SUBMISSION 26

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Department of Innovation
Industry, Science and Research

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Stephen Boyd
Committee Secretary
Standing Committee on Economics
PO Box 6021
House of Representatives
Parliament House
CANBERRA ACT 2600

Dear Mr Boyd

INQUIRY INTO RAISING THE LEVEL OF PRODUCTIVITY GROWTH IN THE AUSTRALIAN ECONOMY

I refer to previous conversations with Mr Damien Ellwood on 7 August 2009 in which we advised that the Department of Innovation, Industry, Science and Research would be providing a submission to the Inquiry.

Our submission provides what we hope the Committee will find to be useful information on innovation as an important lever for productivity growth. We consider innovation through new and better products and methods of production is critical to getting more and more highly valued outputs from any level of inputs. In terms of driving innovation, while acknowledging the role of competitive markets, we believe that innovation capabilities reflected in the research base, skills and managerial capability are also significant drivers.

The submission also highlights the specific importance of research and development and small business (which are specifically covered in the Committee's terms of reference) in contributing to productivity growth.

If you require further information, please contact myself or Damien Ellwood (6276 1336).

Yours sincerely

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Principal Adviser

September 2009

Submission to the House of Representatives Standing Committee on Economics

Inquiry into raising the level of productivity growth in the Australian Economy

Department of Innovation, Industry, Science and Research

SEPTEMBER 2009

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1 Executive summary

Innovation is essential to productivity growth. Innovation does not just happen. It will involve decisions made in both private sector and government sectors to invest time, effort and money in exploring new ideas. From a business perspective, the profit motive and competition will be important drivers of innovation. Similarly, flexibility in the workplace and regulatory environment can facilitate the adoption of new practices and processes.

A key focus of the Department of Innovation, Industry, Science and Research (DIISR) is on a further factor influencing innovation – innovation capability. This comprises the human and knowledge capital as well as infrastructure and institutions that are needed to identify and exploit new products, new processes and new organisational methods. This essentially involves supporting the research and innovation infrastructure and skills base, developing public sector research capability and supporting private sector skills and capabilities, including managerial skills, where there are market failures.

While this area of focus is well recognised in the innovation literature, it is not always linked to productivity. Productivity is more typically linked to microeconomic reform, which overlaps with the competition and flexibility planks of innovation. DIISR recognises that all these factors are not only important but interconnected, with innovation capability being particularly important in generating and exploiting the new ideas needed to sustain productivity growth.

Economic research supports the link between research and development (R&D) and productivity. The Organisation for Economic Co-operation and Development (OECD) has identified that public and private R&D exert significant effects on productivity in Australia. It found that a 1 per cent increase in business R&D led to a long run increase in productivity of 0.11 per cent, with a comparable result of 0.28 per cent for public research. The scale of this is significant against an average annual rate of growth in multi-factor productivity of 0.8 per cent over the last decade.

There is also evidence to suggest that small firm size is an impediment to innovation, not just because it inhibits access to technology and networks, but also because small firms may have less developed management capabilities.

Innovation capabilities have particular relevance to Australia.

- Australia has a large number of small firms. These firms can contribute significantly to our productivity performance, yet because of their size they may face impediments in being able to determine and adopt best practice both in technology and management.
- Some key aspects of our innovation performance, including expenditure on business R&D, the proportion of firms innovating and collaboration between public and private researchers, are low by international standards.
- Australia’s small size and distance from major economic and research centres means that to be world competitive we must have a well developed innovation absorptive capacity and be a skilled importer and integrator of technological developments elsewhere in the world

The Government's innovation statement, *Powering Ideas: An Innovation Agenda for the 21st Century*, includes a range of initiatives designed to support innovation, with a strong emphasis on enhancing innovation capability. It provides new incentives to undertake more R&D in both the public and private sectors. It supports our research capability both in skills and infrastructure through the Super Science Initiative. Also, through the Enterprise Connect program, the Government has established a network to support the capability of small to medium enterprises (SMEs) to operate at best practice.

DIISR considers that through the *Powering Ideas* framework there is a solid platform already in place upon which to build productivity improvements. However, it is important to recognise that the task is not complete. Efforts to enhance productivity cannot stop, as our competitors in the global market are always looking for new ways of enhancing their own productivity and thereby boosting their competitive edge. *Powering Ideas* is a 10 year agenda and in this context DIISR considers as it evolves it could have regard to:

- the need to consider extensions and improvements to the mechanisms to support the adoption of best practice operation, in both technology and management, in SMEs over time, reflecting the lessons learned from the operation of Enterprise Connect;
- that there are benefits in placing support for Commonwealth investment in research infrastructure on a more secure long term footing including funding recurrent as well as capital expenses;
- that to support our innovation goals over time it will be necessary to ensure our universities produce sufficient research graduates - a Research Workforce Strategy is being developed to that end;
- the need for measures to continue to support effective collaborations between business and universities and public sector research agencies;
- that Australia's productivity aspirations are likely to necessitate increasing levels of R&D expenditure over time to at least the OECD average as a reasonable expectation; and
- that innovation in Australia will be supported by an open economic system which facilitates the flow of ideas within the innovation system and the interaction of participants in the Australian innovation system with the rest of the world.

2 The importance of innovation to productivity

2.1 Productivity data

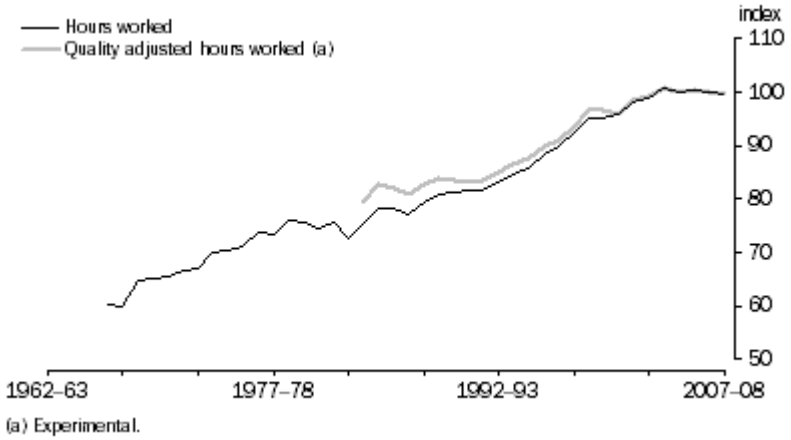
Productivity is a measure of the rate at which units of output of goods and services are produced per unit of input (for example labour, capital and raw materials). Increases in productivity can result from minimising the use of inputs for a given output or maximising output for a given input. The two most frequently used measurements of productivity are: labour productivity and multi-factor productivity (MFP). Labour productivity measures the ratio of real output to labour input, while MFP is a measure

of output to a weighted combination of labour and capital inputs. Sometimes this is referred to as total factor productivity.

At the aggregated level, growth in labour productivity positively correlates with average income growth, while MFP growth reflects improvements in efficiency.

MFP growth has been particularly important for Australia. In 2007, the Productivity Commission indicated that from 1964 to 2005 around 65 per cent of economic growth per capita in Australia could be ascribed to MFP growth.[1] MFP is an indicator of efficiency as it measures how effectively the main factors of production—labour and capital—combine to generate output. MFP growth is of interest because it reflects improvements in efficiency and it can be fostered through investment in innovation, improved management techniques and skills development.

Figure 1. Australia's multifactor productivity, 1962-63 to 2007-08 (2006-07 = 100.0)



Source: ABS, Australian System of National Accounts, 2007-08 (cat. No. 5204 0), p.10

As can be seen from Figure 1, MFP growth has stalled and has declined slightly in recent years. Per capita income has grown during this period due to rising employment levels and improvements in the terms of trade. As noted by the Productivity Commission in its 2007–08 Annual Report, "In the past Australia has benefited from terms of trade increases and increasing labour force participation. However, these factors can not be relied upon in the future for economic prosperity because of changing international circumstance and the ageing of the population".[2]

In the longer term it will be necessary to redress the decline in MFP to support rising incomes over time.

2.2 Drivers of productivity and economic growth

The economics literature argues that long term growth and productivity increases are largely driven by endogenous technical change, where investment in new ideas, including through R&D, and some forms of physical and human capital (such as

[1] Productivity Commission, *Public Support for Science and Innovation*, (2007), p. 110.
[2] Productivity Commission, *Annual Report 2007–08*, p. 5.

infrastructure and education and training) generate positive spill-overs that can be used by other firms and so generate productivity and economic growth.

Similarly, the Productivity Commission indicates that MFP is driven by innovation, which can in turn be driven by "incentives (competition, government assistance and regulation), flexibility (labour arrangements and regulations impacting on production decisions) and capabilities (skilled people, knowledge systems and infrastructure)."[3]

Further, innovation is also critical to economic growth. For example, as noted by the OECD, "developing the innovative effort, including formal research and development, is the sine qua non of growth".[4] The OECD also note that while a stable macroeconomic environment provides the overall basis for growth, key factors such as government policy to foster innovation and enhancing human capital are needed for growth to occur.

Innovation in this context is the implementation of a new or significantly improved product (goods or service) or process, a new marketing method or a new organisational method in business practices, workplace organisation or external relations. Through these changes, more value can be added from a stock of inputs; that is to say productivity is improved.

While innovation is often characterised in different ways for different audiences and purposes, it always involves the creation, flow and/or absorption of ideas. It is the speed and quality of the creation, transmittal and absorption of ideas that facilitates innovation.

2.3 Innovation at the enterprise level

It is important to recognise that innovation and productivity improvements are primarily about change in individual businesses and government enterprises, and it is the collective performance of businesses and government enterprises that underpins Australia's productivity and income.

Innovation depends above all on an enterprise's ability to create, acquire and manage knowledge. For many businesses, success involves developing business opportunities by commercialising new products, processes or services faster than their competitors. Companies can achieve competitive advantage through acts of innovation. This innovation requires deliberate decisions to invest in skills and knowledge, physical assets, brand reputations etc, to add new resources, developing different capabilities or take on new challenges to move beyond what the company is already good at. In this way competitive pressures and the profit motive create the incentive to innovate.

Firm level data indicates that Australian businesses that innovate are more than twice as likely to report increased productivity and 63 per cent more likely to report increased profitability than businesses that don't.[5] The approach taken by a firm to innovate can be proactive (including the development of new sales territories, taking advantage of promising business opportunities, developing new technologies, attaining reputation etc.), or reactive, in response to competitive pressure or overproduction for relevant markets, potentially only revolving around price. It is

[3] Productivity Commission, *Annual Report 2007–08*, p. 16.
[4] OECD, *Innovation and Growth: Rationale for Innovation Strategy*, (2007).
[5] Australian Bureau of Statistics, *Characteristics of Australian Business, 2006–07* (cat. no. 8167.0).

proactive innovation that involves enhancing the stock of knowledge leading to productivity improvements over time. It is this innovation where capabilities of firms may be more important.

Innovation and improvements in performance are not straightforward for many businesses. For example, McKinsey indicates that while innovation has been and is intended to be one of the top corporate drivers of growth in the next three to five years, most executives are disappointed in their ability to stimulate innovation.[6]

Innovation in firms in Australia has been on the increase. In 2007–08 45 per cent of businesses were innovation active and that number is trending up. [7] However, the most recent comparable data from the OECD indicates the proportion of firms innovating in Australia is below the OECD average and well below comparable countries such as Canada, United Kingdom and New Zealand.[8] This OECD data is for 2002–04 so doesn't record any recent increases. It is encouraging to note that Australian businesses reported increased innovation activity levels; however other countries are reporting significant increases in their levels of innovation activity. For example, the United Kingdom reported that the proportion of innovation active businesses had increased from 49 per cent in 2001 to 68 per cent in 2007.[9]

2.4 Absorbing knowledge from the rest of the world

Australia has always been a net importer of foreign technologies, which means that innovation often takes the form of systems integration—combining imported technology, existing knowledge and local problem solving to develop new products and production systems. This pattern is likely to continue due to the relatively small contribution Australia makes to the total global stock of knowledge. For example, Australia produces 3 per cent of the world's formal research and its capacity to innovate depends very much on how effectively the other 97 per cent is harnessed and applied.[10]

Economic openness and competitive markets are important to the flow of ideas. Where openness and competition exist, there will be pressures for firms to operate at, and incorporate, best practice. This does not however guarantee that innovation will occur, as capability is required for absorbing knowledge, techniques and technology, generating knowledge and adapting existing knowledge, and identifying opportunities. In this way some component of a firm's or a country's investment in knowledge will be required to gain the benefit of others' knowledge creation.

Because of Australia's remoteness, the flow of ideas may be affected. Some knowledge and ideas are conveyed in direct personal interaction that is a function of co-location. There is evidence that the increasing importance of personal interaction has meant that the impact of distance on economic growth is increasing in importance.

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[6] J. Barsh, M. Capozzi and J. Davidson, "Leadership and Innovation", *McKinsey Quarterly*, January 2008.
[7] Australian Bureau of Statistics, *Summary of IT Use and Innovation in Australian Business, 2007–08* (cat. no. 8166.0)
[8] OECD *Science, Technology and Industry Outlook 2008*, p. 233.
[9] London: Department for Innovation, Universities and Skills, *Annual Innovation Report 2008*, (2009), p. 3.
[10] Australian Government, *Powering Ideas: An Innovation Agenda for the 21st Century*, (Canberra, 2009), p. 40.

There is also evidence that some technology is local in use rather than global—despite advances in communications—because the benefits from spill-overs in using knowledge decline dramatically with distance.[11]

Given the challenges faced by Australia, it is important that the resources devoted to building innovation capability and linkages are sufficient to allow for the absorption of knowledge from abroad.

2.5 The role of government

The Australian Government plays a critical role in encouraging innovation, both through setting appropriate framework conditions and through more direct assistance measures.

The Government helps to create favourable conditions for innovation by managing the economy responsibly, regulating effectively, and making investments in education, research and infrastructure. It maintains an operating environment which is supportive of business, with the emphasis being on open competition and the free flow of investment, products, people and ideas, both domestically and internationally.

The Government is actively fostering and investing in skills development, another essential component of our innovation framework.

The Government is also active in providing direct incentives to build innovation performance and enhance productivity. The Government:

- provides support in the form of grants and tax incentives to overcome market failures that discourage private investment in innovation, not least the reluctance of financiers to provide capital for innovative but untried products;
- provides support in a limited number of instances for industries to adjust to structural changes in the economy and to facilitate shifting resources for higher productivity and growth in future years;
- provides support for the identification and implementation of innovative changes in business to build internal capacity and capitalise on their growth potential;
- funds vital research - especially basic research -that would not or could not be done by the private sector; and
- is a major provider and consumer of innovative products and services, driving innovation across the economy by demanding new and better inputs from the private sector, and developing new and better ways to deliver its own services, whether in health, education, defence, the administration of justice, or services to business.

The Australian Government is investing $8.58 billion in science and innovation in 2009–10, compared to $6.88 billion in 2008–09 - an increase of 25 per cent. The science and innovation budget was $6.56 billion in 2007–08. A quarter of the Commonwealth's innovation investment goes towards programs that encourage business investment in innovation, including R&D tax incentives. The remainder is

[11] G. Withers, "Can distance be defeated?", in *Competing from Australia*, at ceda.com.au/public/publications/growth/growth_58.html.

shared between the higher education sector, research agencies, and multi-sector initiatives such as the Cooperative Research Centres Program.[12]

The 2009-10 Budget contained several new measures to support *Powering Ideas*: *An Innovation Agenda for the 21st Century*. These include support for world class university research, a Super Science Initiative focusing on national research strengths, a new Research and Development Tax Credit, a new Commonwealth Commercialisation Institute and other measures to boost business innovation. In addition to the Budget package, a number of industry specific incentives were introduced during 2008 (see **Appendix 1** for further details).

The Government has also established a range of on-going consultative and advisory mechanisms to support policy development over time including Industry Innovation Councils, the Innovation Australia Board and the National Research Infrastructure Council.

3 The level of research and development

3.1 How does R&D drive productivity growth?

Economic research has established that R&D is one of the key drivers of long run increases in productivity. R&D leads to the development of new knowledge that can increase the efficiency with which inputs to production such as capital and labour are translated into outputs in the form of goods and services. R&D also has an important second role in developing the capability for absorbing knowledge generated elsewhere as it assists in developing the necessary expertise to understand and assimilate new ideas. The impact of R&D in absorbing knowledge was quantified in a recent International Monetary Fund (IMF) study which found this benefit of R&D to be significant.[13] The evidence that domestic R&D is necessary for absorption of overseas technology undermines arguments that Australia can simply free ride on overseas innovations without focusing on domestic innovative capacity.

The most obvious and recent example of the impacts of R&D can be seen in the development of ICT. In this case R&D led to advances in computing which have allowed increased production with less use of human and physical resources in industries ranging from cars to banking. The impact of R&D can be seen in a number of other examples from advances in agriculture which have increased crop yields to developments in solar and wind power which promise to reduce the use of fossil fuels.

The knowledge produced by R&D drives productivity growth because of its unique characteristics. Unlike other goods, it is difficult to exclude access to information and it can be employed by multiple users at the same time. Knowledge is therefore subject to increasing returns with information generated by organisations or individuals being used and developed by others to create value. This is in contrast to other inputs to production such as capital and land where the addition of more inputs eventually leads to diminishing returns. In this way the accumulation of knowledge over time leads to

[12] *The Australian Government's 2009–10 Science and Innovation Budget Tables* (Canberra: Department of Innovation, Industry, Science and Research, 2009).
[13] T. Treesel, *Does Technological Diffusion Explain Australia's Productivity Performance?* (Washington: IMF, 2008)

a greater understanding of how to produce goods and services with more efficient use of inputs.

Economic theory has long identified that there is a strong link between R&D and productivity growth, but more recently this link has also been demonstrated in practice through analysis of statistical information on R&D using econometric techniques.

A highly influential study which examined this issue was conducted by OECD economists Dominique Guellec and Bruno van Pottelsberghe in 2001. Using data from sixteen OECD countries over nearly two decades (1980–98) the analysis looked at the impacts of private and public R&D on productivity. The findings of this study indicate that there is a relationship between increases in R&D and productivity growth, with a 1 per cent increase in business R&D correlating with a 0.13 per cent increase in multi-factor productivity over the long term. Similarly, a 1 per cent increase in public R&D correlates with a 0.17 per cent increase in multi-factor productivity over the long term.[14] While this figure does not seem large in the context of multi-factor productivity as a whole, the size of the effect is perhaps seen more clearly when comparing it to the average increase in multi-factor productivity of 0.8 per cent a year over a previous ten year period (1997–98 to 2007–08).

The range of multi-country studies investigating the effect of R&D on multi-factor productivity at a macroeconomic level can be seen in **Appendix 2**.

A more recent, multi-country OECD study made findings that related specifically to Australia.

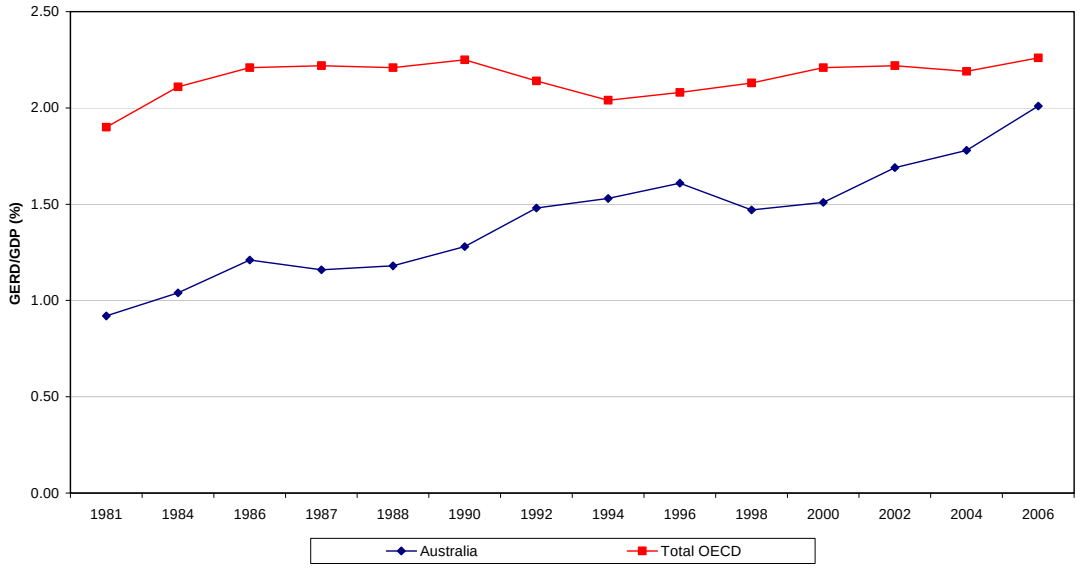
The study found that public and private R&D had significant effects on productivity in Australia. A 1 per cent increase in business R&D would lead to a long run increase in productivity of 0.11 per cent and a 1 per cent increase in public R&D would result in a long run increase in productivity of 0.28 per cent. The impact was far greater than many other factors. The study concluded that knowledge, along with improvements in human capital, was the key driver of productivity growth in Australia and the other countries studied.[15]

3.2 Research and development activity

The level of R&D expenditure in Australia has been growing strongly, rising on average by 9 per cent a year over the last ten years to total $21 billion in 2006-07. This strong growth has seen the intensity of Australia's gross expenditure on R&D (GERD as a share of GDP) increasing over the period 1981 to 2006 to reach 2.01 per cent and gradually converging to the OECD average of 2.23 per cent (see Figure 2).

[14] D. Guellec and V. van Pottelsberghe, *From R&D to Productivity Growth: Do the Institutional Settings and Source of Funds for R&D Matter?* (Paris: OECD, 2001).
[15] M. Khan and K. Luintel, *Sources of Knowledge and Productivity: How Robust is the Relationship?* STI Working Paper 2006/6 (Paris: OECD, 2006).

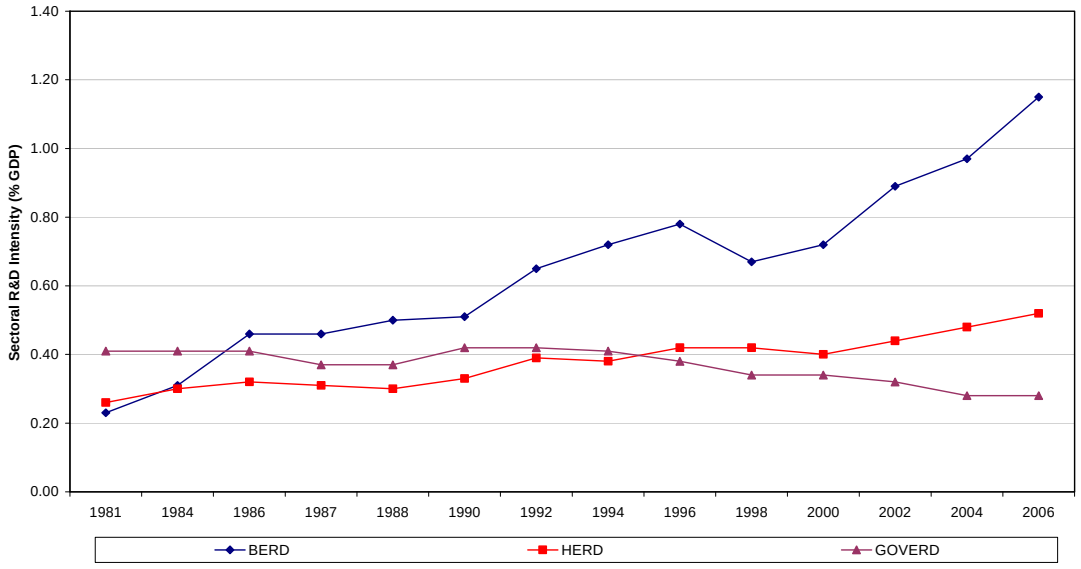
Figure 2. GERD as a percentage of GDP (Australian and OECD average)



Source: OECD Main Science and Technology Indicators, 2009(1); Table 2.

The rise in Australian GERD intensity has been driven mainly by the R&D performed in the business enterprise sector (BERD) and to a lesser extent by the R&D performed in the higher education sector (HERD). The contribution of public research agencies has declined slightly (GOVERD) (see Figure 3).

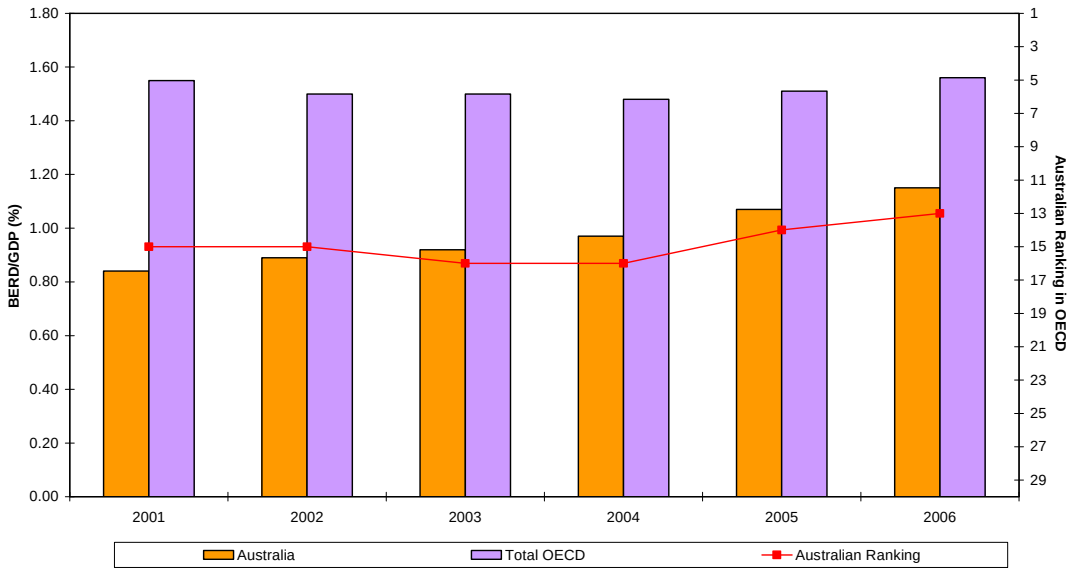
Figure 3. Sectoral contributions to GERD (% GDP)



Source: OECD Main Science and Technology Indicators, 2009 (1); Tables 24, 46 and 53.

While the Australian business sector R&D intensity has been below the OECD average, it is gradually rising closer to the OECD average (Figure 4).

Figure 4. Australian BERD intensity and rankings



Source: OECD Main Science and Technology Indicators, 2009 (1); Table 24

Australia performs relatively better in terms of the combined R&D expenditure by the government and higher education sectors, ranking consistently above the OECD average.

The growth in BERD relative to public sector R&D has seen a greater proportion of Australia's R&D effort on experimental development and applied research than on basic research. While increasing in actual value, the share of basic research in total research has declined from 26 per cent to 22 per cent over the last ten years.

3.3 How public research impacts on productivity

The benefits to productivity from business research are intuitively understood. However, the importance to the economy of basic research is worth noting, with many studies showing high rates of economic return on this research, and many private sector innovations flowing from the research and substantial spill-overs generated. The benefits are generated in a number of ways.

Basic research provides a common stock of useful knowledge. It is a public good that, in codified, or written, form is inexpensive to distribute. This means that firms and other organisations are able to draw on the new ideas developed in public research institutions to develop their own new products and processes. Public research institutions can also stimulate the flow of useful knowledge by acting as access points into the international network of knowledge and new ideas. Because the research sector is dedicated to increasing the common stock of useful knowledge, action to expand its capacity will yield high returns. Evidence for this can be seen in

international research which suggests that up to three-quarters of private sector patents draw on public sector research.[16]

Public research develops trained researchers who have skills, background knowledge, access to networks and experience in using the latest research techniques and equipment that can go far beyond the readily available codified knowledge. This tacit knowledge can provide benefits for employers of researchers, both directly from use of the tacit knowledge, and indirectly through an increase in the absorptive capacity of organisations that allows them to more easily identify and develop ideas in related areas. These benefits are most apparent in emerging scientific areas where the available knowledge is only partially codified.

Development of public research capability and world class research infrastructure can also attract investment from foreign firms and institutions seeking to make use of the available expertise. More broadly, development of human capital expands the learning capabilities of a society and increases our ability to solve complex problems.

A UK government report made the following conclusions relevant to any well functioning university. "The role of universities is crucial. They are powerful drivers of innovation and change. They produce people with knowledge and skills; they generate new knowledge and import it from diverse sources; and they apply knowledge in a range of environments. They are also the seedbed for new industries, products and services and are at the hub of business networks and industrial clusters of the knowledge economy".[17]

The preceding comments focus on the economic benefits of R&D arising from public research activities. However it is important to recognise that there are social and environmental benefits generated by public research that do not show up in productivity statistics. For example, public research can increase our capacity to respond to a variety of environmental challenges, such as sustainable water use, protection of biodiversity, land degradation and soil salinity, and climate change. It can also provide solutions to social challenges such as in the area of health care.

Reflecting these benefits, the Government provided additional funding in the 2009–10 Budget for research infrastructure and to support postgraduate researchers. Investments in these areas will support public sector research capability and should be made on a long term basis having regard to research priorities and trends in the researcher workforce, with a financing base that ensures the investments are sustainable. The latter is important as research infrastructure has both capital and recurrent costs and the supply of graduate researchers is influenced both by direct scholarship support and the funds within universities to support their training.

3.4 The right level of R&D

R&D expenditure in a country will reflect a range of factors including a country's economic structure, features of its national innovation system and the nature of the

[16] F. Narin, K.S. Hamilton, and D. Olivastro, "The Increasing Linkage Between U.S. Technology and Public Science", *Research Policy*, vol. 26 (1997). More generally, see A. J. Salter and B.R. Martin, "The Economic Benefits of Publicly Funded Basic Research: A Critical Review", *Research Policy*, vol. 30 (2001).

[17] *Opportunity for All in a World of Change: A White Paper on Enterprise, Skills and Innovation* (London: Department of Trade and Industry, 2001).

social, economic and environmental challenges it faces. Specific aspects of this will include the share of hi-tech industries in the economy, the use of contracting to business or public research agencies to undertake government R&D and the level of biodiversity of a country. Reflecting this, there is considerable variation in the levels of R&D and the composition between government and business R&D among OECD countries.

The economic literature firmly suggests that in the absence of government support for both private and public R&D, too little will be undertaken. Reflecting this, governments, including the Australian Government, provide extensive support for R&D. The economic literature as yet does not say how much support or what level of R&D is optimal.

Some countries do have particular target levels for R&D.

- The United States has recently announced a target of 3 per cent of GDP for all R&D spending.
- Finland has a target of 4 per cent of GDP for all R&D spending.

In 2002 the European Union set a target of 3 per cent of GDP for R&D for its members to achieve by 2010; however few countries are likely to meet this target.

Australia's level of R&D to GDP at 2.01 per cent is well below these international targets. In *Powering Ideas* the Australian Government set out a range of measures to support innovation that will result in higher levels of R&D expenditure. These measures focus on improving the performance of aspects of the innovation system and channelling funds into particular research priorities, including climate change.

While it does not target a particular level of R&D expenditure, *Powering Ideas* is premised on a view that Australia's existing R&D levels need to be increased.

Some observations relevant to the levels of R&D expenditure required to support long run productivity growth are:

- business research expenditure in Australia, while increasing, remains below the OECD average as a share of GDP;
- challenges faced by our industries in responding to climate change and the pressures of globalisation to move up the value chain are likely to necessitate additional R&D expenditure; and
- the relative lack of large firms, our well established public research institutions and some of the challenges from our size, and biodiversity will necessitate a strong public sector research base.

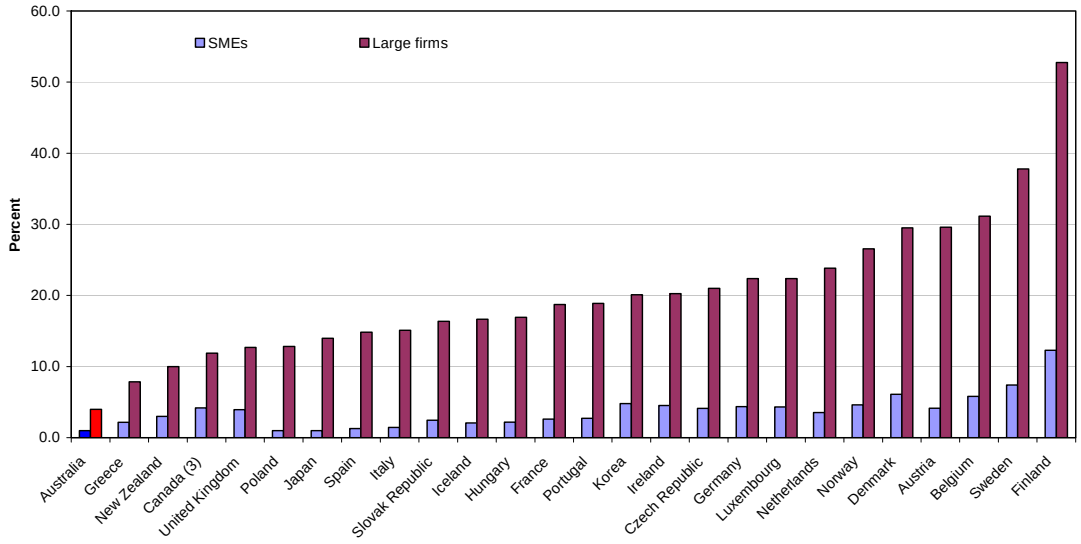
In addition to levels of R&D research, collaboration between firms and between industry and research institutions is a key mechanism to enable firms to access knowledge and to transform it into economic value. *Powering Ideas* emphasised the importance of collaboration to successful innovation given its role in increasing the capacity to absorb knowledge. However, as it also recognised, Australia performs poorly in this area. For example we rank last in the OECD on rates of collaboration between firms and universities (Figure 5).

As underlined by Gary Banks, chairman of the Productivity Commission, in a recent address, "there may be a case for shifting the balance of R&D support more towards promoting collaboration and clustering/networking, rather than paying individual

firms for R&D activity."[18] There is a case for exploring ways in which effective collaborations between business and universities and public sector research bodies can be enhanced.

The application of research in the market place is also a critical part of the innovation system. The 2009–-10 Budget has provided additional support in this area through the Commonwealth Commercialisation Institute. The institute will help commercialise and develop the best ideas developed by our universities and publicly funded research organisations. As such it will make the most of home grown innovations and get the best value for taxpayers' investment. The operational model for the institute is being developed in consultation with industry, the venture capital sector and other financial institutions.

Figure 5. Firms collaborating with higher education institutions on innovation, by size, in 2002-2004



Source: OECD (2007) Science, Technology and Industry Scoreboard 2007 – Innovation and Performance in the Global Economy, p. 77.

[18] G. Banks, Colin Clark Memorial Lecture, Brisbane, 6 August 2008.

4 Small to medium sized enterprises and productivity

Small to medium sized enterprises (SMEs)[19] are the dominant form of business in Australia. There were approximately 1.93 million active small businesses and only 78,000 medium businesses in 2006–07. SMEs represent approximately 99.7 per cent of all businesses. Small business contributed 39 per cent of private industry value added in 2007–08, while medium businesses contributed 22 per cent.

SMEs accounted for 73 per cent of total private sector employment in 2007–08. Small businesses provided employment for 5.1 million people in 2007–08, while medium businesses provided employment for 2.2 million people.

OECD data shows that Australia is more SME intensive compared with key OECD nations. According to the most comparable and comprehensive OECD data available for selected sectors, 98.3 per cent of businesses in Australia were small businesses, compared with 87.4 per cent in the United States and 94.6 per cent in the United Kingdom. [20]

The large number of SMEs in the economy (particularly small businesses) makes it vital that Australia has highly innovative small firms and economic systems that facilitate productivity improvements. In addition, SMEs often provide inputs to larger firms and hence facilitate productivity improvements across the economy.

4.1 SMEs and innovation

ABS survey data presented in Table 1 below highlights that small firms in general innovate less than larger firms. Of businesses employing less than 20 persons, a little over 40 per cent were undertaking innovative activity in 2007–08. While this figure is increasing, it remains well below the 60 per cent for larger firms.

[19] The official ABS definition of a small business by employment size is a business with 0–19 employees, while the official ABS definition of a medium business is a business with 20–199 employees. Under some circumstances, turnover ranges can also be used to define the size of a business.

[20] Structural and Demographic Business Statistics (SDBS), OECD government officials site.

Table 1. Summary of innovation activity in Australian business by size - 2007-08

			Businesses with innovative activity which was:		
	Estimated number of businesses	Businesses with introduced or implemented innovation (innovating businesses)	still in development	abandoned	Businesses with any innovative activity (innovation-active businesses)
	'000	%	%	%	%
Employment size					
0–4 persons	451	31.6	17.9	5.7	37.0
5–19 persons	197	49.8	28.6	9.4	56.1
20–199 persons	60	60.0	35.5	8.4	65.9
200 or more persons	3	65.9	46.2	6.8	70.8

Source: ABS Cat. No. 8166.0

There is no right level of innovation and there may be instances where SMEs, because of their size or the nature of their business, have less scope to innovate. That said, the difference in innovation is significant and there are many reasons to believe SMEs may under-invest in innovation.

- The OECD noted in its Science, Technology and Industry Scoreboard, which brings together internationally comparable indicators to explore the progress of national innovation strategies, that: "In almost half of the countries surveyed, 40 per cent or more of all large firms had developed an in-house product innovation. Among SMEs, the share developing in-house product innovations exceeded 20 per cent in only around one-third of the countries."[21]
- The OECD says that it can be difficult for SMEs to access and make effective use of the risk management skills needed for innovation, as well as capital, technology, education and vocational training, quality business organisational forms, marketing skills and software.[22]
- The OECD also says that SMEs can be deterred from investing in employee training because other employers will capture the training benefits if employees change jobs.[23]
- A study from the Queensland Business School compared Australian manufacturers' innovation practices against European peers and identified shortcomings in the management of product development and in business models. The study found little evidence of investment in advanced technologies for product design, or for techniques for organising new product development, effective linkages with innovation-demanding customers, or the packaging of services around product offerings. While not

[21] OECD *Science, Technology and Industry Scoreboard 2007*.
[22] *Industrial Performance and Competitiveness in an Era of Globalisation and Technology Change (DSTI/IND(97)23/Final*) (Paris: OECD, 1998).
[23] *SME and Entrepreneurship Outlook 2005* (Paris: OECD, 2005), p. 78.

specifically focussed on SMEs, the study has relevance as the majority of manufacturing firms are SMEs.[24]

Innovation involves investment either in acquiring or developing knowledge. SMEs may face information difficulties around their limited awareness of the technological possibilities as well as business opportunities. This limited awareness can be accentuated by high search costs and the need to access external sources of information. Small firms may lack resources to absorb that knowledge and to build their own innovative capacity. Also, SMEs may lack the systems and corporate structures to implement new technologies and best practice.

4.2 Addressing the SME capability gap

Enterprise Connect is a $50 million a year program to provide comprehensive support to small and medium sized enterprises. It is an entry point to upgrade and connect to the best technologies and research available and to obtain professional advice on business and organisational models.

Enterprise Connect operates through six manufacturing centres and six innovation centres and a network of almost 100 business advisers. It provides business reviews to firms which include analysis of business strategy, the external business environment, internal business operations and technology requirements. To date the main areas of focus of business reviews have been on human resources and business strategies.

SME access to technology is also supported through the Small and Medium Enterprise Engagement Centre (SME-EC) in the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The SME-EC helps SMEs define technical issues and the appropriate ways to address them. Where relevant, it develops research programs to meet businesses' needs.

The Government's programs to encourage research and innovation in business more generally have an emphasis on supporting SMEs. Changes to the R&D tax concession announced in the 2009-10 Budget have increased the support available to SMEs undertaking research. There are also a range of venture capital programs that support the commercialisation of research by SMEs. These programs do support capability building within the firms by developing the management and entrepreneurial skills of researchers and building links and shared knowledge with the finance and business community to exploit technology-based business opportunities.

It is important these SME support programs focus on meeting genuine SME needs and evolve as these needs change. The Innovation Australia Board and the various Enterprise Connect Advisory Boards monitor the performance of the programs and provide expert independent advice to Government to ensure ongoing relevance and value for money as well as the evolution of these programs to meet the changing business environment.

It is of interest that initial results from Enterprise Connect have highlighted that management capability within small firms, not technological capability, is the main limiting factor to successful innovation - and thus productivity improvement. Enterprise Connect findings suggest that unless firms are operationally sound (e.g.

[24] Prof. Dodgson and Dr. Innes, *Australian Innovation in Manufacturing: Results from an International Survey* (Brisbane: University of Queensland Business School, 2006), p. 4.

have a coherent strategy, good human resource practice, formalised systems, sensible financial management etc.) they may struggle to effectively scope, develop, and take new products and services to market. The management systems and approaches in many Australian SMEs - even those that would be classed as medium sized firms - can be fairly rudimentary. Enterprise Connect concludes that most of its clients could lift their productivity by improving the way they plan and manage strategy, continuity, business operations, human resources, finance and production.

5 Strong economic fundamentals as a driver of productivity

Several studies have shown the importance of strong economic fundamentals in fostering productivity and economic growth in Australia over recent decades. Australia was one of only three OECD countries to experience a strong acceleration in productivity in the 1990s. The main reasons for this appear to be a combination of microeconomic reform and sound macroeconomic management, openness to trade, investment and ideas, and well functioning economic and social institutions.[25]

5.1 Gains from greater openness of the economy

Australia's economy is increasingly integrating with other economies. The Productivity Commission estimates that from the mid-1980s, Australia's annual productivity growth from increased openness of the economy was about 0.5 per cent.[26] The IMF has come to similar conclusions.

Increased openness can contribute to increased productivity and economic growth by putting pressure on firms to be more innovative in the marketing of products and services, and in the way they organise their business. Openness can also encourage firms to enter foreign markets and to seek access to global supply chains. This can lead to specialisation of labour, greater economies of scale and access to knowledge spill-overs from technology embodied in capital goods.

In the past, Australia's distance from other markets has greatly limited productivity and economic growth. This disadvantage has been reduced by greater openness and lower transport and communications costs, although it remains an important factor.

Australia's remoteness from major markets and small size largely contributes to the difference in productivity with the US.[27] The OECD has estimated that Australia's remoteness and small size reduces its GDP by as much as 10 per cent.

5.2 Firm creation and entrepreneurship

The entrepreneurial capital of a society covers both economic and social factors, including the willingness of the financial system to support entrepreneurs, regulatory

[25] G. Banks, "Micro Reform's Productivity Payoff", *The Australian*, 18 February 2002.
[26] D. Parha, "Sources of Australia's Productivity Revival", *The Economic Record*, Vol. 80, No. 249, 2004.
[27] B. Battersby et al., *International Trade Performance: The Gravity Model of Australia's Remoteness*, (Canberra, Department of the Treasury, 2006); B. Battersby, *Does Distance Matter? The Effect of Geographic Isolation on Productivity Levels* (Canberra, Department of the Treasury, 2006).

and administrative environments, education and training, as well as cultural and social issues. In countries where entrepreneurial activity is low, government regulations and cultural and social considerations act as constraints.[28]

Entrepreneurship represents a critical link between innovation, R&D and economic growth, as it facilitates the transfer of knowledge between the organisations that create knowledge and new firms that can apply it. An environment that encourages entrepreneurship and the creation of new firms also provides the means by which knowledge and ideas can be turned into new goods and services. Entrepreneurship also encourages diversity and increased competition between firms, which provides the best conditions for the knowledge spill-overs endorsed by the endogenous growth theory.

Regulations and compliance costs play a significant role in the desire and ability of entrepreneurs to create new firms. The Productivity Commission estimates that at least a quarter of the compliance burden is unnecessary to meet the policy objectives of the regulation. The commission also estimates that such compliance may cost up to 4 per cent of GDP, i.e. around $40 billion a year.[29]

5.3 Infrastructure

Infrastructure is a critical input to business activity. Infrastructure is provided in many forms, including transport and communications networks, and energy generation and distribution networks. Infrastructure can raise productivity in the economy if the infrastructure industries provide their services more efficiently and if the provision of infrastructure services in turn enables firms and industries using the infrastructure to improve their productivity.

Improved telecommunications infrastructure is the basis for a range of innovations and resultant productivity gains. The availability of an advanced telecommunications infrastructure enables innovations such as flexible manufacturing systems, just–in–time management systems, distributed data networks, advanced services, improved intra- and inter-corporate information flows, greater access to customers and faster flows of information inputs to innovation.

National Competition Policy (NCP) reforms have seen governance and structural reforms to government business suppliers of infrastructure services to make them more commercially focussed and expose them to competitive pressure; third-party access reforms to essential infrastructure services and, more generally, to guard against overcharging by monopoly service providers, especially in the infrastructure area; and a process for reviewing a wide range of legislation. The NCP also incorporated previously agreed reform programs for the electricity, gas, water and road transport sectors.

While NCP reforms are now largely complete, DIISR's research indicates that there remain opportunities in infrastructure services where productivity improvements can be attained.

[28] K. Kukoc and D. Regan, "Measuring Entrepreneurship", *Treasury Economic Roundup*, Summer 2008, www.treasury.gov.au/documents/1352/PDF/02_Entrepreneurship.pdf.
[29] Productivity Commission, *Potential Benefits of the National Reform Agenda*, 2007, p. 351.

For example, DIISR has been investigating the land-side supply chain element of Australia's five main container ports. For businesses that export and import through these ports, efficient port services and associated supply chains are crucial to their international competitiveness. DIISR undertook some initial consultations with stakeholders about the opportunities and challenges in providing efficient sea freight supply chains to support business competitiveness now and in the future. This confirmed that there are concerns about inefficiencies in the land-side freight supply chains, which it is estimated impose millions of dollars per year of unnecessary costs on businesses.

More data is needed in order to understand the scale of the problems. To help collect this data and to facilitate any necessary reforms, DIISR recently commissioned two pilot studies to obtain data about inefficiencies in the land-side supply chain corridors for two of Australia's major container ports, Sydney and Melbourne. DIISR is investigating whether there is a need for the further work in this area.

6 Forward agenda

If Australia is to improve its productivity, the nation needs to perform more proactive innovation to overcome challenges relating to our industry structure and isolation. This may include continuing to extend Australia's R&D capability, the interaction between research institutions and business, and SME capability for improved productivity.

Recently, the Australian Government has committed significant resources to improving Australia's innovation performance. In recognition that resources are finite, the Australian Government has adopted seven National Innovation Priorities to focus the production, diffusion and application of new knowledge. All of these priorities are equally important. They address the country's long-term weakness in business innovation, and in collaboration between researchers and industry. The National Innovation Priorities listed below complement Australia's National Research Priorities, which help focus public-sector research.

> Priority 1: Public research funding supports high-quality research that addresses national challenges and opens up new opportunities.
>
> Priority 2: Australia has a strong base of skilled researchers to support the national research effort in both the public and private sectors.
>
> Priority 3: The innovation system fosters industries of the future, securing value from the commercialisation of Australian research and development.
>
> Priority 4: More effective dissemination of new technologies, processes, and ideas increases innovation across the economy, with a particular focus on small and medium-sized enterprises.
>
> Priority 5: The innovation system encourages a culture of collaboration within the research sector and between researchers and industry.
>
> Priority 6: Australian researchers and businesses are involved in more international collaborations on research and development.

Priority 7: The public and community sectors work with others in the innovation system to improve policy development and service delivery.

DIISR considers that *Powering Ideas* provides a solid platform upon which to build productivity improvements. However, it is important to recognise that the task is not complete. Efforts to enhance productivity cannot stop as our competitors in the global market are always looking for new ways of enhancing their own productivity and thereby boosting their competitive edge.

DIISR notes that *Powering Ideas* is a ten-year agenda. Areas where it may evolve include:

- the need to consider extensions and improvements to the mechanisms to support the adoption of best practice operation in SMEs over time, reflecting the lessons learned from Enterprise Connect;
- placing support for Commonwealth investment in research infrastructure on a more secure long term footing, including funding recurrent as well as capital expenditure;
- consideration of the outcomes of the research workforce strategy that is being developed to ensure our universities produce sufficient research graduates to support our innovation goals;
- the need for measures to continue to support effective collaboration between business and universities and public research agencies;
- increasing levels of R&D in the medium term to at least the OECD average as a reasonable expectation in order to meet our productivity aspirations; and
- that innovation in Australia will be supported by an open economic system which facilitates the flow of ideas within the innovation system and interaction of participants in the Australian innovation system with the rest of the world.

APPENDIX 1

2009-10 Budget and other measures to support productivity through innovation

More support for world-class university research

- $512.0 million for the *Sustainable Research Excellence in Universities* initiative to help address the gap in funding for indirect research costs (augmenting and reforming the Research Infrastructure Block Grants Scheme, and more than doubling the level of support over time);

- a new *Joint Research Engagement* program, replacing the Institutional Grants Scheme, to support research between universities, industry and end users;

- $52.0 million to establish *Collaborative Research Networks*;

- $51.7 million to increase the *Australian Postgraduate Award* stipend by over 10 per cent from $20,427 in 2009 to $22,500 a year in 2010;

- $35.8 million for Excellence in Research for Australia, which will guarantee the quality of Australian research and ensure that Australian taxpayers get value for money; and

- $51.6 million to replace the current inadequate indexation arrangements for research block grants from 2012 with an index that better recognises the cost pressures on Australian universities.

A new Super Science Initiative to explore the knowledge frontier

- $160.5 million for *Super Science: Space and Astronomy* – to reinforce Australia's leadership in a field that inspires us with wonder and delivers practical applications for a growing international market;

- $387.7 million for *Super Science: Marine and Climate* – to tackle the most pressing environmental challenges of our time and unlock the hidden wealth of Australia's vast ocean territory;

- $504.0 million for *Super Science: Future Industries* – to support research infrastructure for biotechnology and nanotechnology, including the supercomputing capacity needed to deliver cutting-edge research in the 21st century;

- $27.2 million for 100 new *Super Science Fellowships* for early-career researchers; and

- an extra $11.3 million in support for Questacon to strengthen and improve its science and education facilities and boost its highly successful outreach and communications program.

Infrastructure

- the $802.0 million in new funding for universities and research organisations under Round Two of the *Education Investment Fund*, including $321.7 million for research infrastructure, which complements the $1.58 billion the Rudd Government has invested in university infrastructure since early 2008;

- $400.0 million under the *Clean Energy Initiative* to ensure that Australia continues to build its research and development capacity in the critical area of clean energy generation; and

- establishing a new National Research Infrastructure Council to coordinate future infrastructure investment policy.

More support for Australia's business innovators

- access for business to an estimated $1.4 billion per year through a simpler tax incentive for R&D, by replacing the current R&D Tax Concession with a Tax Credit – doubling the level of support for innovative small businesses;

- $65 million for a transitional R&D tax measure, to support high technology start up firms during the global downturn by increasing the R&D expenditure limit for the R&D Tax Offset from $1.0 million to $2.0 million for 2009-10;

- $196.1 million for an innovative Commonwealth Commercialisation Institute to help translate great ideas into products and services;

- a retargeted *TCF Innovation Package* to renew the textiles, clothing and footwear sector, with an extra $55.0 million to support innovation, including $10.0 million in new funding (from 2010-11 to 2014-15);

- $14.7 million to continue the successful *Support for Industry Service Organisations Program* to underpin the work of Standards Australia and the National Association of Testing Authorities; and

- the reallocation of $83.0 million, announced in March 2009, for the *Innovation Investment Follow-on Fund* to support companies relying on early-stage venture capital funding, in an environment where capital for high-risk sectors has dried up.

Specific industry initiatives

- The *Re-tooling for Climate Change* program ($75million over 4 years) will help small and medium sized Australian manufacturers reduce their environmental footprint, through projects that improve the energy and/or water efficiency of their production processes.

- The $1.3 billion *Green Car Innovation Fund* which will provide assistance over ten years, commencing 2009-10, to Australian companies for projects that enhance the research and development and commercialisation of Australian technologies that significantly reduce fuel consumption and/or greenhouse gas emissions of passenger motor vehicles.

- The *Automotive Competitiveness and Investment Scheme (ACIS)* which has been introduced to guide the development of the automotive industry. *ACIS* rewards production, investment and research and development through the quarterly issue of import duty credits to registered participants.

APPENDIX 2

Results from multi-country macroeconomic studies on the economic effects of R&D on productivity[30]

Study author and date	Economic Impacts of a 1% increase in R&D on productivity/GDP per capita
Coe and Helpman (1995)	0.247 for G7 and 0.107 for others. Study of 22 countries which looked at impact of private R&D on MFP.
Van Pottelsberghe and Lichtenberg (2001)	0.087 for G7 and 0.008 in small countries. Study of 13 countries which looked at impact of private R&D on MFP.
Lichtenberg and Van Pottelsberghe (1996)	0.083 for G7 countries and 0.017 in small countries. Study of 13 countries which looked at the impact of private R&D on MFP.
Luintel and Khan (2003)	Average of 0.27 for all R&D and 0.06 for business R&D. Study of 10 countries from 1965–1999 which looked at impact on MFP.
Guellec and Van Pottelsberghe de la Potterie (2001)	Average of 0.132 for business R&D and 0.171 for public R&D. Study of 16 countries from 1980–1998 which looked at impact on MFP.
Aiginger and Frank (2004)	0.22 for business R&D. Study of 21 OECD countries from 1970–1999 which looked at impact on long run GDP per capita.
Bassanini and Scarpetta (2001)	0.14 for all R&D and 0.13 for private R&D. Study of 16 OECD countries from 1981-1998 which looked at impact on GDP per capita
Luintel and Khan (2005b)	0.048 for US to 1.102 for Ireland. Study of 19 countries from 1981–2000 which used patent data to assess impact on MFP.
Luintel and Khan (2006)	0.11 for business R&D and 0.28 for public R&D (Australia). Study of 16 OECD countries from 1980–2002 which broke down impact on MFP for each country. Country averages were 0.17 for business R&D and 0.21 for public.
Gans and Hayes (2007)	0.11 for Australia for Business R&D (MFP)

Also, the Productivity Commission conducted a study on the impact of R&D on productivity in the Australian context in 2006. The analysis concluded that it was not possible to demonstrate a link due to inadequacies in the measurement of R&D and the absence of a stable long run relationship between R&D and productivity which resulted from shocks in the late 1980s and 1990s caused by microeconomic reforms.

[30] "Public Support for Science and Innovation", Productivity Commission, Canberra, Australia, 2007

The PC didn't say there was not a link, but that one could not be found due to the constraints identified above. In this context it is interesting to note the Australian findings of the 2006 OECD multi-country study by Khan and Luintel mentioned in the table above. In its 2007 *Review of Public Support for Science and Innovation*, the Commission said that this study represents the best existing empirical analysis of the role of different types of R&D on economic growth.