Chapter 3

The Economics of Innovation and R&D

Innovation and productivity

3.1 The earliest models of economic growth focused on two inputs: labour and capital. When these models were confronted with data, it was soon evident that output grew faster than these inputs. The difference represents productivity improvements which make better use of the inputs.

3.2 As the Nobel prize-winning economist Paul Krugman put it:

> Productivity isn't everything, but in the long run it is almost everything.[1]

3.3 The importance of multi-factor productivity (MFP) growth to the Australian economy was quantified by the chair of the Productivity Commission:

> …over the past four decades MFP growth had 'directly accounted for over one-third of total real income growth in Australia…'[2]

3.4 The main influence that government can have on productivity growth is to:

> …facilitate aggregate productivity growth by maintaining a stable economic environment which fosters competition between firms and flexibility within workplaces. Australian governments also have an important role in capability building by providing firms with access to appropriate public infrastructure and investing in the quality of Australia's workforce..[3]

3.5 Productivity improvements can result from innovation, which has been found to be a key contributor to economic growth:

> Professor Robert Solow, from MIT, was awarded the Nobel Prize in economics in the eighties for demonstrating that technical progress had a far, far greater impact on driving economic prosperity and growth than, indeed, labour and capital together. Technical innovation is absolutely key.[4]

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1 Cited by House of Representatives Standing Committee on Economics, *Inquiry into Raising the Productivity Growth Rate in the Australian Economy*, April 2010, p. 14.

2 House of Representatives Standing Committee on Economics, *Inquiry into Raising the Productivity Growth Rate in the Australian Economy*, April 2010, p. 19.

3 House of Representatives Standing Committee on Economics, *Inquiry into Raising the Productivity Growth Rate in the Australian Economy*, April 2010, pp iii-iv.

4 Dr Christopher Roberts, Cochlear, *Proof Committee Hansard*, 21 May 2010, p. 11.

> Productivity through innovation will be the key to our future competitiveness.[5]
>
> We have known for several generations that innovation pre-eminently determines our prosperity.[6]
>
> Innovation is critical to Australia's growth and its preparedness for emerging economic, social and environmental challenges.[7]

R&D and innovation

3.6 R&D is a primary driver of innovation:

> …research and development undertaken by business drives primary improvements in its productivity…[8]
>
> R&D is a major part of the inovation system.[9]

3.7 It is not, however, the only driver:

> Finally, another aspect of innovation which is often overlooked is the non-R&D, non-public research element of innovation and that is organisational innovation—what needs to happen to improve the management of our organisations to achieve productivity growth.[10]
>
> R&D is only one input into the innovation process. Innovation…encompasses a vast array of activities in the economy, including workforce skills, management, venture capital, technology uptake, work re-organisation and R&D….measures of R&D and innovation are not strongly correlated.[11]

International comparison of Australia's R&D

3.8 The Australian Bureau of Statistics defines R&D, in accordance with the OECD standard, as:

> …creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.[12]

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5 Professor Roy Green, *Proof Committee Hansard*, 21 May 2010, p. 18.

6 *Venturous Australia*, 2008, p. vii.

7 Productivity Commission, *Public Support for Science and Innovation*, 2007, p. 7.

8 Mr Innes Willox, Australian Industry Group, *Proof Committee Hansard*, 21 May 2010, p. 2.

9 Productivity Commission, *Public Support for Science and Innovation*, 2007, p. xvii.

10 Professor Roy Green, *Proof Committee Hansard*, 21 May 2010, p. 18.

11 G Davis and G Tunny, 'International comparisons of research and development', *Economic Roundup*, Spring 2005, pp 74-77.

12 ABS, *Research and Experimental Development, Businesses 2007–08*, cat. no. 8104.0, p. 32.

3.9 In R&D spending relative to GDP, Australia ranks around the middle of the OECD economies (Table 3.1). Perceptions of its spending on R&D place it lower and legislation is not seen as supportive (Table 3.2).

3.10 There is debate about whether this is too little. Michael Johnson Associates submitted that business expenditure on R&D 'has remained too low in Australia compared to our OECD neighbours'.[13]

3.11 The Australian Industry Group was concerned:

> Australia continues to lag behind the OECD average on business expenditure on research and development.[14]

3.12 The Committee heard concerns that Australia's share of global R&D is dropping:

> We know that R&D globally is growing but we no longer are taking as much share of the global R&D as we were formerly. That investment, as we have said, is going to India, China and other countries. [15]

3.13 The Productivity Commission is more sanguine:

> Real R&D in Australia has been growing quite strongly since the mid-1970s but growth has been particularly strong in the 2000s…[16]

3.14 A number of countries have targets for overall R&D (business plus government and higher education). These targets are mostly 3-4 per cent of GDP, well over Australia's current level of 2 per cent.[17]

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13 Michael Johnson Associates, *Submission 5*, Attachment B, p. 7.

14 Mr Innes Willox, Australian Industry Group, *Proof Committee Hansard*, 21 May 2010, p. 2.

15 Ms Deborah Monk, Medicines Australia, *Proof Committee Hansard*, 20 May 2010, p. 9.

16 Cited by House of Representatives Standing Committee on Economics, *Inquiry into Raising the Productivity Growth Rate in the Australian Economy*, April 2010, p. 49.

17 House of Representatives Standing Committee on Economics, Finance and Public Administration, *Australian Manufacturing: Today and Tomorrow*, July 2007, pp 140; ABS, *Research and Experimental Development, All Sector Summary, Australia, 2006-07*, cat. no. 8112.0.

Table 3.1: Business R&D: International Comparison

	Business spending on R&D		Business enterprise researchers
	% to GDP 2007-08	% to value added in industry 2006	per thousand employed in industry, 2006
Japan	2.7	3.7	11
Sweden	2.7	4.6	13
Korea	2.7	3.6	8
Finland	2.5	4.0	13
United States of America	1.9	3.0	11
Germany	1.8	2.8	6
France	1.3	2.3	6
Singapore		2.0	7
Australia	**1.3**	**1.7**	**3**
United Kingdom	1.2	1.7	4
Canada	1.1	1.6	7
Netherlands	1.0	1.6	5
Norway	0.9	1.2	7
Spain	0.7	1.0	3
Italy	0.6	0.9	2
New Zealand	0.5		3
Total OECD	1.6	2.4	6

Sources: ABS, *Research and Experimental Development, Business 2007-08*, cat. No. 8104.0; OECD, *Main Science and Technology Indicators*, 2009/2.

Table 3.2: Global opinion of business research and development (rankings)

	Companies spend heavily on R&D relative to international peers, 2007	Scientific research is supported by legislation, 2008
Switzerland	1	2
United States	2	7
Japan	3	17
Germany	4	10
Sweden	5	5
Korea	6	36
Finland	9	11
Singapore	10	1
United Kingdom	12	25
Netherlands	13	15
France	17	18
Norway	19	23
Canada	21	3
Hong Kong	23	28
Australia	**25**	**13**
New Zealand	38	12
Spain	48	40

Sources: World Economic Forum; IMD *World Competitiveness Yearbook 2008*.

3.15 On the other hand, there are both statistical and conceptual arguments that Australia spending a smaller proportion of GDP on R&D than other countries may not constitute a problem at all.

3.16 A study by Treasury economists pointed out:

> While business expenditure on R&D in Australia appears relatively low, this is, to a significant extent, a result of Australia's industry structure.[18]

3.17 The Productivity Commission reached a similar conclusion:

> After adjusting for Australia's differences in industry composition (which affects R&D intensity) business R&D intensity is now 3rd amongst 20 key OECD economies…[19]

3.18 Compared to other high-income countries Australia has a smaller share of R&D-intensive industries such as advanced manufacturing (eg aerospace and pharmaceuticals). The Treasury economists cite another study which suggests that this is part of an international pattern:

> A country's R&D intensity is largely a reflection of its industrial structure. Countries with high R&D intensities have a high share of their business R&D and a significant part of their economic output in high-technology sectors. In Finland, Germany, Japan, Switzerland and the United States, these industries account for three-quarters or more of business-performed R&D. In low R&D-intensity countries, such as Norway and Australia, high-technology industries (and medium-high technology industries) account for less than 40 per cent — a fact that can be attributed to the natural resource endowments that these countries enjoy that affects their industrial structure.[20]

3.19 The conceptual argument is put by the Productivity Commission:

> …comparisons of input ratios are usually a conceptually unsound basis for assessing optimal investment in R&D. Nothing says that 'high' input ratios are necessarily better than 'low' ones, since it is possible to both under- and over-invest in R&D. For most other inputs – such as labour or capital – the usual interest is not in maximising inputs per output, but rather maximising its inverse (output per input or productivity).[21]

3.20 On this argument, Australia is performing well:

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18 G Davis and G Tunny, 'International comparisons of research and development', *Economic Roundup*, Spring 2005, p. 63.

19 Cited by House of Representatives Standing Committee on Economics, *Inquiry into Raising the Productivity Growth Rate in the Australian Economy*, April 2010, p. 49.

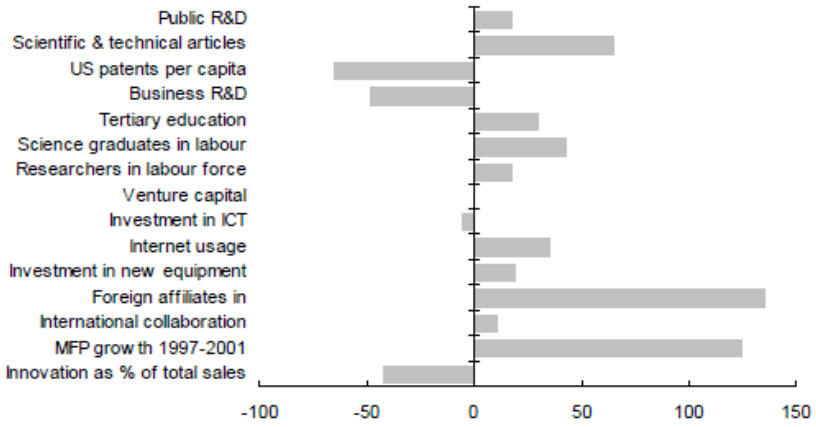
20 J Sheehan and A Wyckoff, 'Targeting R&D: economic policy implications of increasing R&D spending', *STI Working Papers*, no. 2003/8, OECD: Paris.

21 Productivity Commission, *Public Support for Science and Innovation*, 2007, p. 43.

> Australia has a high R&D productivity [which means that] we get a lot of output for less R&D.[22]

3.21 Another reason for a more optimistic view is that, as argued above, R&D is valued for its role in stimulating innovation, and Australia's innovation performance is better than its business R&D would imply (Chart 3.1).

Chart 3.1: Australia's innovation performance compared with OECD average
(percentage difference)



Source: G Davis and G Tunny, 'International comparisons of research and development', *Economic Roundup*, Spring 2005, p. 78.

3.22 Distinguishing between components of R&D, Treasury economists found that Australian businesses do similar amounts of 'basic research' to their international peers, less 'applied research' and much less 'experimental development'.[23] As a House Economics Committee report said:

> This view that Australians are better at inventing than commercialising agrees with anecdotal evidence. Australians invented the atomic absorption spectrophotometer, the black box flight recorder and the orbital engine but all were commercialised overseas.[24]

3.23 Some submissions made a similar point:

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22 Mr Gary Banks, Chair, Productivity Commission, cited in House of Representatives Standing Committee on Science and Innovation, *Riding the Innovation Wave: the Case for Increasing Business Investment in R&D*, June 2003, p. 12.

23 G Davis and G Tunny, 'International comparisons of research and development', *Economic Roundup*, Spring 2005.

24 House of Representatives Standing Committee on Economics, Finance and Public Administration, *Australian Manufacturing: Today and Tomorrow*, July 2007, pp 141-2.

> This "Experimental Development" phase of R&D has long been recognised as the step that Australia is poor at…[25]
>
> Australia is great at inventing. Commercialising new ideas is where the assistance of the tax credit is vital to improving its success rate and productivity.[26]

Australia as a base for R&D

3.24 The Committee heard that Australia's advantages as a venue for R&D are being eroded:

> Australia is home to some of the world's best medical researchers and healthcare professionals. We know that it has world-class research infrastructure, a stable socioeconomic environment, a strong intellectual property system and an efficient regulatory system…But these factors alone are no longer sufficient to stimulate investment growth. There are several reasons for this. The most important among them is the rapid transformation of developing nations in Asia, South America and Eastern Europe as viable destinations for long-term investment in research and development…We all know that India and China have made incredible progress in the past 10 years, not only in terms of their economic development but also as locations for clinical research. We know that countries like Poland, Hungary and even Russia have rapidly emerged from the shadows of the Cold War to become vibrant and progressive members of the world community. While we may marvel at the speed of their success, we should also be worried about the impact this has on Australia, and be particularly worried because, while Australia remains an attractive location for R&D investment for our industry, other countries are now looking even more attractive. Australia is already beginning to attract less biopharmaceutical industry investment in clinical research.[27]

3.25 There may be benefits in keeping R&D within Australia:

> We are assisting to keep those brightest and best minds here in Australia.[28]

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25 Michael Johnson Associates, *Submission 5*, Attachment B, p. 4.

26 KPMG, *Submission 9*, p. 13.

27 Dr Brendan Shaw, Chief Executive Officer, Medicines Australia, *Proof Committee Hansard*, 20 May 2010, p. 2.

28 Ms Deborah Monk, Medicines Australia, *Proof Committee Hansard*, 20 May 2010, p. 8.

Alternative views on R&D assistance

3.26 A recent survey concluded:

> …few countries have undertaken rigorous cause and effect modelling of public policies designed to boost productivity growth.[29]

3.27 As an example of conflicting views, two UK studies reached differing conclusions about the effectiveness of R&D tax incentives:

> Our results tentatively suggest that government innovation policy should focus on direct spending on innovation, specifically funding for research councils, rather than through tax incentives to firms.[30]

> We find evidence that tax incentives are effective in increasing R&D intensity…a 10% fall in the cost of R&D stimulates just over a 1% rise in the level of R&D in the short-run, and just under a 10% rise in R&D in the long run.[31]

3.28 An international comparison by two Treasury economists did not find any evidence that companies in countries with more generous tax concessions do more R&D.[32] Interpreting this lack of correlation is problematic. It could be that R&D assistance is just ineffective in raising R&D. Alternatively, the causation could be running the other way: countries where R&D is low spend more than countries where it is already high, and this inverse correlation offsets any positive correlation.

3.29 One body which did conduct an analysis of the role of R&D tax concessions is the Department of Industry, Tourism and Resources. Their 2007 study concluded:

> The R&D Tax Concession has a strong overall impact on firm behaviour both *during* the project and *after* its completion. There were few firms surveyed that reported little or no change in behaviour as a result of using the R&D Tax Concession, with 86% of firms changing behaviour *during* their R&D project and 98% of firms reporting behavioural change *after* the project…As many as 4,403 firms have a 'stronger understanding of the benefits to the firm of R&D and commercialisation', 4,186 have an 'enhanced commitment to R&D including through increased R&D resources' and that for 3,856 firms, the projects proceeded more quickly due to the R&D Tax Concession…An estimate of the economic impact from changes in behaviour induced by the R&D Tax Concession was in the

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29 House of Representatives Standing Committee on Economics, *Inquiry into Raising the Productivity Growth Rate in the Australian Economy*, April 2010, p. 3.

30 J Haskell and G Wallis, 'Public support for innovation, intangible investment and productivity growth in the UK market sector', *Imperial College Business School discussion papers*, no. 2010/01, February 2010, p. 21.

31 N Bloom, R Griffith and J van Reenen, 'Do R&D tax credits work? Evidence from a panel of countries 1979-1997', *Journal of Public Economics*, vol 85, issue 1, July 2002, p. 1.

32 G Davis and G Tunny, 'International comparisons of research and development', *Economic Roundup*, Spring 2005, p. 73.

> range of $150m to $300m in 2004-05…These findings suggest that the impact of programs may become embedded in the participating firm's commercialisation processes and increases its capacity to effectively undertake R&D.[33]

Committee view

3.30 The Committee notes that Australia's R&D performance, allowing for its industrial structure, is comparable to its peers. The Committee believes there is potential for R&D to support growth in the economy through the better targeting of assistance and changes to intellectual property as proposed by this bill.

33 Department of Industry, Tourism and Resources, *How R&D Assistance Influences Company Behaviour*, July 2007.