nature
www.nature.com/nature
Vol 448 | Issue no. 7156 | 23 August 2007

Innovation versus science?

Harder economic times will force governments to ask tough questions about their investments in research.

Science and science funding have enjoyed a good run over the past 20 years or so. During the unusually long economic boom after the end of the cold war, governments of all political stripes have accepted the argument that it is in their interest to support 'the best science'. Something like a global consensus has emerged on the value of curiosity-driven, basic research. The predominant argument behind this consensus has been the belief that excellent science — of whatever discipline — is likely to spur innovation, which will in turn foster economic growth.

At the same time, direct government sponsorship of technology development has fallen out of vogue. Considerable expenditure continues, of course, and if the military sphere is included, it still dwarfs the resources devoted to basic science. But the idea of explicit state support for the development of drugs or circuit boards or civilian airliners has been pretty well driven off the table. There has been an assumption — even in comparatively centrist nations such as France and Japan — that governments aren't good at 'picking winners'.

This particular era of science and technology policy may now be drawing to a close. Even before last week's juddering stock markets sparked talk about a possible US, or even global, recession, policy-makers in industrialized countries were watching the flight of much industrial production to China and India with intensifying alarm.

As a result, the word 'competitiveness' is back on the agenda, particularly in the United States. When political leaders look at research budgets in the light of competitiveness, they are always prone to be more drawn to the direct support of innovation through technology programmes, than to its indirect support, through basic science. As a result, they may start asking questions that are inherently difficult for scientists to answer, such as, what will be the economic spin-off from this work? What are we getting for our money?

These questions are currently being posed most directly in the United Kingdom, where the research councils, which support most university science, seem to be undergoing a subtle change of direction. Some scientist groups are already nervous about a paper, "Increasing the economic impact of the research councils", that was published in January by the councils' steering group.

There is a risk that this process could result in perceived economic relevance displacing scientific merit, to a significant extent, as the determining factor in the selection of research-council grants. Before that happens, it would be reassuring if the leaders of the research councils emphatically reiterated that their primary function is to promote scientific excellence — and that they will best support Britain's national interests, economic and otherwise, by doing exactly that.

A similar trend is beginning to emerge in the United States. The competitiveness legislation passed by Congress and signed into law on 9 August is positive for science — it lays heavy emphasis on supporting basic research in mathematics, the physical sciences and engineering. Yet it is by no means certain that this approach will be reflected in the annual budget process. The Democrats, who now control both houses of Congress, have traditionally favoured technology programmes, sometimes over scientific ones, and that pattern could resume as fears about national competitiveness become more acute.

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The argument will then be made for different scientific programmes to 'prove themselves' in answer to the taxpayers' question: what have you done for us lately? It is important, in such an environment, for scientists to hold their nerve. In particular, they should resist the inevitable demand that they start to compete with each other on the basis of specious metrics that bureaucrats, given half a chance, will construct as surrogates for economic impact.

Straitened economic circumstances, whenever they arrive, will mean straitened times for science: that much the research community must be ready to accept. It can also anticipate attempts to cut and splice the pie on the basis of ungrounded expectations that some disciplines will yield economic dividends, and others won't. Researchers have at least two weapons that they should keep well honed: a compelling historical narrative showing the unpredictable paths from science across all disciplines to economic and other benefits; and a demonstration that those best-placed to innovate on the basis of science — and, in turn, to stimulate scientific ideas — are well set up to do so. ■

Indentured labour

The deal at the foot of the scientific totem pole remains a raw one.

The Federation of American Societies for Experimental Biology (FASEB) has just released a report on the career trajectories of young life scientists in the United States (see page 848). It is likely to give pause to some of those currently considering graduate training as a route to a career in the academic life sciences.

The survey finds that over two decades the number of academically employed life scientists in tenured or tenure-track positions has remained stuck at about 30,000, while the number of doctoral degrees awarded in the life sciences has doubled. Thus the proportion of postdocs actually reaching tenured or tenure-track positions has dropped from nearly 45% in the early 1980s, to just below 30%.

The data also reveal a hard-to-reach career getting farther out of reach. The age at which the average PhD holder receives his or her first full National Institutes of Health grant has risen from 34 in 1970 to 42 now. Postdocs, facing such a late start to their professional lives, are increasingly jumping ship to industry.

Academic institutions rely heavily on graduate students and postdocs to bring in tuition or overhead funding and to carry their share of the teaching load. The motivation for principal investigators is even stronger. Students and postdocs carry out the day-to-day work in laboratories serving as cheap, well trained labour. Moreover the nature of discovery often seems to require big numbers: far better to have six postdocs working on several projects, in case one of them gets results that will ensure funding for the laboratory for years.

This pattern has, of course, been familiar for years — and not just in the United States. Postdocs find themselves bouncing around the world from lab to lab, seldom earning much more than they would have done in their first year on the job market with their undergraduate degree. Funding is short, the hours are long, and prospects uncertain.

Postdocs have occasionally attempted to band together in solidarity and seek a better settlement from their employers, the institutions and universities. But this movement has been stronger in the social sciences than in the hard sciences. The transient nature of the work, together with its convoluted employment structure, has made it difficult for them to speak effectively with a single voice. Instead, the plight of the postdoc will probably change only if the issue of scientific training is addressed from the top, where it may be necessary to consider the possibility that too many scientists are being trained.

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There is an argument that, from a national policy perspective, the current situation is ultimately productive. The pace of discovery is quickened by a sizeable workforce, and able scientists end up doing multiple jobs, most of them in the private sector of the economy. It might not be exactly what the students had in mind in the first place, but the situation hardly constitutes a major cause for concern.

But FASEB's data suggest that too many graduate schools may be preparing too many students, so that too few young scientists have a real prospect of making a career in academic science. More effort is needed to ensure that recruitment interviews include realistic assessments of prospective students' expectations and potential in the academic workplace. And training should address broader career options from day one rather than focusing unrealistically on jobs that don't exist. ■

Technology trap

California is right to sound a cautionary note on electronic voting.

Designing an electronic voting system that is easy to use, efficient and secure may sound like an easy thing to do. And the pay-off — a democracy in which more people can participate and trust — seems desirable. But an academic analysis of three widely used systems in California has found monumental weaknesses in each of them. As a result, the state is slowing down its adoption of such systems until significant improvements are made. Others should exercise similar caution.

The study, commissioned by California's secretary of state, Debra Bowen, was led by computer scientists at the Berkeley and Davis campuses of the University of California. It found that the systems sold by three companies — Sequoia Voting Systems, Hart InterCivic and Diebold — had not been designed with security requirements in mind. And one particular deficit alarmed representatives of all political parties: the possibility that computer viruses could distort vote counts.

On 3 August, Bowen decertified the systems, which were already in use in counties where about half of the state's voters live. That means that in the primary elections next February, voters will return to paper ballots. Bowen has pledged to fully recertify the machines when they comply with a list of basic requirements: but the study authors question whether the software and hardware are amenable to ready repair. "They have serious security problems that will take years to fix," says David Wagner, a study leader at the University of California, Berkeley.

This isn't the first time that specialists have warned against electronic voting systems. The Voting Technology Project, for example, a joint effort between the Massachusetts and California Institutes of Technology, highlighted their failings back in 2001 (see *Nature* **412,** 258; 2001).

Yet the march of voting automation continues worldwide, often driven not by the public good but by election officials' desire for low staff costs and quick counts — as well as by the marketing machines of the systems' suppliers. Even in the United States, the Californian analysis is unlikely to make much of a difference in the many other states where the same electronic systems are being introduced. Verifiedvoting.org, a non-partisan lobby group that campaigns for reliable voting, says that although some secretaries of state are paying attention to the study, others — especially in the south and the midwest — don't seem to be interested.

There remains a body of public officials who seem to favour expediency and convenience over the democratic imperative of an accurate count. The firms that sell the systems have, meanwhile, argued that in the real world of elections, the systems will be overseen by election officials and candidates who would protect against the kind of disruptions identified in laboratory studies.

After the scandal that unfolded in Florida in the 2000 presidential election, when President George W. Bush eked out a narrow victory after prolonged legal arguments over disputed ballots in several counties, Congress passed a law that, among other things, helps to fund the replacement of existing, outmoded voting equipment. Now it is set to revisit the issue, with Senator Dianne Feinstein (Democrat, California) pledging to hold hearings that will pick up where the review in her own state left off. This may spur broader federal action to strengthen voting systems.

The consistent message from studies of electronic voting systems has been that the technology is often being implemented before it is ready to achieve the levels of security and reliability that voters are entitled to expect. Other jurisdictions worldwide should follow California's lead, consult with computer scientists, and act where necessary to stop this from happening. ■