Submission to House of Representatives

Committee on Innovation and Science

Inquiry into

Business commitment to R&D in Australia

Department of Industry, Tourism and Resources

Contents

Executive summary

For businesses, innovation is the process by which new ideas are transformed, through economic activity, into sustainable, value-creating outcomes - into tradeable products, processes and services. Research and development (R&D) is an input to innovation and so also are creative work practices, entrepreneurial leadership skills, intellectual property (IP) management and novel packaging/marketing of goods and services.

A variety of factors including the prevailing market conditions contribute to the volatility of business expenditure on R&D (BERD). BERD in Australia has grown over the longer term - from 1981-82 the average annual growth rate has been 13.7%. While expenditure declined from 1995-1996 to 1999-00, in 2000-01 it increased to $4.8 billion in current prices, some 18% higher than the $4.1 billion recorded in 1999-00. As a percentage of GDP, expenditure increased from 0.65% to 0.72%. This has grown from 0.24% in 1981-82.

The largest businesses, employing 1000 or more, account for 39% of total R&D expenditure and the smallest businesses, employing less than 20, account for 11%. Medium-sized businesses (20-199 employees) and businesses employing 200-999 account for 27% and 23% respectively - that is, 62% of BERD is attributable to large businesses (200 or more employees). Expenditure increased in all major sectors, with the mining sector increasing by 57% (reversing a fall over the past three previous years), manufacturing increasing by 8%, the financial and insurance industry by 91%, and property and services by 12%.

The level of expenditure on R&D is determined by business in the context of the overall business environment and dependent on many factors outside the Government's control, particularly as markets alone will tend to underspend in this area**.** The level is likely to be quite different for different countries, reflecting the variations in industry structures and economies. For this reason, international comparisons with respect to business expenditure on R&D are problematic.

Economic growth can be stimulated by the accumulation of human capital in its broad sense - investment in education and research may not display the diminishing returns typical of more traditional non-R&D related physical capital. For example, while a metal-press in a factory can press only one unit at a time, a tested and proven engineering design can be incorporated simultaneously in an unlimited number of bridge constructions. Ideas and discoveries also provide the platform for new ideas and discoveries - a positive feedback attribute. These characteristics exhibit spillover economic benefits and a long-term positive impact on the generation of future ideas and discoveries and their contribution to further economic growth.

In this context, innovation and R&D are considered to be the major drivers of growth and productivity. The OECD has demonstrated that R&D contributes to output and total factor productivity growth and the Productivity Commission estimates that the social rate of return on Australia's R&D is 25-90%. Private R&D expenditures can generate significant spillover benefits to the economy justifying government intervention to increase investment in R&D and ultimately to increase economy-wide welfare.

For innovation to flourish, the broad economic fundamentals must be right and governments have a role to play in establishing financial, regulatory and commercial conditions to stimulate innovation, entrepreneurial behaviour and attract investment. For example, business investment in R&D is facilitated by a stable political and economic environment, access to skilled personnel, links to R&D expertise, and R&D industry incentives.

The Commonwealth Government has implemented a number of reforms designed to improve the productivity and growth performance of the Australian economy, including deregulating financial

markets, the reduction of trade barriers and labour market reforms, and reforms to business taxation. These reforms can be expected to make a significant contribution to lifting levels of R&D.

The Government has announced its long term commitment to stimulating R&D and innovation, most recently through its five year $3 billion Innovation Statement *Backing Australia's Ability*. Programs to encourage industry investment in R&D range from those that are broad, entitlement-based to more targeted programs for specific sectors. An important element of enhancing Australia's capacity for innovation through *Backing Australia's Ability* has been the whole-of-government approach adopted and the consultation with industry and the research communities.

Success in the market place is the primary indicator of the benefit to business of investment in R&D seen in company growth, listing on the stock exchange, and the value of shareholdings. It is essentially up to business to develop the necessary strategies for commercial success, including the contribution from R&D.

Impediments to business investment in R&D differ according to the size of businesses and because of different sectors' needs. Some of these have been recognised and addressed through the Industry Action Agenda process. In addition, Government has responded to the lack of available cash for R&D for small fast growing firms by introducing the Tax Rebate (Offset). New business often cannot afford the cost of services to manage intellectual property protection and marketing strategies – the COMET program was introduced to assist these firms. In addition, a new Innovation Exchange organisation, to be run by the private sector, has just been established to assist industry to access new technologies and R&D solutions from around Australia and overseas.

There have been many R&D success stories from both domestic and foreign owned businesses. For example, Californian-based Varian Inc has recently transferred one of its production lines from the US to a Melbourne-based facility operated by Varian Australia, with over $100 million in exports expected to flow from this investment. Exposure to increased competition has driven R&D in the automotive industry - through its commitment to R&D, Robert Bosch (Australia) has gained a lead role within the international Bosch Group for the development and manufacture of automotive products.

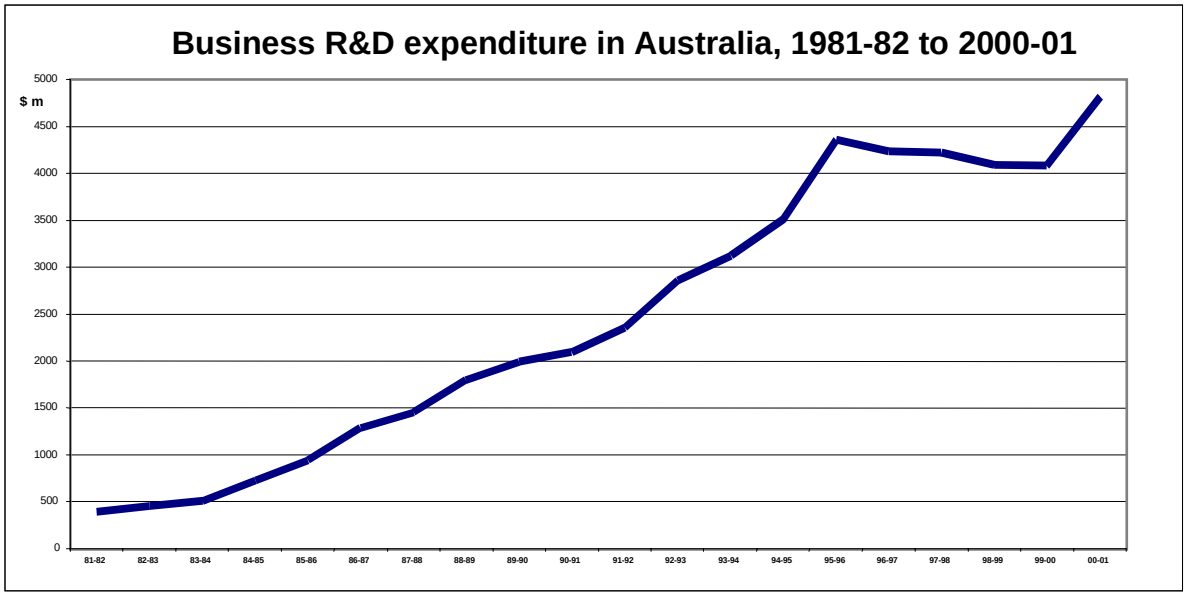
Some generic developments that could contribute to desirable increases in BERD are greater interaction among players in the innovation system and increased involvement by foreign owned firms with Australia as a base for global innovation and export. Both these developments would build on Australia's strong science infrastructure and its comparative advantages as a base for conducting R&D. That significant developments in these areas are already happening serves to highlight the potential for further advances. The development of business clusters and inter-firm collaboration, better public/private partnerships in conducting and commercialising R&D and investment attraction activities (by Federal and State Governments and importantly subsidiary firms themselves), can serve to facilitate higher levels of quality R&D.

1. Current business expenditure on R&D (BERD) and past trends

The Australian Bureau of Statistics (ABS) *Survey of Research and Experimental Development Businesses 2000-01* showed an increase in BERD. Expenditure increased to $4.8 billion in current prices, 18% higher than the $4.1 billion recorded in 1999-00. In volume terms, with the effect of changes in prices and wages and salaries removed, R&D expenditure increased by 12% compared with 1999-00.

The largest businesses, employing 1000 or more, account for 39% of total R&D expenditure and the smallest businesses, employing less than 20, account for 11%. Medium-sized businesses (20-199 employees) and businesses employing 200-999 account for 27% and 23% respectively - that is, 62% of BERD is attributable to large businesses (200 or more employees.

Expenditure increased in all major sectors, with the mining sector increasing by 57% (reversing a fall over the three previous years), manufacturing increasing by 8%, the financial and insurance industry by 91%, and property and services by 12%.



Source: ABS Catalogue 8104 for 1992-93 and 1994-95 onwards; ABS Catalogue 8114 for 1991-92 and 1993-94.

The above chart shows the trend in business expenditure on R&D over the period 1981-82 to 2000-01 in current dollars.

The trends in BERD over the period up to 1984-85 were closely matched to the trends in business cycles, but the reporting of R&D expenditure was also less reliable than today, since much of this type of expenditure had been treated as a general business expense. Introduction of the R&D Tax Concession in 1985 was intended to raise the low level of R&D at that time.. It also brought with it an accounting discipline to R&D.

Since the early 1980s, the growth pattern in BERD has been fairly consistent, with the exception of 1995-96 and 1996-97, when BERD was clearly above trend, and 1998-99 and 1999-2000 when it was below trend. The peak and subsequent decrease in BERD from 1995-96 to 1999-2000 reflects the impact of a number of influences. However, key among these were two factors.

First, 1996 saw a significant one-off increase in the utilisation of R&D incentives, as markets became aware of the likelihood of significant impending changes to the R&D Tax Concession

arrangements. Indeed, in 1996, the Government took action to restore integrity to the broad-based R&D tax incentives through a number of measures, including removal of R&D syndication. Other measures included amendments with respect to the types of deductions that could be claimed and limits on the time within which companies could submit claims. In addition, the Government introduced new R&D measures via grants and reduced the tax concession rate from 150% to 125%.

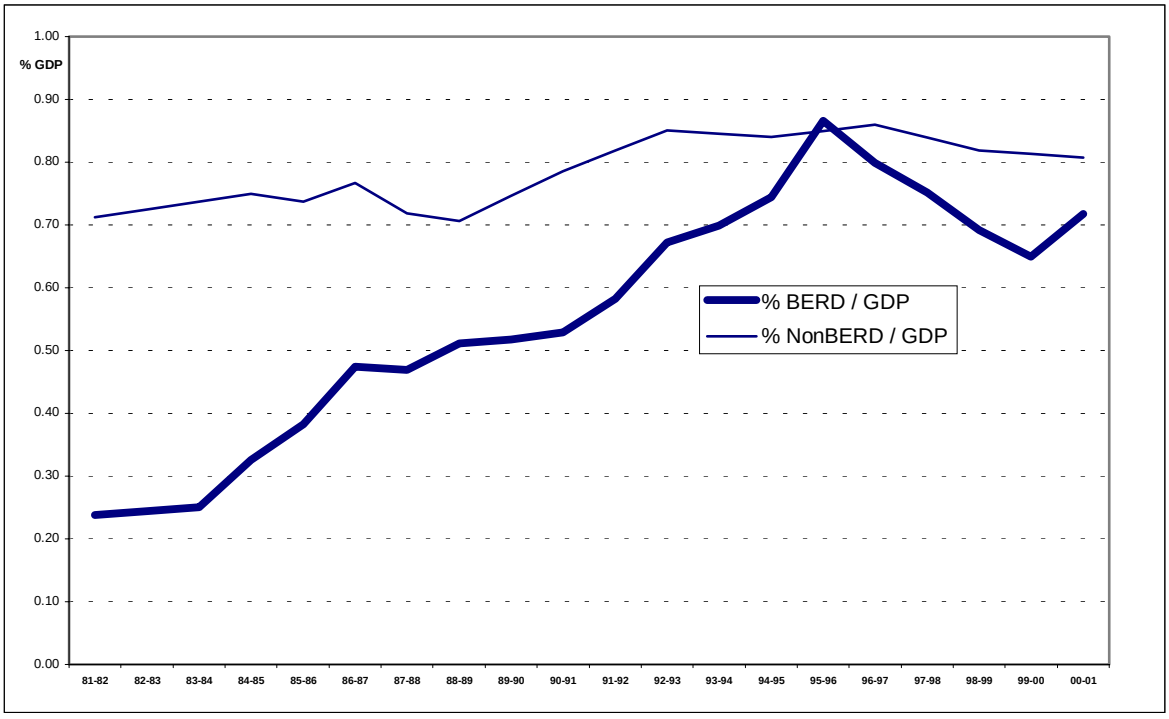
The second key factor to impact on BERD at this time was the peaking of the mining investment boom and its abrupt end after 1997-98.

Although some of Australia's decline in reported BERD over these years can be attributed to the removal of syndication and to tightened eligibility criteria, the overall quality of subsequent R&D expenditure is likely to have increased.

Following these developments, the 2000-01 outcome largely restores the previously established linear development of BERD over the 12-year period to 1994-95.

A striking trend in BERD over the period since 1992-93 has been a relatively steady growth in R&D expenditure in services, particularly in computer and communications-related services (ICT services). The 2000-01 BERD data indicate that, for the first time, R&D expenditure in services and construction industries exceeds that in manufacturing. 37% of Australia's business effort in R&D now relies on an ICT-related skills-base.

Business and non business expenditure on R&D (% GDP), 1981-82 to 2000-01



Source: ABS bulletins 8104.0, 8109.0, 8111.0, 8112.0, 8114.0 (various years) and 5206.0 (March 2002).

Non-BERD as a per cent of GDP has grown from about 0.7% to about 0.8% over the 20 years to 2000-01. Over the same period, BERD has grown from around 0.25% to 0.72% of GDP, representing an almost ten-fold increase in current dollar BERD and an almost three-fold increase as a per cent of GDP.

The table below shows that business expenditure constitutes 47% of total Australian expenditure on R&D, with 23% by government, 27% by higher education and 3% by private non-profit.

Australian expenditure on R&D, by sector 2000-01

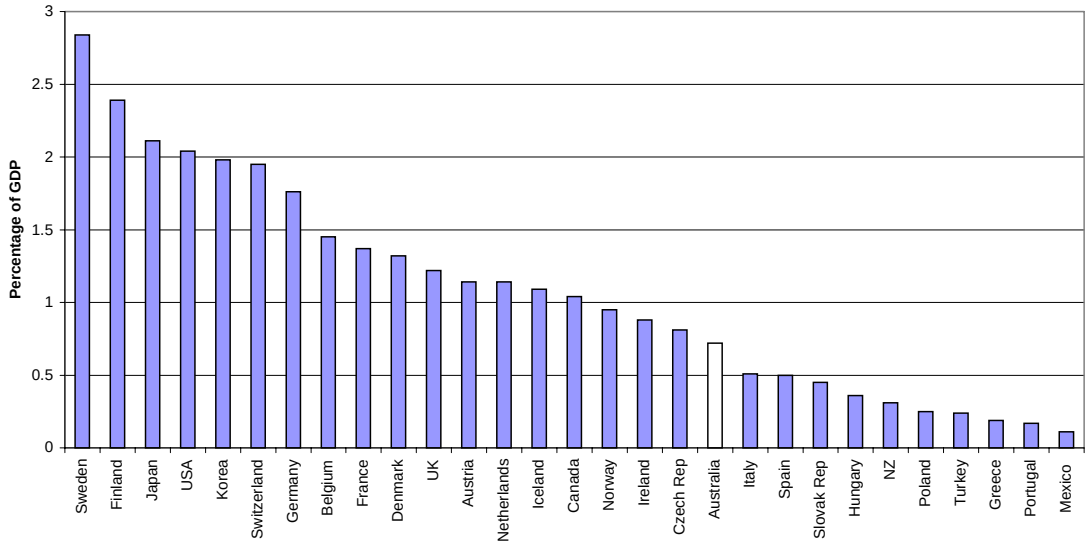
Sector of R&D performance	00-01 *$ m*	00-01 *% GDP*
Business enterprises (BERD)	4825	0.72
Federal Government agencies	1425	0.21
State and Territory agencies	944	0.14
Universities (HERD)	2775	0.41
Private non-profit organisations	283	0.04
Total expenditure (GERD)	**10251**	**1.53**

Source: ABS Bulletin 8112.0 (July 2002)

1.1 International comparisons

As a percentage of GDP, BERD increased from 0.65% to 0.72% in 2000-01, although Australia still remains relatively low when compared with other OECD countries. As shown in the following chart, GDP to BERD across OECD countries varies considerably, from around 2.8% in Sweden down to around 0.1% in Mexico.

BERD as a Percentage of GDP
Source: OECD MSTI Number 1 (2002)
Data from 2000 or latest available year



The difference in BERD to GDP ratios between Australia and some other OECD countries reflects a number of factors including differences in industry structure and the relative intensity with which industries typically engage in R&D. Australia, for example, has a relatively small manufacturing sector and a relatively high level of foreign investment but with few multinational companies headquartered here. It must be recognised, however, that, although there is in general a greater propensity for multinationals to conduct R&D in their home markets, 38% of foreign owned manufacturers in Australia conduct R&D here compared with only 18% on average for the OECD. This activity makes a contribution to BERD in Australia.

Some of the industry structure factors that influence the variation in BERD to GDP ratios across countries simply reflect the diversity of comparative advantage. In general, the relative level of national investment in various economic activities will reflect the relative potential of those activities to generate national wealth, and will ultimately determine the structure of the national

economy. There is good reason to assume that such relativities will show a considerable degree of variation across countries.

Just one example of such features that can significantly impact on national levels of BERD is the extent of defence industry activity. In the US for example, defence R&D, as a % of GDP, is about 8 times higher than in Australia, and around 40 times higher than in Italy. Despite the obvious link between defence industry activity and BERD, it would almost certainly not be in Australia's economic interests to endeavour to replicate the relative capacity of the US in the defence industry area.

Certainly there is strong evidence that, if left to markets alone, national investment in R&D will likely be sub-optimal, and that on this basis there may be a prima facie case for public support for R&D. Nevertheless, this does not detract from the proposition that the proportion of GDP that nations should devote to R&D (and indeed other investments) should be expected to be different.

These matters make international comparisons of relative expenditure on R&D by business and/or by governments difficult to interpret and of limited value on their own. They will nevertheless continue to form a part of the wider information base on which judgements about the appropriateness of national investment in R&D will be made.

2. Benefits for Australia of greater private sector investment in R&D

Evidence shows that both firms and the economy more broadly benefit from R&D and that there are many avenues of access to it. The mechanisms as to why this occurs are complex and only partly understood at the aggregate level. However, R&D appears to make a significant contribution to national growth and, as far as measurement can reveal, provides social benefits which extend beyond those who undertake the R&D.

New economic growth theories focus on the accumulation of human capital in its broad sense - returns to investment in education and research may not display the diminishing returns typical of more traditional non-R&D related physical capital. For example, while a metal-press in a factory can press only one unit at a time, a tested and proved engineering design can be incorporated simultaneously in an unlimited number of bridge constructions. Ideas and discoveries also provide the platform for new ideas and discoveries - a positive feedback attribute. These characteristics are quite different from those arising from investment in a piece of machinery used in a repetitive manufacturing process, for example, and exhibit spillover economic benefits and a long-term positive impact on the generation of future ideas and discoveries and their contribution to further economic growth.

2.1 R&D as a driver of growth

2.1.1 Empirical evidence of the impact of R&D on growth[1]

Econometric techniques of measuring the contribution that R&D makes to national GDP consider the contribution of R&D (together with other factors of production such as capital and labour) to either growth in gross output (normally measured as GDP) or growth in productivity (often measured as multi-factor productivity). Productivity growth provides a key link between R&D and output growth.

[1] Industry Commission, *"Research and Development", Report No. 44, 15 May 1995*

2.1.1.1 Overseas studies

Various studies have attempted to measure the contribution of R&D to economic growth across countries. By comparing productivity growth directly with R&D stocks, it is possible to derive a measure of the social returns to R&D. The available evidence suggests that, at the national level, measured returns to R&D are high. This is consistent with the hypothesis of the existence of spillovers under which returns to the nation exceed the returns earned by individual investors.

In their study, Coe and Helpman (1993) found that a one per cent increase in R&D would provide a 0.23 % increase in multi-factor productivity for the G7 countries and a 0.08% increase for non-G7 countries. Patel and Soete (1988) have also estimated these elasticities for a range of countries and obtained somewhat higher estimates: the United Kingdom (0.82%), United States (0.61%) and Canada (0.26%). While such differences may indicate differences in methodology and data problems, they can also reflect a myriad of economic differences. For example, the responsiveness of productivity to domestic R&D may vary with the extent of the benefits a country obtains from international spillovers, the level of international trade exposure of a country, improvements in education and training and capacity utilisation.

It is also important in considering estimates of the response to increased R&D expenditure to be aware that such increases can come only at the expense of expenditure on other capital, and that a decrease in other capital may have offsetting negative impacts. The key question is whether additional R&D expenditure will enhance productivity by more than the negative impact of the corresponding fall in expenditure elsewhere. In considering this issue, it also needs to be recognised that R&D is by its nature much riskier than many alternative investments and will therefore be expected to clear a much higher hurdle rate of return.

An OECD report[2] argues that links between innovation and growth are now well established:

> ***R&D provides an important contribution to output and total factor productivity growth.*** The empirical evidence typically shows that a 1% increase in the stock of R&D leads to a rise in output of 0.05-0.15%. There is also evidence that R&D may play a different role in small and large economies (Griffith *et al*., 1998) … in smaller ones, it primarily serves to facilitate technology transfer from abroad.
>
> ***There is a close relationship between investment in technology at firm level and productivity performance*** (OECD, 2000b). The relationship also exists at sectoral level, although it is weaker, given the wide variations in firm behaviour. At the economy-wide level, it is often difficult to establish a clear link between an indicator of technology effort and productivity growth. The difficulty has a number of sources (OECD, 1998a). First, both innovative effort and productivity may be incorrectly measured. Second, there may be a lag between innovative effort and its translation into productivity gains. Third, it is difficult to disentangle the impact of technology from other factors affecting productivity. Finally, a large part of economy-wide productivity gains are due to the diffusion process. The firm-level evidence shows that technological change can bring significant productivity gains, but only when accompanied by organisational change, training and upgrading of skills, *i.e.* when the new technologies are thoroughly "learned".
>
> … the evidence goes beyond these three main links. First, differences in per capita income across countries are partly due to technology gaps (Fagerberg, 1994). This suggests that low-income economies may have a potential for catching up with high-income economies by applying technologies developed abroad. Second, useful evidence can be gathered from innovation surveys. They demonstrate that firms invest in innovation because they want to gain market share, reduce cost and increase profits. Innovation surveys covering 12 European countries suggest that over 30% of manufacturing turnover is derived from new or improved products ([UK] Department of Trade and Industry, 1999). … research based on these surveys confirms the role of innovation in improving firm performance. (OECD, 2000a)

[2] See OECD (2000) A *New Economy? The Changing Role of Innovation and Information Technology in Growth* Paris: OECD.

The annual UK Department of Trade and Industry R&D Scoreboard has consistently reported that R&D intensity[3] is positively correlated over the medium term with company performance measures such as sales growth, productivity and market value.

The recent US Congressional briefing by the Progressive Policy Institute in Washington DC concluded that there is a significant private return to investments in R&D at the firm level, and much higher social rates of return to R&D investments. It found private rates of return on R&D investment to be between 7% and 43%.

2.1.1.2 Australia

The Productivity Commission conducted an investigation of the relationship between R&D, productivity and growth. A first approximation to estimating possible returns to R&D was obtained by comparing annual rates of productivity growth with the annual investment in R&D. On the basis of this methodology, the social rate of return to R&D spending in Australia using this methodology was estimated to be approximately 50 %.

This simple measure does not take account of other factors which could influence productivity growth, including micro-economic reform, education and training, learning by doing, the possibility of spillovers from international R&D efforts - all of which would tend to lower estimated returns to domestic R&D. It is also based on the (very conservative) assumption that productivity growth in the non-market sector is zero. Taking these factors into account, the Commission found that the rate of return to domestic R&D varies around the average of 50% from a conservative 25% (by taking into account the effects of education and time on productivity growth) up to 90% (by assuming productivity growth in the non-market sector to be the same as in the market sector).

None of the measurement frameworks takes account of induced economy-wide effects on growth as productivity improvements raise saving and investment, inducing further rounds of output growth.

For a small country such as Australia, a potentially important influence on productivity and output growth is the effect of improvements over time in the quality and technical content of imported inputs (technology transfers) and other research spillovers from other countries. Benefits of foreign R&D are likely to flow to Australia through the import of improved machinery, equipment and supplies from overseas and the interaction of foreign and Australian researchers. After taking both of these factors into account, the Commission found that a one per cent rise in foreign R&D stocks would raise Australian multi-factor productivity by between 0.028 and 0.08 %, yielding an economy-wide rate of return to foreign R&D of 8-23%.

Overall, the Commission's analysis indicated strong positive returns to R&D investment, consistent with overseas studies. Nevertheless, data problems and differences in economic structure between countries and within countries over time preclude tying these rates of return down to a narrow range of values.

2.2 Case for government support

Econometric studies have found that social rates of return to R&D can be up to five times higher than private rates of return. Because private investors will not invest beyond the level of private returns that they are able to obtain, R&D expenditure by businesses may be below the socially optimal level[4] if left to market forces alone. Some form of Government support for private R&D is therefore justified to increase investment in R&D and ultimately to increase economy wide welfare.

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[3] R&D intensity is defined as R&D expenditure as a proportion of annual turnover (gross assessable income).

[4] Bureau of Industry Economics (1993), *R&D, Innovation & Competitiveness, An evaluation of the research and development tax concession.* AGPS, Canberra.

However, any measures must be cost effective - the benefits must compare favourably to the costs of intervention to ensure there are net economic benefits from Government intervention.

By supporting cost-effective options for increasing business investment in R&D, governments are acting responsibly, seeking the best outcomes in terms of new products and processes that in turn improve employment and living standards. It is not the role of government simply to increase R&D input but rather to ensure the best innovation outcomes.

An OECD report, *Public and Private Financing of Business R&D*,[5] noted that: "Market based mechanisms such as tax credits can boost overall levels of business R&D where they are depressed and can be effective in reaching large numbers of firms." This report also suggested that "more direct forms of support may be needed to produce sizeable changes and to redirect industry efforts towards areas with potentially large social and economic benefits".

The Commonwealth Government introduced the R&D Start program, a competitive grants program, in 1996 to assist Australian industry to undertake R&D and commercialisation through a range of grants and loans, thus providing a balance of support. An independent evaluation of the program in 2000 found a high level of achievement of the program's objectives in fostering R&D activity and commercialisation. Similarly, an independent evaluation of the R&D Tax Concession in November 2000 indicated that the scheme had positive outcomes, including inducing increased R&D spending by users, creating a competitive edge in pursuing market opportunities and leading to commercial outcomes.

While it is too early to assess the new 175% R&D Tax Concession incremental regime, some of the earlier Industry Commission and Bureau of Industry Economics studies have suggested that an incremental regime would be more effective at increasing R&D expenditures than a flat rate tax concession. Other studies (eg, Brean and Leonard, 1998[6]) have indicated that tax credits based on incremental spending have a sharper incentive effect and tend to give better stimulus for companies to increase R&D expenditures at the margin.

3. Key drivers and potential impediments to R&D

R&D is one component of innovation - the process by which new ideas are transformed, through economic activity, into sustainable, value-creating outcomes. Innovation is achieved only when the idea has been converted into an economic outcome.

Innovation is today considered to be the major driver of growth and productivity. Innovation includes firms undertaking R&D and translating that into tradeable products, processes and services. It also includes creative work practices to reduce costs, smart IP management, entrepreneurial leadership skills, novel marketing and packaging of goods and services that may not involve R&D.

3.1 Drivers and impediments to R&D investment

Firms conduct R&D to create a competitive advantage by introducing or developing new or improved processes to lower costs, or new or improved products or services to capture market share and thereby maintain and increase profits and achieve growth.

Decisions on business R&D will, like business decisions generally, be motivated by rates of return considerations. A range of other considerations during investment will also be relevant for R&D,

[5] OECD *Public and Private Financing of Business R&D*, 19-20 March 2002 (DSTI/STP(2002)23)
[6] Brean, D. and J. Leonard, 'Taxation, Technology, and Canada's Competitiveness', Choices, Vol.4, No.1, January 1998

such as availability and cost of capital, supply of labour and market opportunities. Within this broad paradigm, there will be a wide variety of reasons behind a business investing in R&D including:

- Supporting existing business activities;
- Establishing new business developments;
- Facilitating related business diversification;
- Selling R&D services to other companies;
- Providing the skills to help reverse engineer competitors' products;
- Helping to predict future technological trends;
- Complying with social and political expectations;
- Export opportunities;
- Portraying a positive corporate image; and
- Creating future options through new knowledge and technology.

These firm-specific drivers give an indication of what influences the level of BERD for the economy. However, the level of R&D investment will also be influenced by broader economic factors such as:

- Stability of the economic and political environment;
- Regulatory, financial and commercial conditions, including access to finance, IP regime and taxation environment;
- Availability of, and access to, efficient and competitive product and labour markets;
- Incentives for investment where market failures exist; and
- Skills and firm competencies in diffusing new technologies.

Australia's innovation performance based on internationally comparable data is consistently high - in the top 10 of the 30 OECD member countries. Much of our strength in innovation and R&D comes from the relative strength of our skills base, the competitive cost of labour, and the capacity of Australian businesses to transfer technology throughout the economy. Australia has the highest number of domestic and international strategic alliances for the size of its economy. Further, Australian businesses have one of the strongest relative capacities to integrate technology into their operations - the number of young science technology graduates in the labour force is 42 % higher than the OECD average.

Research by the US-based Economist Intelligence Unit has rated Australia second only to the United States in its provision of an environment conducive to the development of e-business opportunities. This is critical to Australia maximising its position in the emerging information economy.

However, a number of factors are often seen as inhibiting our level of BERD. Australian industry is characterised by a large number of small firms, the dominance of foreign-owned firms in some industries and few large firms that operate as home-based multinationals. This leads to gaps in the availability of global distribution channels and limited availability of domestic innovators and producers. Australia has a small population and home market especially for specialised products. It is also remote from the world’s larger markets.

In this context, in his Warren Centre Innovation Lecture, Dr James Fox, Managing Director of publicly-listed Vision Systems Limited,[7] gave his recipe for business success:

> *- with a tiny domestic market and vast distances to major international markets, only companies with a vision to target customers outside Australia will ever have the scale to invest in the required R&D and the international marketing costs that are needed.*
>
> The rules Dr Fox proposed for keeping a start-up on track included: target at least 75% of sales overseas; base the business on both the manufacture and distribution of high value and high margin products and contract R&D services; operate the R&D resource as a stand alone business, serving external customers as well; invest 10% of sales in new product R&D; and invest in IP and sales and marketing and be a virtual manufacturer.

3.2 Studies of Factors Driving R&D

A study prepared for ITR in January 2001, entitled "Benchmarking Study of R&D Costs in Selected Segments of Australian Biotechnology", investigated factors influencing location decision-making processes. The study was prepared by a consortium comprising Ernst & Young, the Hay Group and the Strategic Industry Research Foundation.

While this study focused on comparison of costs of undertaking biotechnology R&D in several countries, it also investigated drivers of investment in biotechnology. A survey was conducted of senior R&D leaders and business executives in Australia and overseas who are either working in, or who have expertise in. the international biotechnology industry. They were asked to judge the importance of some 23 factors that could influence decision making about the location of R&D.

The top four factors that received highest ranking in order were:

- Availability of skilled personnel;
- Economic and political stability;
- Links to R&D expertise, eg, universities etc; and
- R&D industry incentives, eg, tax breaks, grants etc.

The next five ranking questions in order were:

- Efficiency of international telecommunications;
- Expertise and links to high technology manufacturing;
- Access to Venture Capital, capital/financial markets;
- Salary and related costs of R&D personnel; and
- Reliable and up to date knowledge about life-science opportunities in target country.

The research team suggested that "the deliberate brevity of the survey and the limited number of respondents preclude strongly held conclusions. However, it does support the view that a multitude

[7] 2002 Warren Centre Innovation Lecture http:www.warren.usyd.edu.au/bullein/NO29/ed29art2.htm

of factors, both tangible and intangible in nature, are relevant to presenting a compelling "value proposition" for investment,….".

The results of this study are consistent with those of an earlier study, "R&D Location Decision Making Study", commissioned by the then Department of Industry, Science and Technology in 1995, which was undertaken by Strategic Industry Research Foundation.

The study's objective was to identify the reasons why companies chose Australia as an R&D base, and covered a range of influences, such as costs of doing R&D, availability of skilled personnel, proximity to markets and centres of expertise, features of the Australian economy and lifestyle, and support programs for R&D. The researchers conducted interviews with representatives from 25 companies from a variety of industry sectors.

The results showed that the availability of skilled personnel was by far the most important factor nominated by companies and Australia's attractiveness, in terms of the quality of researchers and graduates and access to centres of expertise, was identified as very important by most companies. The innovative nature of the Australian research community was also mentioned in this context. Taxation incentives, such as the R&D Tax Concession, emerged as the second most important factor.

Comparing the results of the two studies suggests that the availability of skilled personnel has remained the most important decision-making factor for the location of R&D operations in Australia. The surge of "economic and political stability" from rank 6/7 to the second most important decision-making factor may be a result of the Asian financial crisis which began in 1997. Links to R&D expertise has remained an important issue, as has the availability of industry incentives such as tax breaks and grants.

4. Government initiatives to encourage business R&D in Australia

4.1 Australia's Policy framework

For innovation and any other driver of economic growth to flourish, it is vital to get the broad economic fundamentals right. The Commonwealth Government is continuing its focus on sound macroeconomic policies to create a stable environment in which industry can invest with certainty and confidence and microeconomic reform and competition policy to ensure labour and product markets operate efficiently.

Government also has a role to play in establishing financial, regulatory and commercial conditions to stimulate innovation, entrepreneurial behaviour and attract investment through, for example, the intellectual property (IP) regime and taxation environment. Other critical initiatives that focus on achieving innovation outcomes are policies that facilitate changes in business culture, work practices and the transfer of new technology.

The Government has implemented a number of reforms designed to improve the productivity and growth performance of the Australian economy. Much of this reform agenda would be expected to have an indirect impact on BERD through its effect on other incentives for firms to undertake R&D.

Reforms which expose markets to increased competition, particularly international competition, can act as an important driver of innovation. For example, the effective rate of assistance for the manufacturing sector has fallen continuously and sharply since the mid 1980s. Over the same period, the trend rate of growth in manufacturing output per hour worked compares favourably with

that achieved for the non-farm sectors of the economy over the current expansion[8]. Technological advance has been a pervasive force in this change.

Reforms such as deregulating financial markets are likely to have improved the supply of capital to firms, providing more scope for them to explore new and innovative products and processes. The reduction of trade barriers would have encouraged a number of firms to have taken measures to improve their competitiveness. Labour market reforms have also contributed to improvements in labour productivity, which lower the cost of R&D to firms by reducing the real cost of undertaking R&D.

More recently, the Government has undertaken substantial reforms to business taxation. These reforms could be expected to make a significant contribution to lifting levels of R&D. Important measures include:

- a reduction in the company tax rate to 30%; and
- introduction of a simpler, internationally competitive capital gains tax regime, including lower capital gains taxation for individual taxpayers and superannuation funds; and incentives for venture capital investment.

At the same time, microeconomic reform is reducing business costs by making product and labour markets more competitive.

This strategic framework is complemented by programs which enhance business performance by fostering innovation, developing export markets and encouraging investment. The impact of these changes on incentives to undertake R&D, relative to other business investments, involves a number of factors that will vary from firm to firm.

4.2 The Government's Innovation Statement - *Backing Australia's Ability*

The initiatives outlined in *Backing Australia's Ability* are the latest in a series of measures introduced by the Government to encourage research, development and innovation. The *Investing for Growth* statement in December 1997 increased support for business innovation by providing $1.26 billion over the four years from 1998-99, with additional funding for R&D grants, venture capital and technology diffusion.

4.2.1 R&D Tax Concession program

The R&D Tax Concession is the Government's principal initiative to increase the amount of R&D being conducted by businesses. It is a broad-based, entitlement program and part of the company tax system with the benefit is claimed through the annual company tax return.

As part of *Backing Australia's Ability*, the Government enhanced the 125% R&D Tax Concession with a comprehensive, targeted package that builds on the lessons learned by successive Governments following 15 years of operating an R&D tax incentive.

The R&D Tax Concession provides a range of measures designed to encourage increased investment in R&D by Australian companies, namely:

- a new 175% Premium (Incremental) Tax Concession targets "additionality" by providing additional benefit for increases in R&D effort, focussing on labour-related R&D
  - not giving more support for the same effort, thereby having greatest potential to lift Australia's levels of business expenditure on R&D;

[8] Reserve Bank of Australia, 'The Manufacturing Sector: Adapting to Structural Change', March 2001

- a new R&D Tax Offset (Rebate) allows small companies, particularly tax loss companies, to obtain a tax offset equivalent to the 125% R&D Tax Concession and, where eligible, the 175% Premium R&D Tax Concession - enabling them to "cash out" their R&D tax losses;
- continuation of the 125% Tax Concession provides certainty allowing eligible companies to deduct up to 125% of eligible expenditure incurred on R&D activities from assessable income when lodging their tax returns; and
- a 125% deduction for effective life depreciation of assets used in R&D activities (on a pro-rata basis for shared use) enables companies to claim the full value of plant consumed in or associated with R&D activities.

4.2.2 COMET

The Commercialising Emerging Technologies (COMET) Program was introduced in November 1999, as a $30 million, three-year initiative. In January 2001, *Backing Australia's Ability* provided an additional $40 million to extend the Program. The Program is designed to increase the commercialisation of innovative products, processes and services by providing individuals, early-stage growth firms and spin-off companies. COMET is largely centred around mentoring as it is delivered by private sector Business Advisers located around Australia. COMET offers a tailored package of support for such things as business planning, market research and intellectual property strategies, to improve the potential for successful commercialisation.

4.2.3 Venture capital

Pre-Seed Fund

The Pre-seed Fund is a 10-year, equity-based program. It was announced as part of *Backing Australia's Ability* to encourage universities and public sector research agencies to develop their discoveries and create new business opportunities. The funds will invest up to $1 million in each selected project or company.

The Commonwealth is contributing $72.7 million to a total pool of over $100 million which will be managed by 4 fund managers. Licensing agreements are currently being negotiated with the four fund managers. It is anticipated that these licence agreements will be finalised in the first Quarter of 2002-03.

Innovation Investment Fund

The Innovation Investment Fund (IIF) program was established in 1998 to promote the commercialisation of Australian research and development by supporting the provision of early stage capital, including seed, start-up and early expansion stages, to new technology based firms, and to facilitate the creation of a self-sustaining, early stage technology based venture capital market. The program also aims to develop experienced early stage venture capital fund managers and establish a revolving or self-funding program.

The Government has licensed nine private sector capital funds as IIF funds to support the provision of early stage capital to new technology based firms. In total, the program is providing $358.4 million of early stage capital, of which the Commonwealth is contributing $220.7 million and the private sector $137.7 million.

4.2.4 Other R&D support

The R&D Start program provides grants and loans to complement business expenditure for R&D. The program is generic and competitive and is capped at $180 million per annum.

Targeted R&D programs provide support for particular sectors:

- The Automotive Competitiveness and Investment Scheme (ACIS) encourages firms to conduct R&D in Australia through a 45% allowance on expenditure and there are also generous allowances for plant and equipment acquired for R&D;
- The Pharmaceuticals Industry Investment Program (PIIP) partially compensates participating manufacturers for the reduced prices they receive under the Pharmaceuticals Benefits Scheme, in return for their commitment to undertake activities, such as R&D, in Australia;
- The Textiles, Clothing and Footwear Strategic Investment Program encourages the industry to invest and innovate to enhance its competitiveness; and
- The Shipbuilding Innovation Scheme, is aimed at encouraging the development of an internationally competitive shipbuilding industry in Australia, pays a benefit of 50% of eligible R&D capped at 2% of eligible construction costs.
- The Biotechnology Innovation Fund provides grant support to encourage researchers and industry to take their innovations through the proof of concept stage and thereby increase the likelihood of commercialisation.

Other sector-specific R&D and innovation support programs are provided through various Commonwealth Government agencies, including Agriculture, Fisheries and Forestry - Australia and Communications, Information Technology and the Arts.

The States and Territories also have in place policies aimed at increasing R&D, innovation and entrepreneurship, and recent administrative changes such as those in Victoria and Queensland have given innovation a sharper policy focus. Each State and Territory Government administers a range of programs to support firms to undertake innovation, while several are fostering the development of technology-based industries such as biotechnology. Initiatives include the establishment of investment funds in biotechnology by South Australia and Queensland, and investments in major infrastructure facilities, for example, through Victoria's Science, Technology and Innovation Infrastructure grants program, including the Collaborative Optical Leading Testbed in Ballarat to create the next generation of high-speed communication networks.

5. Demonstration of successful R&D outcomes

The following material illustrates some achievements of Australian companies from investment in R&D and innovation. The material is also illustrative of the different ways in which Governments can encourage R&D and innovation, be it through removing market impediments, influencing the environment or creating incentives.

5.1 Encouraging foreign-owned businesses' contribution to Australian business expenditure on R&D

Australia is seen as an attractive location in which to conduct R&D. A positive innovation environment has encouraged a higher than average proportion of foreign-owned manufacturers to conduct R&D here, 38 % compared with the OECD average of 18%. Multinational corporations operating here view Australia as home to a high-level skill base. They have maintained their levels of R&D, particularly in the automotive, pharmaceuticals and information and communications technologies sectors, despite economic downturns worldwide.

In its article *Foreign ownership characteristics of businesses undertaking R&D in Australia in 1999-2000*, released on 1 August 2002, the ABS (Cat No. 1350.0, *Australian Economic Indicators*) reported expenditure on R&D in Australia by foreign-owned businesses in 1999-2000 of $1,690m. This makes up 42% of expenditure on R&D by all businesses in Australia in 1999-2000 ($4,045m

in current prices), a significant contribution. In addition, 17% of R&D expenditure by Australian-owned businesses is sourced overseas. Human resources (in person years) devoted to R&D by foreign-owned businesses comprised 41% of the total human resources devoted to R&D.

Majority USA-owned businesses made the largest contribution to R&D activity of all foreign-owned businesses, contributing more expenditure and human resources devoted to R&D than all other foreign-owned businesses combined.

Australia is considered to have a strong R&D base and this provides Australia with a competitive advantage when it comes to investment in Australia by multi-national companies. Moreover, a policy environment which encourages foreign direct investment can lead to increased technology transfer and greater business commitment to R&D, as the following examples illustrate.

- GKN Engage of the UK has established an aerospace engineering design and analysis facility in Melbourne and Sydney. GKN is a global engineering services company, focused on providing project-managed design, analysis and computer modelling services primarily to the aerospace industry, and also for the automotive and rail industries. GKN Engage has invested approximately $25 million and created over 100 high value jobs as part of this project in Australia. The depth of highly skilled engineers and a time zone that enables follow the sun capability with the US and Europe were the key reasons for Australia winning this project.

- Californian-based Varian Inc recently transferred one of its production lines from the US to a Melbourne-based facility operated by Varian Australia. Varian Australia will manufacture scientific instruments known as analytical High Performance Liquid Chromatographs, which are being used by researchers as an aid to discovering new drugs for treating diseases such as cancer. Over $100 million in exports and 65 new high skill jobs are expected to flow from this major US investment. This investment is a recognition of Australia's world-class strengths in manufacturing and innovation. Invest Australia played a key role in bringing this investment to Australia.

- General Motors Holden In order to secure the Holden V6 engine plant for Australia, the Commonwealth Government provided financial assistance of $12.5 million to Holden for training of automotive industry employees and the development of industry relevant technology. Holden's investment provides a significant boost to the manufacturing capability of the Australian industry and is a great example of industry innovation. It will use new light metals materials and state of the art manufacturing processes, which will also lead to improved environmental outcomes. Holden also agreed to support Australian supplier involvement in international e-commerce procurement systems and explore the potential for world competitive Australian suppliers to participate in the global General Motors supply chain.

Australian-based companies have also been prominent in enhancing their R&D capacity.

- Robert Bosch (Australia) Pty Ltd (RBAU) is a major exporter of automotive electronics. Its commitment to R&D has gained it a lead role within the international Bosch Group for the development and manufacture of automotive products. RBAU spent more than $150 million on R&D during the five years to 2001. Technologies which it has developed for export include chassis systems (anti-lock braking systems, traction control, steering wheel sensor), body electronics (immobiliser, body computer, heating/ventilation/air-conditioning components), automotive electronics (diodes), and engineering services.

- Bishop Technology Group Ltd is a developer of technology, which has historically relied on patents to bring its innovations to the market. The company has integrated its business into the global automotive world as a developer of leading-edge steering technology. In 2001, over 11 million vehicles worldwide (20% of the world car market) used Bishop technology. In

addition, Bishop has recently entered into a joint venture with manufacturing facility in Germany with Mercedes-Benz Lenkungen (a subsidiary of DaimlerChrysler) to develop steering equipment in Germany for use in Mercedes Benz vehicles. Bishop has also become an "innovation centre" for DaimlerChrysler with a joint venture which allows them to be involved at an earlier stage of product development of steering systems.

- In southern Queensland, there is a structure with the potential to revolutionise bridge building technology in Australia. Developed jointly by Wagner Investments and the University of Southern Queensland, the bridge is made from fibre composite. It offers a lighter, more durable and ultimately cheaper bridge-making alternative and heralds a new era in construction.

- In Perth, the innovative vision of the HarvestRoad company has resulted in the development of a web-based content management system known as Hive which is being marketed globally. HarvestRoad has been named as one of the Deloitte Technology Fast 50 companies for the second year in a row. It is generating exports and job opportunities.

- Keycorp is a leading supplier of electronic commerce solutions, including electronic payment terminals, branch delivery equipment, FlatScreen LCD monitors and smartcard systems. The company operates globally, employing over 800 people worldwide with offices in Australia, Canada, Hong Kong, Japan, UK and New Zealand.

- Moldflow Corporation is a recognised global leader of software for the plastics injection moulding industry. Moldflow's markets are overwhelmingly outside Australia, with 14 main offices overseas including in Japan, Korea, England, Germany, Italy, France and the USA. While planning for global development, Moldflow plans to maintain its technology development base in Australia.

A number of these companies have benefited from the Government support arrangements mentioned earlier.

6. Strategies for demonstrating more effectively to business the benefits of higher private sector investment in R&D

Success in the market place is the primary indicator of the benefit to business of investment in R&D manifested through company growth or listing on the stock exchange, the value of shareholdings etc. The private sector will not be interested in R&D for its own sake unless there are opportunities for commercialisation.

The Government has a range of strategies designed to assist business to invest in R&D. A key Commonwealth measure designed to help raise industry awareness of the benefits of investment in R&D and innovation is the **National Innovation Awareness** initiative. The objective of the $35 million *Backing Australia's Ability* initiative is to promote Australia's economic, social and environmental well-being by raising understanding of the importance of innovation and encourage business decision-making that is based on an informed understanding of the importance of innovation to the long-term success of Australian business; to attract young people into further study and careers based on science, technology, innovation and entrepreneurship; and create a culture that encourages and rewards innovative and entrepreneurial behaviour and appreciates the benefits both to individuals and to the nation of calculated risk taking.

To help develop a strategy that achieves these objectives, the Government established the National Innovation Awareness Council, consisting of eminent business, academic and scientific figures, chaired by David Miles, in June 2001. The Council's Strategy will be important in raising awareness and in helping to stimulate cultural change in the way Australians see innovation and

R&D and their benefits over the next four years. To date, activities have included Promoting Young Entrepreneurs to encourage young people into innovative careers, and competitive grants for innovation awareness raising activities. An example of a successful awareness grant was the staging of the first Innovation Festival across Australia in May this year.

The **Innovation Access Program - Industry** assists industry to innovate more readily by increasing access by Australian researchers and firms to global research and technologies. For example, the recently announced InnovationXchange, established by the Australian Industry Group, with the support of the Program, will assist Australian industry to access information from around Australia and overseas on the latest research and innovations in both hard and soft technologies, education and training resources, commercialisation resources and Government programs.

Another initiative through the Innovation Access Program is the Technology Advisory Service (TAS), which will provide practical access to technology for day-to-day and short-term problem solving to all small and medium enterprises. Another example is the Australian membership in the Intelligent Manufacturing Systems (IMS). This is an industry-led, international R&D program established to develop the next generation of manufacturing and processing technologies.

To facilitate industry access to information about government support, the **Business Entry Point** (BEP) was established under the Government Online Strategy. It provides a consolidated point of online access for business at all levels and areas of government through its website; facilitates the take-up of e-commerce by Australian businesses and the Government's agencies; enables transactions online; and reduces the compliance burden for businesses. As a complement to BEP, Industry Online includes the Department and AusIndustry Internet sites and the AusIndustry hotline. This provides businesses with access to accurate up-to-date information on policy and programs administered by the Department, and information about the Government and its work.

Finding competitive advantage may rely increasingly on collaborative processes, through market-led networks, clusters and other linkages which industry can foster. **Action Agendas** are industry-driven, and aim to position specific industry sectors to realise the opportunities of international markets and new technologies, overcome impediments and barriers, and encourage sustainable economic development and national growth.

Invest Australia is the Australian Government's national investment promotion and facilitation agency. Its aim is to attract productive foreign direct investment into Australia to support sustainable industry growth and development. It promotes Australia as an investment location, facilitates major projects, and provides a wide range of services to companies and foreign investors seeking to establish or expand operations in Australia.

Investment specialists, in key locations around the world, work with Australian staff and State and Territory Governments to market the competitive advantages of investing in Australia and identifying potential investors. Invest Australia also provides continued support to assist companies considering expansion within Australia.

As part of its effort to attract foreign investment, particularly in R&D, Invest Australia’s approach takes into consideration the major drivers of an R&D investment location decision.

An important element of enhancing Australia's capacity for innovation through *Backing Australia’s Ability* has been the agreement of private sector and educational and research institutions to work in partnership with Government. To maintain and improve our innovation and R&D capacity, the continuation of this collaborative work by industry and Government is vital. Partnerships, linkages and clustering are being encouraged by government programs such the cooperative research centres, Building on IT Strengths (BITS) program and major national research facilities.

The States and Territories are active in encouraging partnerships between the public and private sectors to foster innovation. The majority have established Innovation Councils, with membership drawn from the research and education, private and public sectors, to advise the government on promoting public and private innovation, and awareness-raising policies and programs. In 2000-01, State and Territory commitment to R&D was $943 million (or 9.2% of Gross Expenditure on R&D compared with the Commonwealth's 13.9%). Examples of initiatives include:

- The Queensland Industry Development Scheme has provided $8.5 million over three years to help businesses maximise their growth.
- The South Australian Advanced Manufacturing Technology Program, funded at a level of about $350,000 per annum, aims to assist companies applying innovative technologies and techniques to improve effectiveness and efficiency by piloting the introduction of new technologies.
- The Technology and Commercialisation Program ($20 million over fours years), operated by the Victorian Government, is used to stimulate the commercialisation of ideas and the incubation of high-technology businesses. This program is complemented by contestable grants to support strategic private and public sector infrastructure and equipment in priority industry sectors and strategic technologies which amounted to $54 million in 2000.

It is important that adequate incentives are in place to encourage our industries to participate in such opportunities to leverage research outcomes. All too often, there is a wide gap between the cultures of research institutes and industry, and it is only through ongoing communication and alliances that better relationships will be developed. Similarly, Australia needs to take active advantage of the major investments from overseas countries that can contribute to innovation outcomes. Effective marketing of our skills and pro-active participation by overseas industry in Australian centres of excellence will provide major benefits to Australian commerce.

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