expand with more resources and creative governance structures”. Nearly every big science venture of today began as a budding small idea yesterday. It is imperative to incentivise the small ideas as some of them might ultimately scale up to join the big league. One route to help the cause of science is by provisioning more funds for small-scale research projects as well. The Economic Survey offers that glimmer of hope.

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