Submission No. 18

AUSTRALIA'S INNOVATION CHALLENGES: THE KEY POLICY ISSUES

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EXECUTIVE SUMMARY

Well-designed public policy is an essential component of innovation performance in successful innovating economies. There are two main reasons for this. First, innovation requires the creation and maintenance of complex knowledge bases that cannot be provided by firms alone. Second, innovation is characterised by investment commitments in conditions of great risk and uncertainty - so incentive structures and risk management processes are necessary, and these are shaped critically by public policy.

This submission argues that Australia faces two distinct but related strategic challenges with respect to innovation. The first is the creation of essentially new industries and services based on radical technological changes. The second is the pervasive technological upgrade needed to retain competitiveness in the industries and services Australia already possesses.

Meeting these challenges will require policy tools and approaches different to those currently employed in Australia. We suggest that there are two central problems to be addressed:

- The appropriate role(s) of Australia's 'knowledge infrastructure' (of universities, research institutes etc) in creating and maintaining capabilities for innovation.
- The role(s) of business in the commercialisation of innovations, and the problem of innovation incentives and risk management in business creation and development.

This submission argues that the division of labour between the knowledge infrastructure and business (both new and existing) has often been understood in an oversimplified way. The problem is not to incentivise the knowledge infrastructure to provide commercialisable knowledge. Rather, it is necessary to separate out the infrastructure problems and the business development issues.

The task of the knowledge infrastructure is to create and diffuse generic and scientific knowledge bases that support innovation problem-solving across Australia's industrial structure. This requires a long-term integrated approach to the levels, composition and governance of knowledge infrastructure investment, and to the interactions between infrastructure and business.

Commercialising innovations is the task of business, for which new financial mechanisms are needed to create incentives and control risk. This requires new approaches to tax policy (providing genuine incentives for innovation investment) and to risk management (including in the form of a system of income-contingent loans for investment).

Introduction

Innovation policy is central to innovation performance, and hence to wider economic performance. All major theories and all empirical analyses of economic development treat innovation as the key explanatory factor in growth. But innovation rests on complex capabilities that extend well beyond those possessed by firms, and it requires long-term investment in conditions of great risk and uncertainty. These characteristics of innovation performance imply serious market and system failures. This is why successful innovating economies invariably possess successful public policy systems. Such systems tend to focus on knowledge creation and risk management.

This submission argues that Australia faces two distinct but related strategic challenges with respect to innovation. The first is the creation of essentially new industries based on radical technological changes. The second is the pervasive technological upgrade needed to retain competitiveness in the industries Australia already possesses. Meeting these goals will require policy tools and approaches differing from those currently employed in Australia. The authors of this submission have for more than 20 years researched the sources, characteristics and effects of innovation, both in Australia and overseas.[1] In this submission, we offer some results of our own work along with those of others. We believe these findings can provide approaches to two central policy problems that must be resolved if the strategic challenges are to be met:

- The appropriate role(s) of Australia's 'knowledge infrastructure' (of universities, research institutes etc) in creating and maintaining capabilities for innovation.

- The role(s) of business in the commercialisation of innovations, where the problem is the growth of firms able to innovate in a serious and continuous way. Here the problems are to do with innovation incentives and risk management in business creation and development.

We argue that the division of labour between the knowledge infrastructure and business (both new and existing) has often been understood in oversimplified and misleading ways.

The problem is not to incentivise the knowledge infrastructure to provide commercializable knowledge. Rather, it is necessary to separate out the infrastructure problems and the business development issues. The task of the knowledge infrastructure is to create, maintain, and diffuse generic and scientific knowledge

[1] At the time of writing Professor Smith works for the European Commission at its Joint Research Centre (Institute for Prospective Technology Studies) in Seville, Spain. Professor West has been at the Harvard Business School for the last 18 years, teaching innovation, technology management, and business strategy. During 2005 both are returning to Australia as Professors of Innovation at the University of Tasmania and founders of a new Centre for Innovation Research.

bases that support innovation problem-solving across Australia's industrial structure. This requires a long-term and integrated approach to funding and governance.

Commercialising innovations is the task of business, for which new financial mechanisms are needed to create incentives and control risk. We argue that tax incentives and innovation finance both need to be rethought; we suggest several possibilities, including a system of income-contingent pooled loans for innovation finance.

This submission draws on results from a new field of social science research. Over the past twenty years or so a major transnational research effort has created a new field, "Innovation Studies". Although persistent innovation is one of the few genuinely defining features of modern society, innovation research on a significant scale began only very recently. From the mid-1970s, an increasing number of researchers – usually within small research institutes attached to universities in Europe, or to business schools in the USA – turned their attention to innovation. Innovation Studies is now a significant field in both Europe and the USA; it is emerging as a field in Australia.[2] Innovation Studies explores the origins, rate, characteristics, and effects of technological and organisational change, and the business processes through which innovation underpins economic growth.

Technology can be thought of broadly as the knowledge and learning necessary for new products and processes. Innovation is the commercialisation of product and process novelty. So, Innovation Studies focuses on the structure and operations of learning, including science and R&D as well as diverse non-R&D learning processes, and on the array of corporate activities involved in bringing innovations to the market.

Innovation processes and the innovating firm: research results

It is sometimes argued that innovation consists of the discovery of new scientific or technical principles (perhaps occurring in universities), followed by engineering development in companies, leading to commercialisation. One of the key themes of modern Innovation Studies is rejection of this idea. Innovation cannot be understood in terms of a discovery phase followed by a commercialisation phase. Recent innovation research has recognized that the innovation process varies considerably across industries, and follows different sequences in different technologies. Robust conclusions from Innovation Studies, relevant to the Australian situation, include the following:

- Innovation involves continuous interaction and feedbacks between perceptions of market opportunities, technological capabilities, and learning processes within firms. The strategic capabilities of firms are central here: the ability to perceive opportunities and to invest in realizing them are the main characteristics of an innovating firm. These strategic capabilities are not

[2] The most comprehensive overview of the field is Jan Fagerberg, David Mowery and Richard Nelson (eds), *The Oxford Handbook of Innovation* (Oxford: OUP) 2004.

automatically present in firms and in fact seem to be very unevenly distributed among them.

- Research and Development (R&D) is often not a source of innovation but an effect of innovation decisions. Firms very often seek to innovate by exploiting their existing knowledge assets. Unforeseen problems often emerge, however, and these require R&D for their solution. From this perspective R&D should be seen not as a process of discovery that initiates innovation, but as a problem-solving activity within already-existing innovation processes.
- Solving innovation-related problems often requires recourse to knowledge and skills outside the firm. So cooperation and collaboration between innovating firms and suppliers, customers, design or engineering consultants, universities or research institutes are frequent characteristics of modern innovation processes. In general, innovating firms are collaborating firms. In this context, the role of universities and research institutes is not to generate innovations, but to solve background problems relevant to innovation processes.
- Innovation requires sustained investment under conditions of uncertainty. Firms cannot know the future and their strategic innovation choices can be very risky indeed. Nevertheless, they must invest in a wider range of innovation-related assets – human skills, new capital equipment, design capabilities, strategic marketing, engineering development programmes, and more. So innovation requires corporate governance systems that both permit and encourage such investment, and that can manage the risks involved. The combinations of these assets that are required for innovation differ considerably across industries.
- A key characteristic of innovation capabilities, at the levels of both firms and countries, is that they are cumulative. They build up over time, and they often depend heavily on past investments and sustained investment over long periods.

To sum up: innovation capabilities are capability-based, cumulative, collaborative in character, and highly uncertain. So any successful innovating economy needs mechanisms and institutions to sustain investment over time in capabilities, to manage collaboration, and to cope with risk and uncertainty and their implications for business development.

Innovating industries and their knowledge bases

Much recent innovation policy, in Australia as elsewhere, has focused on 'high technology', 'knowledge intensive' industries, and the so-called 'frontier' technologies that support these industries. In Australia – as in virtually all other advanced countries - this leads to priority research policy areas placing a strong emphasis on ICT, biotechnology, and nanotechnology.[3] These fields, and by extension the industries based on them, are R&D-intensive, science-based and closely linked to university research. Industries such as ICT hardware and software, pharmaceuticals (including biopharma), and semiconducting materials have shown rapid growth in output and trade (although not in Australia).

[3] See http://www.dest.gov.au/priorities/transforming_industries.htm#1 for an overview of Australia's research priorities in economic fields.

It is important to support these industries, and to foster business growth within them, for two main reasons. First, they appear to be areas of major technological opportunities, with unpredictable possibilities for future development. Second, they are areas of generic applicability – ICT, biotech and nanotech have actual or potential applications as inputs across many other activities, and therefore open up the possibility of significant productivity-enhancing effects.

However it is also very important to keep the industry dimension in perspective. High tech industries (usually defined as industries with R&D/Sales ratios of more than 4%) make up only a small component of manufacturing, and an even smaller component of GDP. This is of course true for Australia, but it is true of all OECD economies: there is no OECD economy in which high tech manufactures make up more than 3% of GDP. All OECD economies, including Australia, rest on a combination of large medium-technology and low-technology manufacturing industries (such as food and beverages, or fabricated metal products), and large-scale service activities (of which the largest are education, and health and social services). Innovation surveys carried out in Australia and many other countries show that these industries contain significant proportions of innovating firms, that they develop new products, and generate significant amounts of sales from new and technologically changed products.[4]

The expanding data and evidence on innovation in these low and medium-technology industries and services suggests that we should take a wide view of innovation and its effects, recognising that growth is generated across many sectors of the economy. Of course we should not deny the existence and importance of radical technological breakthroughs. But it is important to challenge the oversimplified idea that high-tech industries are 'leading' sectors, and that growth rests on their technologies in some simple way. Rather we should recognise that innovation and hence growth impulses are pervasive across the economic system, which would explain why many so-called 'low-tech' sectors and low-tech economies have been growing rapidly. In other words, growth impulses are dispersed across the system because innovation also is widely dispersed - it is not the case that innovation is confined to a small group of high-tech sectors. Growing sectors innovate in different ways, with a great deal of variety in methods, approaches and results. This diversity among industries is particularly important with respect to knowledge creation.

How does the system of knowledge creation and use relate to this picture of dispersed innovation and growth? In a general way, we might distinguish between two modes of knowledge creation and use. Firstly we need to distinguish between R&D-based knowledge and non-R&D forms of knowledge creation. Non-R&D inputs to innovation include, for example, market research, design skills, trial production and testing, prototyping and engineering experimentation, and software development. These non-R&D inputs are essential to innovation across all industries, but they are

[4] In all sectors of the Australian economy at least 30 percent of firms are innovating over any 3-year time period. In manufacturing, the most intensively innovating sectors are machinery and equipment and chemicals, each with about 50% of firms innovating. Nevertheless in such 'traditional' industries as food products, textiles and metal products between 30 and 35 percent of firms are innovating: see Australian Bureau of Statistics, *Innovation in Australian Business 2003*, 8158.0, Canberra, 2005, pp.7, 10.

often a larger component of low-tech activities. Non-R&D expenditures on innovation are usually significantly larger than R&D expenditures, so they should not be neglected by innovation policymakers.[5] Secondly, turning to R&D we can distinguish between internal R&D, on the one hand, and R&D which flows into firms and industries from external sources, on the other. Internal R&D is a major characteristic of high-technology industries. Within such industries firms tend to employ high proportions of scientists and engineers, and to have close links with universities. Indirect knowledge creation, based on external R&D, in which industries use knowledge created elsewhere and deploy it in ways suitable to their own needs, happens across medium tech and low tech industries, and is a prime form of knowledge creation. This type of indirect, externally created knowledge is of particular importance for the Australian economy.

How is external knowledge created and how does it flow? Knowledge creation often happens through an interactive process with other firms, universities, research institutes, etc. Empirical research in a number of countries under the auspices of the OECD has shown that innovating firms are invariably collaborating firms, that collaboration persists over long periods, and that the publicly-supported infrastructure (such as universities and research institutes) provides important collaboration partners. The implication here is that innovation studies and policy should have a focus that is wider than the individual firm: the focus should be on the 'knowledge infrastructure'.

If we think of universities, research institutes, and so on as a knowledge infrastructure, how important is such infrastructure? In fact, a striking empirical feature of innovation in the modern era is the vital role of infrastructural organisations in developing and diffusing major technologies. It is surprising how often the fundamentals of major technologies – computing, biotechnology, mobile telephony, the GPS system, container transport etc - have been developed in government labs, publicly-owned companies, universities, military R&D programmes, etc.[6] Given the prevalence of such infrastructural inputs to modern technology, however, it seems unlikely that their role is merely accidental.

How does knowledge flow between the infrastructure and firms and other organisations? There is a range of mechanisms, including the following. Knowledge can:

- be embodied in intermediate products and capital goods
- flow via scientific principles used in engineering design
- flow via patents and licenses
- flow via technical and engineering consultancy services
- be exchanged via joint ventures

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[5] In 2003, Australian innovating firms spent $A5.8 bn on R&D, and $A13.1 bn on non-R&D innovation inputs, ABS, *Innovation in Australian Business 2003*, p.8.

[6] There are numerous examples, of which the most spectacular is the US success in computing, which had its roots in major infrastructure investment by government. For an overview, see Computer Science and Telecommunications Board, *Funding a Revolution. Government Support for Computing Research* (Washington USA: National Academy Press) 1999.

- be created through scientific and technological collaboration (informal or formal)
- flow via the education system and movement of skilled personnel
- be created via extramural R&D and contract research

All industries engage in more or less all of these activities, most of the time. The cumulative impact, in terms of evolving knowledge complexity, can be very great. For example, the food processing industry performs very little internal R&D, yet it uses complex processing and sensory technologies involving functions related to hygiene and safety, preservation, nutritional quality, logistics, and so on. These functions rest on such scientific fields as informatics, biochemistry, and microbiology. So by any reasonable standard, this is an innovative, knowledge-based industry with deep links to the science system.

The case of food processing can be generalised. Industries such as wine, fabricated metal products, or textiles can involve complex underlying knowledges related the performance properties of processes or products. These knowledges are often created, maintained and diffused by a network of infrastructural institutions. The technological knowledge of the Australian wine industry rests on universities (whose oenology courses were arguably the first in the world to put winemaking on a scientific basis), research institutes, producer associations, R&D funding programmes, and an active equipment supply sector.

We can therefore speak of 'distributed' knowledge bases – distributed across many producers and users. So, apparently traditional, mature, and low-technology industries (as measured by R&D-to-sales ratios) may in fact be users and repositories of high-grade scientific knowledges, and thus important loci for innovation. This suggests a need for attention to the nature, characteristics, creation, and diffusion of such knowledge, and for closer policy attention to the nature and roles of the knowledge infrastructure across industries.

Knowledge infrastructures and innovation

What is the appropriate role of the knowledge infrastructure in the commercialisation of technologies? It helps here to distinguish between three basic levels of knowledge in production and innovation.

First, there is the technological knowledge-base of the firm—which is focused on particular products, and therefore highly specific to the particular markets within which a firm operates. Firm knowledge bases involve localised expertise relevant to skills that have been developed over time, and that offer the firm a competitive advantage in its markets. Such detailed skills and expertise are powerful sources of strength in innovation and competition, but they also involve weaknesses. The fact that firms attempt to specialise around existing areas of competence means that there are limits to their technological capabilities and awareness. This leads to a phenomenon which Martin Fransman has referred to as 'bounded vision':

> ... the field of vision of for-profit corporations is determined largely by their existing activities in factor and product markets, in production and in R&D, and by their need in the short and medium term to generate satisfactory

> profits. The resulting bounded vision implies that new technologies emerging from neighbouring area where the corporation does not have current activities are likely to take some time to penetrate the corporation's field of vision ... The need to generate satisfactory profits in the short to medium term therefore further bounds the vision of the corporation, contributing in some cases to a degree of 'short-sightedness'. One example is the creation of technologies for 'the day after tomorrow' where the degree of commercial uncertainty is frequently great. In view of their bounded vision, corporations often tend to under-invest in the creation of such technology.[7]

On the one hand such bounded vision means that the long-term strategic capabilities of firms can often be limited. On the other, it means that when firms seek to solve innovation-related problems, they must frequently look outside the boundaries of the firm for solutions: they draw in outside information, expertise, and advice.

A second level of knowledge refers not to firms but to the shared knowledge parameters of the industry in which they operate. Industries tend to have core areas of knowledge capability that are essential to *any* firm seeking to act operate the industry. This is a form of generic knowledge, common across many players in an industry. In referring to the wider dimension of technology, Richard Nelson has suggested that

> ... a technology consists [in part] of a body of knowledge which I shall call generic, in the form of a number of generalisations about how things work, key variables influencing performance, the nature of currently binding constraints and approaches to pushing these back, widely applicable problem-solving heuristics etc ... generic knowledge tends to be codified in applied scientific fields like electrical engineering, or materials science, or pharmacology, which are 'about' technology.[8]

Finally, there is a much wider knowledge base in society as a whole, extending well beyond particular industries and relating to the broader understanding of properties of nature. By and large this is the domain of fundamental sciences. The sciences form an extremely wide set of knowledges that may in principle be applied across many industries and activities, and that are important supports across industries.

Our argument is that the knowledge infrastructure should not be involved in the specifics of innovation at the firm level. What is needed from the knowledge infrastructure is problem-solving capabilities related to the second and third types of knowledge we have described above: that is, generic knowledges related to specific industries, and broader scientific knowledge bases. This does not mean an open-ended commitment to all fields of knowledge. Infrastructures should be relevant to the industrial structure. The task of the knowledge infrastructure is to maintain the wider knowledge bases that – beyond the level of individual firms – are necessary to support and develop the actual or prospective industrial structure. This does not necessarily mean an exclusive emphasis on new industries. The history of the advanced

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[7] Fransman, Martin (1990) *The Market and Beyond. Cooperation and Competition in Information Technology in the Japanese System*, Cambridge:CUP, p.3

[8] Nelson, Richard (1987) *Understanding Technological Change as an Evolutionary Process*, Elsevier: Amsterdam, pp.75-76

economies has not necessarily been a history of creating new industries: of course, new activities have emerged, sometimes (as with the vehicle industry) on a spectacular scale. But growth has also taken the form of continuous and pervasive upgrading of already-existing industries – in most advanced economies, the largest industrial cluster is today exactly what it was two hundred years ago, namely the food sector. But the characteristics of this sector have been massively changed via innovation, and this has been a source of growth. Indeed, no other industry comes close to matching the sustained productivity improvement, over two centuries, of agriculture. So, the infrastructure has two major tasks: upgrading what exists, and fostering the new where the new can feasibly be created.

This perspective suggests that direct commercialisation of innovations should not be a function or task of the knowledge infrastructure. Commercialisation, however, defined in a recent DEST report as 'the process of converting science and technology, new research or an invention into a marketable product or industrial processes', is very much in focus in Australian policy, which concentrates on the financial and other incentives to promote it.[9]

By contrast, we argue that the challenge for the infrastructure is not to produce commercialisable results, but to create the knowledge conditions that enable new firms to emerge, and existing firms to innovate. The knowledge infrastructure—especially universities and research institutes—cannot substitute for or replace firms as the originators and bearers of innovation. Evidence from international debates suggests that attempts to transform universities and other elements of the knowledge infrastructure into commercial enterprises themselves will very likely be both ineffective and destructive to these institutions' ability to play their most important roles.

If the knowledge infrastructure is to play a dynamic role in economic development, then it is not enough simply to understand its proper role. An integrated policy approach is needed, resting in the first instance on an appropriate public-private forum or agency that can discuss and debate the knowledge infrastructure as a whole, and its appropriate funding levels and methods, composition and governance. The knowledge infrastructure is a whole-of-government issue. The challenges of thinking through its emphases and priorities, and its areas of continuity and change, should no longer be left to fragmented agencies.

Innovation and Business Creation

The bearers of innovation should thus continue to be businesses, both existing and new. But, if government policy is to promote innovation effectively, it must be based on a realistic understanding of the reasons businesses choose to innovate in the first place, and the actual challenges they face as they do so.

Put most simply, businesses innovate when they believe such effort will bring higher margins and/or accelerated growth. Innovation delivers these economic benefits to

[9] DEST, *Evaluation of Incentives for Commercialisation of Research in Australian Universities*, March 2005

the extent that it gives the innovating business a privileged position (ideally, from the firm's viewpoint, a *monopoly* position) to satisfy a particular customer demand. When this occurs, innovation strengthens the bargaining position of firms with respect to their competitors and customers. Entrepreneurs, both within established companies and as founders of new ventures, are in reality business people seeking such privileged positions with regard to customers and competitors. New technologies and problem-solving capabilities are tools in this business and managerial process.

From the firm's perspective, then, the social benefits of innovation sought by policy makers, including higher productivity and new products or services, are by-products, or at best means to an end. Firms do not innovate in order to raise productivity or solve economic problems for the country as a whole. They innovate to increase profit and growth, on a risk-adjusted basis, for themselves.

While seemingly obvious, this insight is key to understanding the policy-created parameters that shape innovative businesses' incentives and challenges. Businesses will confront the risk inherent in innovation only if two conditions prevail: the return from innovation is sufficiently greater than that from 'routine', non-innovative, alternatives, and the risk is sufficiently manageable.

Policy makers can substantially influence both these parameters. But it is essential to recognise that the best policy to encourage innovative economic activity might be quite different from that to encourage other economic goals, such as greater investment in infrastructure, more housing, or broader social equity. The key to promoting innovation is to tilt the playing field in favor of higher risk-adjusted returns to innovators.

How might this 'tilting' be achieved, without inducing dysfunctional economic behavior, such as rent-seeking through privileged ties to government? All nations with successful innovation policies have introduced ways to raise the returns from innovation, especially in comparison to non-innovative activities, and to reduce the impact of failure, usually in specified sectors. To define which policy initiatives will realise these goals, it is necessary first to identify accurately what those barriers are, and what they *are not*, in the specific Australian business context. Unfortunately, just what are these barriers is the subject of several pervasive myths in Australia.

The first relates to entrepreneurship. Within Australia, one often hears that the country needs a more entrepreneurial business culture. This may be so, but this claim should not be taken to imply that Australia needs more companies, or more new-company formation. *Per capita*, Australians create roughly at least as many new businesses as comparable developed nations, and more than most. What Australia lacks is not start-up companies, which it has in proliferation, but successful growth of these companies into medium and then large-scale enterprises, of the type that alone can adequately manage the complex problem-solving and innovation-generating process. For an economy of its size, Australia has one of the world's lowest populations of multinational innovating companies.

This problem is especially endemic in the biotechnology sector. Australia enjoys one of the highest rates of new biotech company formation in the world, perhaps the highest, yet suffers one of the lowest average firm size and smallest total market

capitalisation. Australia's listed biotech 'firmlets' are mostly narrowly focused on a single project, with a thin capital base, and as such offer little prospect of growing into ongoing enterprises, or even of surviving the inevitable setbacks on the winding path to commercialisation of a single product. Such a fragmented sector is unlikely to be sustainable as a platform for the nation's participation in a broad and far-reaching technology revolution.

The second myth relates to risk taking. Just as with entrepreneurship, one frequently hears that Australian businesses are excessively risk averse. Yet important evidence suggests the contrary. Australians are famous for their love of gambling, and Australia is a world leader in sponsoring and financing raw material exploration, one of the most risky forms of business enterprise known. Why the difference? Why should Australians apparently avoid technology risk, but embrace wildcat mineral exploration? The origins of this difference need further exploration, but an answer is likely to be found in the accumulated knowledge base of Australian management, along with the structure and incentives of investment managers themselves, both of which appear to militate against technology risk.

The third myth is that Australia's economy is too small to lead in innovation. This argument comes in two forms: that Australia lacks the financial resources to experiment with new technologies and that its domestic market is insufficient, and too remote, to support innovation. Compared to other successful nations, however, Australia's economy is of ample size. Consider Sweden, for example: it possesses at least twenty multinational enterprises that are industry leaders on a global scale – yet its population is eight million (of whom 16 percent are immigrants). By contrast Australia has more than twice the Swedish population, and indeed possesses the fourth-largest pool of privately managed investment capital in the world—in the shape, primarily, of its superannuation funds. Its domestic market is economically much larger than most small European or successful East Asian nations.

The challenge of business innovation in Australia is in reality not that Australians don't start enough companies, nor that they don't like risk, nor even that their economy is not large enough. It is that they too often fail to construct sustainable, complex, growth-oriented business enterprises necessary to bring a stream of innovations to market.

The wine industry provides an instructive example of what Australia's innovation system does well, and at what it fails. Over the last two decades, Australians have been responsible for a stream of world-beating innovations in the wine industry, both in viticulture and viniculture, and these have been successfully brought to market. Invention plus commercialisation: in these respects, the industry is an exemplary story – it has been a dramatic growth industry by any reckoning. Universities and research institutes have cooperated with growers and winemakers to produce new varieties and techniques, and create a vital, sustained, export industry.

Importantly, however, Australia has failed in the *business dimension* essential to capture value from this innovation. In spite of its success in growing tonnes of grapes and shipping litres of wine, and even in creating global brands, Australia's wine industry has manifestly failed to build world-class companies that can independently market and distribute their product, the field in which most value in the beverage

industry is concentrated. With one faltering exception, all major wine export, marketing, and distribution out of Australia is now foreign-owned. The lion's share of value created by Australia's wine innovators thus flows to overseas equity holders.

Policy makers can create more favourable conditions for entrepreneurs (in-corporate as well as independent) to build the kind of business enterprises that will sponsor innovation, take ideas through to commercialisation, and, finally, capture value from it, by allowing higher returns for innovators and helping innovators bear risk.

The first aim can be achieved by discriminating between innovative and 'routine' business activity in pricing and taxes. In essence, all governments that have successfully promoted innovation allow innovators to charge more for these products or services, for a specified period of time, and then ask from them lower taxes. Such benefits can come in many forms, and the most effective will be related specifically to the needs of particular technologies.

The second aim can be achieved by supporting the diversification of risk. Innovation is much more risky than 'routine' economic activity because it intensifies each of the major forms of business risk: technical ("will the product work as hoped"); market ("will customers buy this previously unknown item"); and managerial ("can this team work together under unexplored conditions to bring this successfully to market"). After firms and investors make the necessary attempts to reduce the risk to which they are exposed—by, for example, better understanding the underlying science or the consumer markets they face—the only known way to manage risk is to diversify it, in the hope that in a pool of 'bets' winners will more than offset losers.

As a pooler of risk, government enjoys three potential advantages over the private sector: it can diversify across a wider base (in essence, the entire citizenry); it can take its returns in non-financial forms (increased productivity, improved health, more jobs, etc); and it can invest more for the long term. These advantages potentially allow government to act as a risk-bearing partner with private firms, and to enhance their own risk-bearing capabilities.

Three distinct forms of economic vehicle have been employed by governments around the world to assist private firms diversify innovation risk. The first is subsidised loans from commercial banks, in which default risk is borne partially by government and partially by the banks themselves. Such subsidies increase the willingness of commercial banks to lend to innovators, but do not substitute government officials for the due diligence process of private investors.

The second is greater support for venture capital, especially through reduced capital gains tax for technology innovators. In this respect, it is worth noting that even at half the marginal tax rate, Australia's capital gains tax is close to *double* that of the US. Many governments also joint-venture with private investment firms to increase venture-capital funds under management.

And the third is a system of pooled income-related loans. The European Union in effect employs this approach to finance the highly successful Airbus enterprise. In this case, EU Member States provide government loans at commercial rates, to cover 33 per cent of development costs for each aircraft project. These are not repayable if the

project fails, but are fully repayable with additional royalties if the project succeeds; in the event, European taxpayers have made substantial profits from these royalties.[10] Australia has pioneered pooled income-related loans to finance higher education; it is fully familiar with the principle. But it has not yet deployed this instrument in support of innovation.

For any of these vehicles to support diversification of risk successfully without inducing undesirable economic behavior, however, certain conditions would need to be met. The first is that private investors, not government officials, select investments, and that they do so based on commercial criteria, not on, for example, the basis of political ideals, or worse, "who is a mate of the Minister". This proviso is essential to ensure that innovation does not become a game of government-relations prowess, or indeed corruption.

The second criterion ought to be that private investors themselves bear at least some of the risk. This proviso is needed to guard against behavior in which entrepreneurs deliberately take the only the greatest risks, which when borne by someone else (the taxpayer) can encourage adventurism in the hope of occasional major pay-offs.

The final criterion should be that government-subsided investments gain a return which can replenish the pool, even if not a venture-capital-level return. In all cases, innovators should be required to return taxpayers' money when successful, not be simply the passive recipients of non-repayable grants.

Our argument therefore is that Australia has two fundamental needs concerning innovation. The first is for a modified knowledge infrastructure policy, less focused on direct commercialisation, and more oriented towards the generic and scientific knowledge bases that underpin the Australian economy. The second is a modified business development system, addressing the real characteristics of the innovation problems faced by businesses.

Conclusion

This submission does not allow space for these proposals to be elucidated in depth, but each should have a place in a comprehensive business innovation support system, with different tools meeting the divergent needs of various technologies and firms. Taken together, however, the principles that underlie them are those that other

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[10] "Let us go back to 1970 for one minute. Imagine if I had gone then to a bank and said, 'I have just started a management team from various European countries. I intend to make large aircraft to compete with Boeing. Will you lend me $ 1 billion? You may lose all of it. Or you may start to make some money twenty years from now.' I leave to your imagination the welcome I would have had. No financial institution would have taken on such a risk, or if it had the interest rates would have been simply prohibitive. It was therefore up to the governments of each of the countries participating in Airbus Industrie to substitute themselves for the bankers and assume such risks", Jean Pierson, Managing Director, Airbus Industrie, April 1991, at a lecture at Cranfield Management School, quoted in: Lynn, *Birds of Prey*, 1995, p. 150.

countries have shown to be vital to inducing successful technological innovation, in both new industries and existing. The authors would be happy to provide Committee members with more detail on any of these issues that seem potentially productive.

Hobart, April 2005.