Macquarie University
Office of the Deputy Vice-Chancellor (Research)

Submission to Productivity Commission July 2006

Economic, social and environmental returns on public support for science and innovation in Australia

Preamble

Over the last 30 years Australian universities have coped with a wide range of complex changes. For example: increasing student numbers, student fees (HECS/HELP), the pressure to export (international students), the pressure to increase the volume and quality of publications, and increasing pressure to protect intellectual property and commercialise research, etc. It is noteworthy that thirty years ago the proportion of funding for Australian universities was typically above 60% of operating costs. It is now typically less than 30%, despite the fact that institutions still attract the title "publicly funded". Nevertheless, institutions have risen to the challenge and have significantly improved their performance across all of these areas.

With regards community engagement, and particularly commercialisation of research, as an example at Macquarie over the last five years the University has:

- Established the Macquarie Institute of Innovation – committed to providing education in innovation and entrepreneurship to produce graduates and staff with skills and insights needed to launch new ventures, lead the development of new economically significant enterprises, and drive transformational change.
- Established an Office of Business Development (OBD) charged (in cooperation with the Office of the Deputy Vice-Chancellor (Research) ("DVCR") and the University's Research Company, Access MQ), with the protection of the University's intellectual property, and, where appropriate, its commercialisation
- Revised its Institutional Intellectual Property Policy
- Established new processes for attracting and evaluating Invention Disclosures fro staff and students by way of a working group (the Intellectual Property and Commercialisation Management Committee – made up of members from OBD, DVCR and Access MQ) which meets fortnightly. This group monitors all activities from invention disclosure to eventual sale/licensing/spin-off
- Established an Awards Night – where University staff and students receive awards in acknowledgement of outstanding achievements in the invention/ commercialisation process. This is designed to change the university culture so as to publicly value commercialisation as an academic activity
- Promoted research interaction with local government and industry
- Established an R &D Park on campus, including incubator facilities

All of this has been achieved by University initiative, with no additional public funding. We are sure our experience is not unusual. We need the Productivity Commission to realise and acknowledge that universities have become far more professional in their commercialisation activities and are seriously committed to increasing their productive worth to the nation. Yet for publicly funded universities funding commercialisation activities is usually at the expense of either teaching or research.

As a consequence universities require specific funding support for engaging in commercialisation of research outcomes.

On a Second point, universities traditionally have been, and still are, disseminators of knowledge - that is (and should be) their primary purpose. They teach students, train researchers and are the repository of expertise on all subjects. These activities alone have a considerable impact on the nation's welfare. Yet this traditional aim to disseminate the results of their research is a powerful one, and the increasing pressure to protect their intellectual property, delay publication (dissemination) and become more entrepreneurial is alien to many researchers While it is understood that protection of intellectual property and publication of the work are not mutually exclusive, there is still a perception that this is so amongst many researchers, and some also perceive a loss in peer-esteem in following the entrepreneurial path. These perceptions will only change with time and publication of positive experiences of those staff who do become entrepreneurial.

So, universities are undergoing a culture change, and the internal conflict occurring in the process is one universities constantly grapple with.

Turning to the Productivity Commission's "scope of study", we would like to make the following points:

1. Impact and benchmarking

Economic impact of public support for science and innovation

It is really only in the last ten years that most Australian universities have learned (by hard experience) the way to commercialise their research, especially by way of spin-off companies. Before that the model most frequently adopted was via patents and licensing, and this frequently failed to provide large financial reward. Australian industry has had a very poor reputation in valuing research and innovation, and in supporting universities as a source of such innovation. Interaction with industry (defined here as research end-users) is something universities are keen to undertake, but for which there is little reciprocity. Most research undertaken by universities is in the basic/strategic areas (top-down), and industry sees this as either irrelevant or a too high risk for investment. Nevertheless, Australian universities are very good at basic/strategic research and they should continue to be encouraged to do so by government (by way of increased financial support). That does not meant they cannot also undertake applied research and development - they already do so to a considerable degree. But so far Australian industry has failed to effectively define what it needs, and to effectively engage with the research sector. When it has interacted with universities it has generally expected to not pay full costs, and yet own all intellectual property. This has meant that the universities themselves have heavily subsidised industry for little gain.

It is partly because of this that, over recent years, universities have tended to adopt spin-off companies as a more attractive way of developing their intellectual property. A disadvantage is that the risk of the cost of development of a product is being borne mainly by the institution. To explain that further, development of intellectual property to the point of a patent often does not include an assessment of the potential value of the invention, its proof of concept, its scale up, and so on. Establishment of a spin-off company however, does a lot of these things.

The fact that institutions eventually need to attract substantial amounts of money means that institutions by necessity must "pick winners" and ensure that what limited funds they have are spent effectively. This has the consequence that those spin-off companies (and the intellectual property that they represent) that do survive have a far greater impact on the nation than merely the establishment (and registration) of the intellectual property alone. Universities therefore need encouragement and support from the Government in furthering their endeavours in this area. An example would be direct support of incubators (or at least recognition of investment in them), and a recognition of effective commercialisation procedures and appropriate infrastructure in Block Grant funding to institutions.

Spin-off companies not only represent development of Australian intellectual property, they create new jobs, usually for our high technology graduates, and are potentially prime targets for investment.

Yet, spin-offs cause their own problems. Take the example where a Professor develops an idea that results in a spin-off company. In the past, such a Professor would give up most or all of his/her university appointment to become CEO (or CSO) of the company. These people were frequently excellent researchers and teachers – a huge asset to the institution – and were hard to replace. Despite their entrepreneurial spirit, these researchers often had little experience of the business world. Without very effective guidance and assistance (e.g. in marketing), the spin offs often struggled to survive. This model was not a productive use of talent.

What is really needed are professional managers who run the spin-off along commercial lines, employing the researchers (the Professor in the example above) as consultants (and usually Directors of the Company) to monitor technical progress. This leaves the Professor free to continue doing what she/he is good at, and the valuable resource (to the university) is not lost. But then the problem becomes finding good managers - managing a spin-off company is a high-risk occupation – identifying good managers prepared to take on the job is a problem currently being tackled by many universities.

Benchmarking

There is already a large volume of data for benchmarking the university sector worldwide. However, to the best of our knowledge, there is no benchmarking that compares international government support for this activity. We know that some of our OECD-comparable countries are investing large sums in this area of activity. Examples are Singapore, the UK (third stream funding) and Canada.

It is acknowledged that international benchmarking is difficult in this area as there is a wide diversity in the way publicly funded institutions contribute to different counties' economies. It has been pointed out on many occasions that Australia's size (population) works against major economic initiatives. Simply because Australia has such a small domestic market it finds it difficult to compete internationally in the major manufacturing industries.

On a smaller scale, from a university's point of view, there are several indicators that can be used to measure commercialisation performance. Examples are:

- collaborative research
- consulting and advice to research end-users
- provisional patents

- full patents
- licensing/sale of IP
- spin-off companies

To take each of these points in order:

Collaborative research – while this, especially the subsidised collaborations such as those under the ARC Linkage-Projects Scheme, is often used as proxy for impact, it measure research activity, rather than productive outcomes. Too often the "industry partners" make unreasonable demands on intellectual property ownership for minimal investment on their part. Too often the industry partners display little interest in the research itself, merely the results. The impression is sometimes given that if it wasn't for the tax breaks, they wouldn't bother – it's a question of real commitment to the value of research in Australia.

On the other hand, where industry partners are genuinely committed, collaborations can be very productive and lead to high impact outcomes. It is therefore a question of balance, and on balance we believe collaborative research is a relatively unreliable indicator of impact, and therefore should be used with care.

Consulting and advice to research end-users – while this may have a significant impact on industry and government, these indicators are difficult to measure by a reliable metric method. Consultancies are more likely to be properly funded (full cost recovery), and driven by demand rather than supply. They therefore represent genuine commitment by the sponsor. But as mentioned above, how is this best measured? Cost represents the value to the client, but that may have no bearing on productive outcomes (impact), and may not be innovative at all. This indicator, too, should therefore be used with care within Australia, and may be almost meaningless for international benchmarking.

Provisional patents – are not an effective measure of impact for several reasons. They are relatively inexpensive and they do not represent a measure of real commercialisable outcomes, and therefore impact. They are often used to protect IP because the researchers want to publish; and they are frequently used to buy time while the commercial value of the intellectual property is ascertained. They are often allowed to lapse and consequently do not lead to a full patent and therefore any commercial result. Within Australia, the number of provisional patents taken out by in institution gives an idea of research activity, but does not necessarily measure productivity. It would consequently also be a poor measure for international benchmarking.

Full patents – are a better measure of impact in that they represent a much larger financial commitment by an institution. However, they do not necessarily lead to useful outcomes, and are therefore not a true measure of innovation. Indeed, in the private sector they are sometimes used to prevent such outcomes where an industry wants to protect its market. Nevertheless, they represent a readily available (and verifiable) metric for both national and international benchmarking.

Licensing – the number of licences and their value can both be used as indicators of impact. In our experience the more recent data is more reliable for this purpose, simply because universities have been on a steep learning curve in this area. The growth of professional sections within each university (e.g. offices of business

development, commercial arms, and formal units teaching entrepreneurial skills) has resulted in better management of intellectual property, and an increasing aware ness amongst researchers.

Spin-off companies – the number and eventual success of spin-off companies represent good indicators of an institution's development of its intellectual property. As already indicated, they represent not only the most commercialisable of intellectual property developed by an institution, they also usually represent significant investment by venture capitalists and other investors, as well as the institution itself. They have therefore undergone rigorous independent evaluation of risk and potential economic viability – the equivalent of peer review for quality.

So, most of these indicators can be used to a varying extent to compare institutions within Australia. For international benchmarking, however, whether this data can be readily obtained across a sufficient number of countries, especially with those of similar size & development, is uncertain. Size, and the different mixes of industry/government support for research, means comparative data needs to be treated with care.

2. Impediments to the functioning of Australia's innovation system

There are many impediments to the functioning of Australia's innovation systems starting with the remoteness of Australia itself. Other key impediments are:

- insufficient funding – both government and industry;
- lack of a viable capital market in the early stage technology sector;
- lack of skills in managing new ventures and undertaking technology transfer, marketing and sales [as already indicated universities are improving in this area, but there seems to be no reciprocal improvement from Australian industry];
- lack of experience – for most universities this is a relatively new activity;
- no national mandate to undertake commercialisation activities (cf. the US *Baye Dole Act*); and
- lack of private sector R&D

Since 2001, publicly funded research organisations in Australia have been bound by the *National Principles of Intellectual Property Management for Publicly Funded Research*. Although these National Principles are technically guidelines, all Commonwealth competitive research grants (e.g. ARC, NHMRC) require under their respective funding contracts compliance with them by institutions. By their nature universities are generators of intellectual property. Under the National Principles they are required to not only protect their intellectual property but also develop that intellectual property for the good of the nation. Yet, the Commonwealth provides no additional funding to assist institutions in this onerous task. An argument could be that income derived from any successful commercialisation can be used to fund protection and development of new intellectual property. However, the Commonwealth Government now acknowledges that income from commercialisation of research is, and always will be, a very minor income stream for universities, and in most cases is insufficient to be self-sustaining.

A second problem is the cost of funding development of intellectual property. The received wisdom is that such costs are typically at least ten times the direct costs of

the original research. Universities do not have the resources to support such development.

Thirdly, Australian industry is small and tends to be conservative. It often fails to see the benefit of research and development - it sees such activities only as a cost, rather than an investment. It is very difficult in this environment for Universities to attract external funding too assist in the commercialisation of the intellectual property they develop.

Fourthly, Australia as a whole fails to value science and technology as a worthwhile career for graduates. Compared to the professions, and especially financial careers, science graduates are poorly paid and undervalued. If Australia is serious about having a science and technology-led economy this situation must change what is needed is a high proportion of graduates with combined science and financial management skills. One way to achieve this is for Government to acknowledge this skill area by either making programs in these areas either HELP-free or graduates with these skills relieved of their HELP debt.

3. Possible changes to Australia's innovation systems

It seems there are only two possible ways to increase investment in commercialisation by Australia's publicly funded research institutions. The first is increased funding by government. Under the current political climate in Australia this would seem unlikely, despite overwhelming evidence that other countries are doing precisely this (Scandinavia, the EU in general and Japan are all examples). *[This point is a expanded upon in the IRUA submission to the Productivity Commission.]*

The other alternative is to make investment more attractive to industry, limited though that industry is. Australia's industry is dominated by multinationals, who find it easier to undertake research elsewhere (mainly the USA and Europe). In addition most of Australia's industry (whether it be small, medium or large) is managed by individuals with backgrounds in business, commerce and law – return on investment to stockholders. There are few individuals (in either industry of government) with sufficient training in science and technology to understand the value of local research and innovation who are in a position to influence the sector in that direction. Overseas, industry treats scientifically trained personnel as valuable people who are vital to the future of the industry itself – there investment in research is seen as vital, not an option. In Australia, this does not seem to be the case, despite generous tax incentives.

Secondly, where universities do manage to successfully take an invention to the stage of a spin-off company, there is a lack of venture capital to support these fledgling companies. Incentive mechanisms need to be established to support a viable early stage technology capital market. One option is to create incentives for major funds to invest a small proportion of their funds in this space.

Thirdly, the current tax incentive system is inefficient. It rewards activities that can be claimed as research, whether those activities produce (or are even genuinely aimed at) innovation, or not. While it is acknowledged that there are inherent difficulties in changing taxation laws to reward real performance in terms of outcomes (even impact), rather than claimed expenditure, it seems that it is these difficulties that must be addressed.

Investment by overseas/international partners is a third possibility. However, the publicly funded research institutions are charged with commercialising in the national interest. Investment by overseas partners would seem often to be possibly contrary to this goal. Does this mean we avoid overseas investment? Or should Australia change its policy stance?

4. Broader social and environmental impacts

We believe that the social and environmental impact of outputs from publicly funded research institutions is greater than the economic outputs. Universities produce the educated work force that is needed by a modern economy. Australian universities have consistently met the requirement of making the nation a "clever country" by producing individuals trained in science and technology at least to world standard, and often above. Our scientists are in demand overseas, and the lack of opportunity at home (scientists are undervalued, and relatively underpaid in Australia) means there is an exodus.

So, despite it not being their main mission, Australian universities have successfully embraced commercialisation of research, despite the inherent difficulties of a generally non-supportive industry, and insufficient public support.

A key problem is turning these things around. How do we get Australian industry to value research and the research resource Australian publicly-funded research organisations represent?

Universities represent a repository of expertise and knowledge that can be (and is) called upon by the community. We know the general populus recognise this. Over many years surveys have shown that there is overwhelming public support for the research undertaken within universities. So, there seems to be universal acknowledgment of the value of research and innovation, and for not only the continuing public support of such investment, but frequently for its increased support.

It has been demonstrated that nations that are significant contributors to global innovation feature amongst the wealthiest in the OECD. The future wealth of the nation therefore depends on Australia being a global contributor to innovation as well as the flow on benefits that include the opportunity for wealth-creating industries and jobs.

PWF
31 July 2006