SCIENCE AND TECHNOLOGY POLICY IN AUSTRALIA: THREE STUDIES*

Larry Dwyer

* Review article of: OECD, **Reviews of National Science & Technology Policy: Australia,** OECD, Paris, 1986, pp. 119; Bureau of Industry Economics, **The Public Interest IR & D Program,** AGPS, Canberra, 1985, pp. xx + 174 ISBN 0 644 04555 8; and Bureau of Industry Economies, **Public Support for Research Associations,** AGPS, Canberra, 1985 pp. xi + 96 ISBN 0 644 05246 1.

The OECD report was written in early 1984, a time when Australia had developed a relatively extensive number of science and technology policy instruments through both the Commonwealth and State governments, and yet was experiencing a continuing decline in its industrial competitiveness. The OECD Examiners' tasks were to consider existing institutional arrangements for science and technology in Australia; to propose policies capable of promoting new industries and revitalizing existing industries; to recommend ways of achieving greater coordination between science and technology policy and economic, industrial, educational, manpower and social policies; and to propose ways of measuring the effectiveness of policy instruments.

Four themes are identified in considering Australia's science and technology policies. The first theme is the *economic environment.* While Australia has the advantage of close proximity to the rapidly expanding countries of the Asian-Pacific region it has relied too heavily on high bulk, low value-added commodity exports rather than the high value-added technology based goods and services most capable of contributing to national development. The second theme is the *evaluation of science and technology policies.* Referring to such statistics as the sharp decline in R & D funded and performed by Australian industry over the preceding decade and a half, the decline in total R & D as a percentage of GDP, the nation's poor balance of trade in high technology products, and the small and declining proportion of tertiary education students enrolled in engineering and technology subjects, the Examiners conclude that existing institutional

arrangements have done little to encourage industrial innovation in Australia. This points to the need for mechanisms to coordinate, evaluate and, if necessary phase out, particular policy initiatives.

The third theme, which the Examiners consider to be of the greatest importance involves *attitudes to technology*. They note the widespread view of Australians that technology is in some sense external to national life, an attitude which leads to a consistent undervaluation of national technological achievements and possibilities. The report points out that the process of technological development is seen as discontinuous in this country. The transition from research to development to commercialisation of products and processes, requiring cooperation between research scientists, engineers, designers, management, financiers, marketers, etc., seems to involve the collison of " 'mutually' uncomprehending cultures". Recent calls for the education system to provide more business literate scientists and science literate business persons recognize this problem. Unless community attitudes and institutions change toward a more 'productive culture' Australian industry will not achieve the international competitiveness central to sustained economic growth.

The fourth theme is the *diversity of technology*. The Examiners note that the value of technology can be understood only by considering the diverse needs of different sectors. They regard the most important challenge for technology policy as the applicaton of appropriate policy instruments to different sectors.

The recommendations of the report cover three main areas, *viz.*, education and training; science, technology and industry; and science, technology and government. The Examiners consider the role of education and training to be essential in Australia's efforts to fulfil its scientific and technological potential. *Inter alia* they recommend increased attention to science and engineering education, expanding technological opportunities for women, increased support for university research, improvements in the quality of equipment in tertiary education, increased use of technical employment forecasts, greater commitment to on-the-job training by Australian industry, and the integration of training programs with sectoral technology policies.

In the industrial area the principal recommendation is that the Government should initiate a series of sectoral reviews in such 'sectors' as financial services, medicine, horticulture, tourism, manufacturing and mining, to attempt to reach a common understanding of what science and technology policy can be expected to contribute to each sector and how this should be organised, directed and funded. Sectoral reviews can provide a forum for cooperation between governments, employers and unions in designing technology development strategies suited to the present and future needs of

particular industries. They can also provide a practical way of integrating educational, social and training objectives into a national technology strategy. Another recommendation is that more should be done to promote a wider understanding of the various steps that are necessary to transform a scientific discovery into a product or service to customers. Unfortunately no details are provided as to how this important task might be carried out.

Regarding government policy the Examiners express regret that science and technology are not treated within a single ministerial portfolio. They recommend tax-based incentive schemes for R & D, supplemented by industrial fellowships to provide salary support for needed researchers in small companies. They also recommend that a growing share of the CSIRO budget should be provided by those groups who are expected to benefit from the research. These groups would then have an increased role in setting the Organisation's research goals. Recently, the chief executive of the CSIRO has committed the Organisation to transfer the results of strategic research to industry and to strengthen its links with industry. In the shorter term there will be more effort on tactical projects in collaboration with industrial firms to promote the technical base of Australian industry. The CSIRO policy now is to substantially increase the percentage of its budget which it obtains from the private sector through its technology transfer company Sirotech. Greater effort will be directed to establishing collaborative projects with industry and to undertaking tactical projects under contract from business enterprises on a full cost recovery basis.[1]

While, given the broad ranging terms of reference, much of the discussion lacks depth, and certain of the recommendations are somewhat vague, the report on the whole is a useful review of Australia's science and technology policy and a blueprint for arresting the decline in its international industrial competitiveness. And, unlike the fate that seems to befall the policy recommendatons contained in most reports of this nature, several of the Examiners' recommendations have been acted upon. Some important examples are: the 150 per cent tax concesson for IR & D; sectoral reviews of the science and technology process; improvements in entrepreneurial management support programs; ongoing evaluation of major technology support programs.

The Federal Government has amended the Income Tax Assessment Act to provide a 150 per cent tax incentive for expenditure on R & D carried out in Australia. The concession seeks to increase the level of R & D performed by the business sector and to promote effective use of Australia's R & D expertise. It encourages industry to become more innovative and competitive and to build stronger links with research institutions. However, while business enterprise R & D spending has

increased, the latest figures from the ABS indicate that the scheme has not been as effective as forecast.[2]

Meanwhile a recent study by the Department of Science of business enterprise research spending has questioned the value of such a broad brush assistance scheme.[3] A comparison of R & D spending in high, medium and low technology industries found an increasing shortfall in private sector research spending as the technology level increased, with the most serious shortfall in the high technology field. Since high technology companies in Australia, on average, carry out four to five times less R & D than those in other OECD countries this raises the question whether Government assistance should be more targeted towards high technology industries where the need is greatest, rather than broadly spread across all manufacturing industries. It would also be interesting to know how much R & D activity performed under the scheme is directed toward product innovation, as opposed to process innovation. The revitalisation of Australian industry depends crucially on the ability of industry to produce quality products which are valued in world markets. The present scheme currently costs the Federal Government around $200 million in foregone revenue. While the Examiners' report did not address the question of targeting 150 per cent tax concessions to particular sectors or industries, the failure of the present scheme to discriminate between the value of research in different sectors of industry may well result in a misallocation of scarce resources.

The Federal Government has initiated sectoral studies both in mature industries such as passenger motor vehicles, textiles clothing and footwear, steel and heavy engineering, and in potential growth industries such as communications equipment and information industries. An assistance package paying particular attention to such factors as management and work practices, financial needs, labour adjustment measures and marketing, has been designed for each sector to foster its competitiveness. It is estimated that the sectors now covered by such arrangements total around 29 per cent of manufacturing by value added and 35 per cent by employment.[4] While such schemes have received commitments by government, industry and the union movement to meeting their objectives it is, as yet, too early to assess their success in achieving long term competitiveness in the various sectors reviewed.

The National Industry Extension Service (NIES) launched in July 1986 holds great promise of bringing about greater understanding by managers of Australian industry of the 'process' of science and technology. NIES arose from recognition of the urgent need for a more coordinated and effective national extension service for industry, to reduce confusion over the availability of management support services, to enhance the effectiveness of existing services, and

to better coordinate Commonwealth and state activity. The service, jointly administered by the Federal and State Governments aims to encourage firms to use the most modern management and production systems — including appropriate marketing, design, engineering and quality control techniques linked to market needs. Targeted primarily at small to medium sized firms in the manufacturing and service industries, NIES will provide advice to firms based on the latest information available on management, business planning, manufacturing technology, product innovation strategies, sources of finance, etc. While it is too early to assess the success of NIES, the service should go some way to promote the sought for 'productive culture' within Australian industry and make for more effective product innovation management so important to Australia's future industrial competitiveness.

With respect to the evaluation of major technology support programs as recommended by the Examiners the Federal Government has given the Bureau of Industry Economics (BIE) responsibility for this. Two reviews have been published to date. One assesses the public interest IR & D program while the other assesses the public support for research associations program.

The study of the public interest IR & D program was concerned with Sec. 39 of the Australian Industrial Research & Development Incentives (AIRDI) Act, 1976 which permits the Federal Government to contract out IR & D considered to be in the 'public interest' where this was interpreted as generating substantial social and economic benefits to the community. The intent of the public interest provision was to overcome the tendency of market forces to underallocate resources to IR & D in circumstances of external benefits, risk and indivisibility. However several developments in Australia in recent years have the potential to weaken the case for Sec. 39 support of high risk, low externality IR & D projects. These include: the establishment of second boards on the stock exchange; the creation of the management investment companies (MIC) scheme; changes to the Australian Industry Development Corporation Act; deregulation of the Australian capital markets; the introduction of the 150 per cent tax concession for IR & D. Under the terms of reference, the BIE was to assess the achievements of the Sec. 39 public interest IR & D program and to assess whether, in the light of recent institutional developments and other initiatives, there is a case for continuing Sec. 39 public interest funding.

The Sec. 39 provision was activated in 1978 and, at the time of the study, 350 applications for funding had been considered. Approval had been given to 29 proposals. Some $34.4 million had been spent on the projects with 13 completed. The BIE review found that, of the completed projects, two projects (the bionic ear and a training aid for

the handicapped) were being developed commercially, and a third (the Starlab Space Project) had been adopted as a science policy initiative. Another three projects had been technically successful and had yielded or were likely to yield benefits to Australian industry. The remaining seven projects were either abandoned at an early stage or proved to be technical or commercial failures. On balance it is considered premature to discontinue the public interest programs at least until it becomes clear that the abovementioned institutional changes and policy initiatives render it superfluous. However, the BIE review stresses the need for the selection criteria for funding projects to be tightened and for better project management.

With respect to the selection criteria it is recommended that the scheme should concentrate on funding projects which are expected to generate significant external benefits and where funds are unavailable from other sources. With respect to project management the review recommends such measures as: the calling of tenders for IR & D work where projects are fully funded by the Government; greater attention to be given to the dissemination of technology resulting from Sec. 39 projects where external benefits are to be realized; property rights accruing to the Federal Government to be exploited to gain an adequate return unless this runs counter to the objective of adequate diffusion of the technology to Australian industry; projects to be supported by sound business, marketing and expenditure plans.

These recommendations appear to be sound ones. More attention to the potential external benefits of the projects proposed for Sec. 39 funding and better project management could have resulted in better use of the Government's resources. One recommendation of concern however is that endorsing funding under Sec. 39 for high risk projects lacking external benefits. While the BIE states that such projects should clearly demonstrate a high potential to promote the commercial exploitation of Australian research by an Australian company, one might well inquire as to why, if such potential could be demonstrated, private sector funding would not be forthcoming. As th BIE notes, alternative sources of funding will be available to high risk R & D projects wherever the potential benefits can be appropriated by the developer.

It would be more in keeping with the rationale for Sec. 39, and the thrust of the arguments presented by the BIE review, if externality considerations were regarded as essential in determining the suitability of projects for funding. The recommendations in the report have now been implemented in the new Grants for Industrial Research & Development (GIRD) scheme.

The second study conducted by the BIE concerned public support for research associations. A research association (RA) is an organisation which undertakes cooperative research, technology

transfer and related activities for a particular industry or technology. Aggregate expenditure on R & D by RAs in Australia represents around 1 per cent of the nation's IR & D effort. A program of Government support for RAs has been operating since 1947. The eight RAs receiving funding under the program cover sugar, bread, brick, medical engineering, welding, timber, radiata pine and particleboard research. The Government provides grants to the RAs based on an agreed ratio of grant to grant earning income raised by the RAs to a ceiling of $220,000. The budget allocation for the program in 1985-86 was $2 million. Under the terms of reference the BIE study was: to determine the extent to which the program and grants to individual RAs have contributed to the Australian economy by promoting IR & D and technology transfer activities; to determine whether further support for RAs is justified and, if so, recommend the appropriate level of financial support and suitable administrative arrangements for the provision of such support.

The intent of public support for RAs has been to foster cooperative effort in IR & D. It has long been realized that where the problems encountered in applying new technologies and improving production processes are common to a number of firms, cooperative activity will reduce unnecessary duplication of effort thereby reducing costs to individual firms and making R & D activity and technology transfer more likely. Cooperative effort also provides a mechanism for mitigating the effects of market failure, particularly those relating to risk and externalities. The BIE study found that, in those industries served by RAs cooperative R & D and technology transfer activities did indeed take place which would have been unlikely to have resulted from the independent initiatives of firms. Further, centres of excellence had developed through the RAs which were able to help members solve specific problems. The RAs have also provided a valuable interface between industry, CSIRO and tertiary education institutions. Overall, the net benefits resulting from the activities of RAs were regarded as positive. However the benefits were captured, by and large, only by their members. In very few instances were non-member firms, whether inside or outside a particular industry, able to benefit from the R & D or technology transfer activities of the RAs.

The BIE study concluded that, since the benefits generated by RAs are largely internalised, there is little justification for ongoing public funding of RAs. Given the desirability of maintaining incentives for collaborative research, however, it was recommended that all contributions towards the R & D activities of RAs should attract 150 per cent tax concession regardless of the size of the contribution. Another recommendation was the provision of establishment grants to encourage formation of new RAs. This recommendation is based

on the view that a large section of Australian industry is unaware of the benefits of cooperative research of the sort conducted by RAs.

While the recommendation that Government grants to RAs should cease in favour of allowing contributors to their R & D activities to claim the 150 per cent tax deduction is sound, some questions might be raised concerning the recommendation that establishment grants be provided to increase the numbers of RAs. Except for medical engineering existing RAs are in 'traditional' industries, where the basic technology has not changed significantly over time. The thrust of R & D activities in these industries, moreover, has concerned cost reducing process innovation rather than product innovation. This would also be expected to be the case with the formation of any new RAs seeking to derive benefits from collaborative research. In support of its claim that RAs make a net positive contribution to the economy, the BIE appears to place too much emphasis on the judgement that members of RAs 'generally consider that benefits exceed costs'. One might well have expected more precise estimates of the relevant costs and benefits in the evaluation report. At the same time it must be acknowledged that the task of measuring the external benefits of R & D projects is an extremely difficult one.

The OECD Review has been very useful in pointing out gaps in Australia's science and technology policy. For their part, the Federal and State Governments in Australia are to be commended for their willingness to act on various recommendations. The BIE studies represent important steps in the attempt to monitor policies and programs to revitalize Australian industry. The task of reversing the long term decline in the nation's industrial competitiveness is proving to be enormously difficult but recent initiatives of the sort mentioned above have provided an institutional and policy framework which compares favourable with those in other OECD countries. To a large extent it is the managers of Australian industry who must now seize the opportunities available.

REFERENCES

1. Keith Boardman "CSIRO in the 1990's" *The Innovator,* 1, 2, 1987, pp. 73-76.
2. Figures quoted in *Sci Tech,* a monthly round-up of science and technology in Australian, 7, 7, July 1987, p. 9.
3. See *Sci Tech, op.cit.* 7, 3, March 1987, p. 4.
4. Department of Industry, Technology & Commerce, *Industry & Technology Policy — an Information Paper,* Policy Development Unit, D.I.T.A.C., March 1987, p. 10.