Submission to the Productivity Commission's Commissioned Study into Public Support for Science and Innovation

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Introduction

A significant effort has been undertaken in this report to grasp the major influences on the development of publicly funded science and technology in Australia. The exposition of R&D expenditure and returns was well conceived and developed. However, in my perception, what this report suffers from is a failure to grasp the true nature of innovation and its implications. In this brief submission, I will raise the issues I believe are important and that have the potential to open the agenda further by offering a parallax view. The brief statements will be supported by reference to works which support the statements, some of my own, some referring to important works of others. Having read discussed the submissions of a number of my colleagues, I have chosen not to duplicate a number of critical points already made in these submissions.

The issues:

Issue 1: The need to update the assumption upon which the Report's research is based

The greatest flaw I see in this report is its focus on a traditional industrial economic equilibrium perspective. The assumption being that equilibrium is the typical state and change is an interloper. This is the foundation of many conceptualisations of industry competitive environments based upon Schumpeterian principles (themselves first published in 1911). The reality in "Post-Schumpeterian" industries, being knowledge based, high technology, cross-disciplinary, is that they as a result, they face constant change a rapid diffusion of innovations, leading to a consistent disequilibrium in these markets. All of these features make traditional strategic tools only partially useful, given that most are based upon assumptions of equilibrium, discontinuous change due to disruptive tehnologies and regular returns to stability (Hine and Kapeleris, 2006; Hine, 2006).

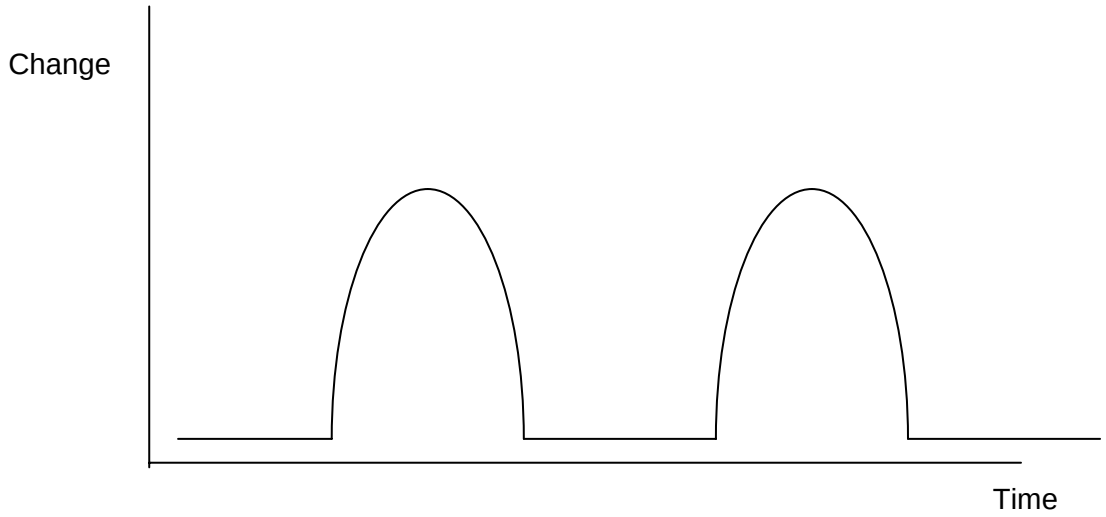

Figure 1 Schumpeterian change in traditional industries

Figure 1 represents the situation which has traditionally occurred in the industrialized sector. In the work of Schumpeter, the institutional framework had a major role in the industry innovation processes. The impact of developments in innovative capacity were infrequent and potentially devastating to the existing industry. The industry would move through a

period of turmoil during the innovative upheaval in which existing firms would be displaced or dramatically changed. This is the process of creative destruction referred to by Schumpeter. However over time this innovative upheaval would be integrated into the dramatically changed industry. As this occurred the rate of change in the industry would reduce to a near zero level until the next innovative upheaval. The extent of the upheaval would be impacted by institutional factors which would promote or reduce the diffusion of the innovation.

The shift in focus of the knowledge based industries mean that raid change is constant. This takes the industry's development into a Neo-Schumpeterian realm, where change is pervasive.

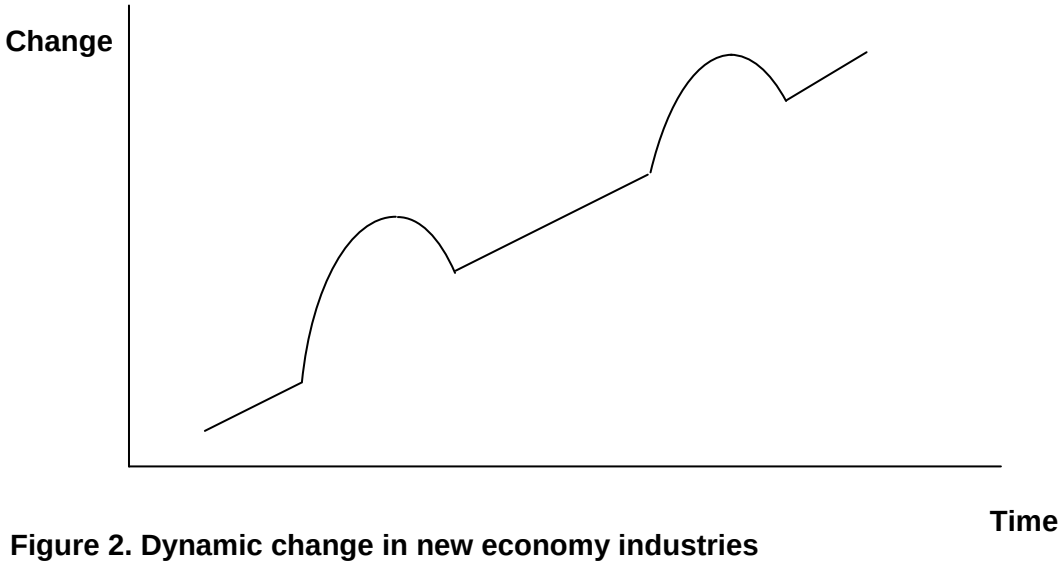

Figure 2. Dynamic change in new economy industries

Figure 2 above portrays a different situation, one which is more likely to face new and emerging industries, particularly those in sectors of the economy more directly impacted by changing and developing technology. Due to the constant development and implementation of new science and new technology, as promulgated through scholarly publications and patents, most areas of biotechnology operate in a climate of near constant change. However even in this change climate there comes opportunities for groundbreaking innovations which will create more dramatic change fluctuations.

In Figure 2, the slope of the line represents the extent of incremental (evolutionary) innovation occurring between the revolutionary peaks. The institutional framework can also have an impact upon the slope of the change line, in its degree of support for or hindrance of innovative efforts within the industry. However the impact of the institutional framework will be mitigated by other industry specific factors such as propensity to adopt new technology, ability to incorporate generic technological developments into the industry and diffusion of industry developed innovations. Therefore in the adoption of new technology in industries such as biotechnology, size and institutional support are important. Economies of scale still come into play in a capital intensive industry such as biotechnology, and early adoption means a quicker infusion of the benefits afforded by technological advances.

Recommendation 1:
Alter the assumptions upon which the report's research is based. Differentiate between industries on the basis of the extent of change in industries. New and emerging industries, often high technology and knowledge based will create innovations and be likely to diffuse these innovations rapidly. Policy support must recognise this and the reality that the policy

environment must be flexible and responsive to the rapidity of change. Support for diffusion of innovations at an institutional level is crucial, so policy needs to back up these institutions .

Issue 2: Making the distinction between innovation and commercialisation
For national economies the path to competitiveness is increasingly dependent upon their capacity to bring forth new innovations, and more importantly to commercialise these innovations so that the economics benefits can be realized. At the leading edge of science and research, universities and publicly funded research institutions are playing key roles in the creation of knowledge, discovery and development of new technologies. However as far back as 1962, Arrow pointed to need to allocate resources to fund basic science and the problem of appropriation.

In emerging industries such as biotechnology, the institutional framework serves to support the diffusion of innovation throughout the industry, through knowledge sharing, licensing deals, publications and the purchase of new technology and the building of strategic physical infrastructure, particularly through public funding. The height of the fluctuations is a function of the extent of support or hindrance of the institutional framework surrounding the innovation. A supportive institutional environment will create higher peaks in what could still be regarded as the creative destruction phase of industry development. However the destruction will not be nearly as significant as firms within the industry are more used to and willing to incorporate change and the innovations which emerge.

It is important to make a clear distinction between innovation and commercialisation. Those who innovate are not necessarily the same as those who commercialise. Support for innovation, especially R&D must go to those who are generating the innovations. A different kind of support needs to go to those who either commercialise themselves or assist others to commercialise, such as third party intermediaries. Do not expect universities, medical institutes and the CSIRO to commercialise their own innovations. This will distract resources and dilute expertise.

Recommendation 2:
Advocate a clearer separation of roles and a distinction between innovation (idea generation, R&D, new product and process development) and commercialisation (product and innovation diffusion). Find models of success in each, both in Australia and internationally. Do not expect commercialisation results quickly. The transfer of quality knowledge requires time and its own set of competencies which must be learned, as they are not currently resident in Australia in abundance.

Issue 3: Seeking next generation knowledge transfer programs
Innovation diffusion requires the marrying of technological advances with a commercial market ready, willing and able to utilise such innovations. In high technology industries, universities and research institutes and major public sector agencies, such as the Defense Department in the US, have been a major source of technological advances. However it has been beyond the brief of these bodies to step beyond the innovation and undertake the commercialisation effort to achieve diffusion beyond the initial innovation. This can be viewed as a market failure, the main remedy for which has come in the form of legislation to share the knowledge created, and transfer the technology generated from research programs. Foremost in the policy interventions around the world is the Bayh-Dole Act and its “use it or lose it” provision. Such intervention through Government policy and regulation has been the impetus for technology transfer to blossom as an industry.

As a result the US is considered as a benchmark in technology transfer. This has led also to rapid development of relationships between publicly funded research institutions and the private sector to ensure technologies developed are commercialised. As a result, the US is also the hub for research on University-Industry Relationships (UIRs) (Mowery, 2000). These

initiatives, coupled with the Small Business Innovation Research Act (1982), have meant that technology transfer in the US has a strong small business involvement, though still with an emphasis on technology-push innovation either to or from the small firms (Bauer, 2003).

Much discussion has occurred in scholarly and industry journals, as well as at the policy formulation level, as to whether the Bayh-Dole Act is transferable to another country's context. Some have adopted similar legislation,, others have adopted more informal mechanisms for encouraging technological advances out of research institutions. However beyond the discussion on the transferability of Bayh-Dole, and given that the legislation is now 26 years old, it may be more appropriate to first analyse the extent to which the technology transfer process has evolved beyond its initial manifestation. We should be seeking to assess not only the transferability of Bayh-Dole between national contexts, but to understand where technology has evolved to make more informed judgements on appropriate policies and programs.

In the evolution of technology transfer, government intervention policies would be considered to be the pump-priming of the market, overcoming market failure issues and creating a platform for the market to drive future knowledge transfer on a programs or company-by-company basis. The assumption for those countries and regions adopting Bayh-Dole type legislation to enhance their technology transfer effort, is that this will lead to a sustainable boon for innovation diffusion and hence economic development. However, the life cycle of the technology transfer "product" must evolve if it is to survive and expand. However in the 26 years since the Bayh-Dole Act was brought down in the US, despite a rapid diffusion of technology transfer policies and programs around the world, the model for this technology transfer is remarkably similar today to the original manifestations, based upon technology push transfer through the technology transfer offices of universities.

Technology push technology transfer is clearly requisite for markets in which the industry players, who would be expected to be the vehicles for commercialising the technological developments emanating from public sector research, either lack market knowledge and hence awareness of the existence of such technological developments, or are insufficiently technologically advanced themselves to create a demand for the technological outputs. However, it would be expected that over time, where successful technology push technology transfer has provided the economic impact many have argued has derived from Bayh-Dole in the US (Bozeman and Corley, 2004), ensuing market forms of technology transfer would emerge.

Market pull technology transfer has long been theorised about, and has been witnessed on ad hoc bases, and at local and regional levels in various countries. Yet finding existing examples of market pull technology transfer programs is a real challenge. Market-pull technology transfer is potentially significant as it provides the opportunity for more rapid diffusion of the innovation where there is an existing demand from technology ready partners, rather than a latent demand. With a more rapid uptake the economic benefits of the innovation will be realized more quickly and the return on investment of, usually public, funds will be greater.

Recommendation 3:
There is a need to look forward rather than back in seeking new knowledge transfer processes to capitalise on the public expenditure on science and technology, that are themselves innovative rather than standardised. Policy innovation is needed to maintain a growth path for technology and knowledge transfer programs. If there is to be evolution, the next generation of technology transfer programs require consideration.

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