Education and Innovation Theme

Australian government spending on innovation
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Overview

Australian governments spend over $10 billion each year supporting innovation – ideas successfully applied – to do things in new ways. Such improvements are the most important drivers of long-term economic growth, and the contribution it can make to wellbeing.

In Australia, the bulk of innovations that contribute to economic growth are likely to be local adaptations of ideas from elsewhere, rather than home-grown inventions.

Well-directed government support is likely to encourage innovations that are socially worthwhile, but which would not otherwise happen.

The bulk of Australia's public spending on innovation goes towards basic research in public organisations. There is reasonable evidence that this has a positive long-term impact on innovation. It also has other justifications such as the impact of medical research on longevity, and the value of knowledge for its own sake.

The Commonwealth Government also provides substantial support for specific innovation projects conducted by private firms. There is less evidence that such spending produces extra innovation that justifies the costs. Even though almost $1 billion is spent every year, there is little review of its effectiveness.

The largest form of Commonwealth Government support for private sector innovation is the R&D tax credit. 60 per cent of the credit – over $1 billion per year – goes to the largest 3 per cent of innovative firms. There is little evidence that this tax credit substantially increases the amount of actual R&D activity in large firms.

By contrast, there is good evidence that improving the framework conditions for innovation, particularly by reducing the corporate tax rate, would have a significant impact on innovation in the long-run. A lower corporate tax rate encourages foreign direct investment, which in turn increases innovative activity and encourages the diffusion of ideas from other countries.

Australia would probably see more innovation – and increase living standards accordingly – if the R&D tax credit for large firms and much of the direct support for private firm innovation were redirected into funding a reduction in the corporate tax rate of up to 1.5%.

Governments should support innovation. At the same time they should ensure public money is spent where it makes the biggest difference.

1. Introduction

1.1 What is innovation?

Innovation is most elegantly defined as *"ideas, successfully applied"*.[1] A little more descriptively, the OECD defines innovation as:[2]

> *"the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations."*

Each of these forms of innovation can increase productivity

Innovation matters because it drives increases in wellbeing. Innovation is the biggest driver of productivity in the long run,[3] and thus the sum total of resources available to the community to live the good life. As Smith and West observed:

> *...over the long run, the array of techniques available to society improves dramatically in performance and functionality. These changes have major effects on the quality of human life and on human welfare. Improvements in health, life expectancy, nutrition, geographical mobility, housing better working conditions and reduced work effort, educational attainments, and information availability all follow from sustained innovation.*[4]

The innovations made by a particular firm to increase its productivity may be "new to firm", "new to market", or "new to world".[5] An innovation is an "invention" if it is "new to world". "Invention" includes the commercialisation required for the first successful application of a new idea as a commercial venture. Thereafter the same or similar invention may be applied as an "innovation" in many other firms. Of course, *all* innovations, whether or not they are inventions, increase productivity.

Almost every paper on the subject notes that innovation is "broader than just invention". However, many go on to focus on invention, particularly R&D spending and patenting rates, perhaps because measures are easier to identify, and plausibly supportive government policies are easier to find.

However, the focus on invention tends to distract from the most important elements of innovation. Australia is a relatively small part of the world. 98% of the innovations applied by Australian firms will be generated overseas, even if Australia generates inventions in line with its share of global GDP. Only 2.5% of Australian firms' innovations are likely to be new to the world, home grown inventions.[6]

Adoption and implementation of inventions from overseas boost productivity just as surely as ideas generated at home, particularly in sectors such as services that are less exposed to trade – the majority of Australia's economy today. 98% of the productivity uplift in Australia from innovation is likely to be the result of applying ideas, often sourced from industry, that were first invented beyond Australia's

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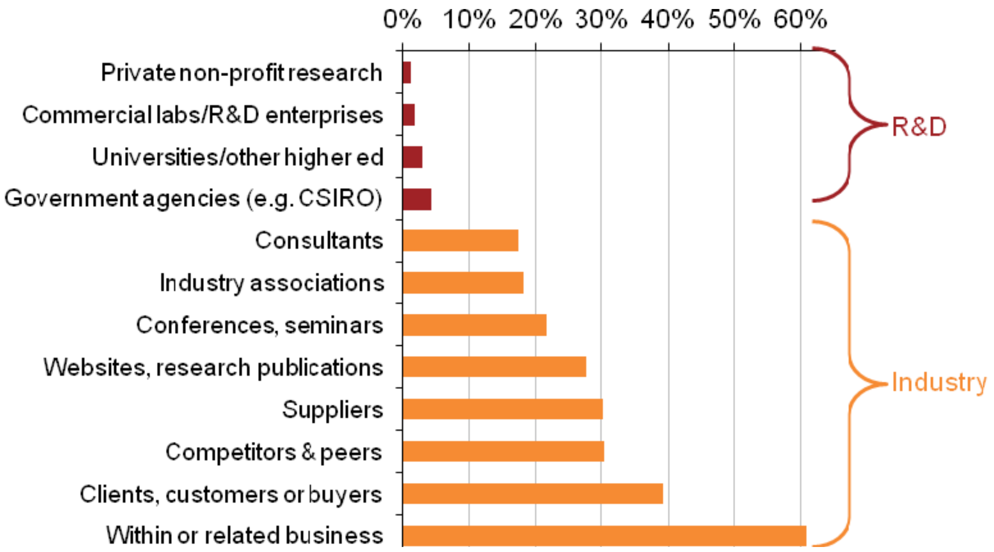
[1] Dodgson and Gann (2010)
[2] OECD (2005)
[3] DIISR (2011)
[4] Smith and West (2007)
[5] OECD (2005)
[6] Cutler (2008)

borders. It is thus not surprising that Australian firms report that they source most of their innovations from industry, rather than R&D (figure 1).

Figure 1: Australian innovative firms' sources of innovation[7]



1.2 Australia's innovation performance in international context

It is difficult to measure innovation, and thus to evaluate innovation policy. This paper does not attempt to solve this problem comprehensively – the OECD's *Oslo Manual* made a start, but only covers technological and process innovations not organisational innovations, and excludes the service and government sectors.[8] Scientific publications and patents measure invention, but these are likely to be only a small part of Australia's innovation story. Innovation can be measured more broadly by companies' self-reported 'time spent innovating', but this at best reflects effort, and perhaps intent, but not effectiveness or success. The ultimate outcome measure is multifactor productivity growth – the improvement in outputs per hour worked, after adjusting for increased capital intensity.

It is popular wisdom that Australia is much less innovative than the rest of the developed world. This no doubt stems from our consistently poor ranking in global "innovation" reports. A number of indices rank Australia between 17th and 22nd in the OECD.[9]

However, these indices primarily rely on measures of *invention*. On such measures Australia is well behind. Australia, relative to the OECD, is:

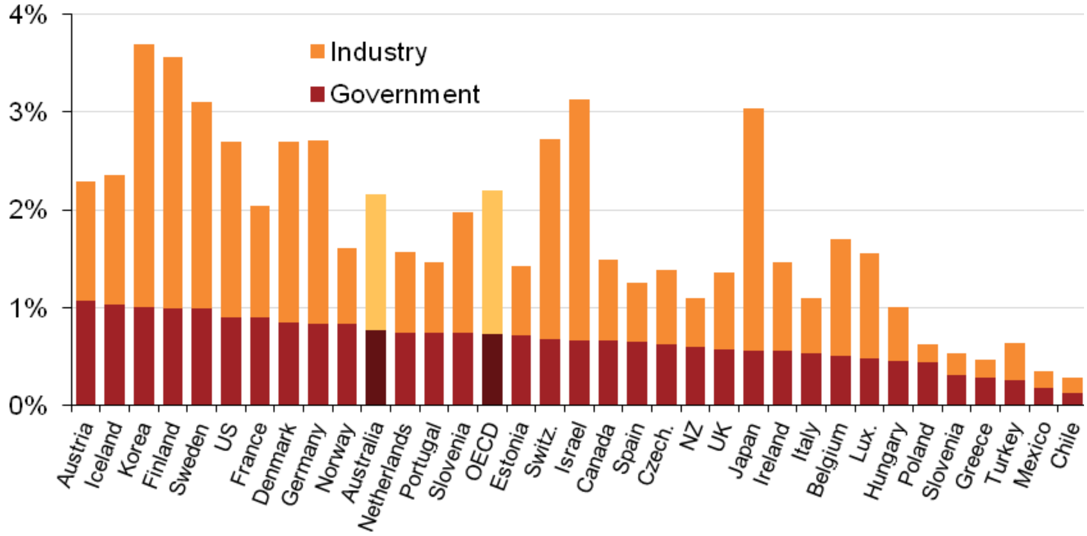
- 18th in citations per researcher publication (but 7th for publications per researcher);
- 22nd in science and engineering graduates as a percentage of total tertiary education graduates;

[7] ABS (2012)
[8] OECD (2005)
[9] Five popular indices are the World Economic Forum Global Competitiveness Report Innovation Pillar; the INSEAD Global Innovation Index; the Atlantic Century Benchmark; the Innovation Imperative in Manufacturing; and the EU Innovation Report.

- 12th on business expenditure on R&D as a percentage of GDP;
- 12th on patent applications filed under the Patent Co-Operation treaty (this represents 1.35% of the OECD total);[10] and
- 6th for trademark registrations per million of population.

Overall, Australia's public expenditure on R&D is slightly higher than the OECD average, and industry expenditure slightly lower, as shown in Figure 2.

Figure 2: Expenditure on R&D in the public and business sectors, as percentage of GDP, 2010 or nearest year[11]



On the inputs of *innovation*, Australia does a little better:

- 9th on total expenditure on tertiary education as a percentage of GDP;[12] and
- 9th in proportion of population aged 25-64 with tertiary education; and 28th for upper secondary school (or better) education[13]

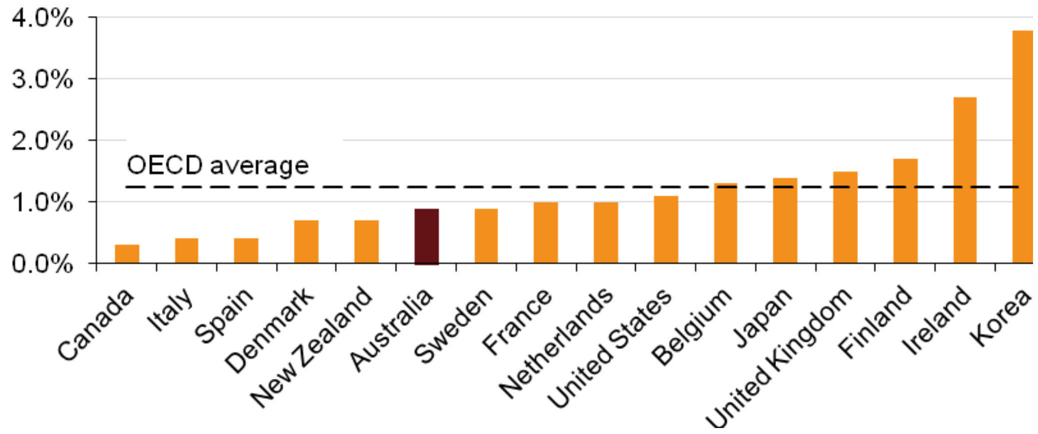
While there is relatively little seed funding for inventions in Australia, more is invested in Australia (as a percentage of GDP) on venture capital and late expansion investments than the US (but less than Finland, Sweden, the UK, Norway, and Denmark).[14]

More relevant than all of those statistics, though, is the impact of innovation on Gross Domestic Product (GDP). Although Australia has a reputation as a "miracle economy" over the last few decades, its underlying productivity due to innovation

[10] OECD (2009)
[11] 2002 for Australia, Austria, Portugal Switzerland and Turkey; 2001 for Greece and Mexico. From OECD (2006).
[12] Note Australia ranks only 22nd on *public* expenditure on tertiary education as a percentage of GDP, which reflects Australia's internationally unusual system of requiring most students to contribute a significant proportion of the cost of their higher education through government-administered income-contingent loans. For the rationale and outcomes of this policy, see Norton (2012a); Norton (2012b)
[13] DIISR (2011).
[14] DIISR (2011).

has grown less quickly than many. Multi-factor productivity growth (MFP) is the contribution to economic growth beyond changes in labour and capital – i.e. growth due to innovation. Australia's MFP grew 0.9% per year from 1985 – 2010, well below the OECD average of 1.24%, as shown in figure 3.[15]

Figure 3: Average multi-factor productivity growth, 1985 – 2010[16]



1.3 The aims of innovation policy

This paper is about what governments can do increase innovation. There is broad consensus that both innovation and the narrower class of invention are encouraged by:

1. framework conditions, including:
   - regulations that encourage competition and allow ease of firm entry and exit
   - a degree of human capital (particularly scientists and engineers, and competent managers), both stocks *and* flows
   - corporate tax rate;
   - some (but not too much) protection of intellectual property rights;
   - intellectual property regimes
2. support for inventive, basic research, and links between universities and business.
3. financial support for innovation in firms, including competitive grant schemes for innovation and the R&D tax incentive for invention; and

Given that most productive innovation does not involve Australian invention, such policies will have the biggest impact if they affect the rate at which Australian firms innovate by adopting inventions from elsewhere.

[15] Even after removing Korea's extraordinary sustained MFP growth, Australia's is still well below the OECD average of 1.07%.
[16] OECD (2010)

This paper analyses what we know about the specific government policy interventions that are effective in encouraging innovation. We ask how this matches with Australian government spending on innovation and discuss what, if anything, it should be doing differently.

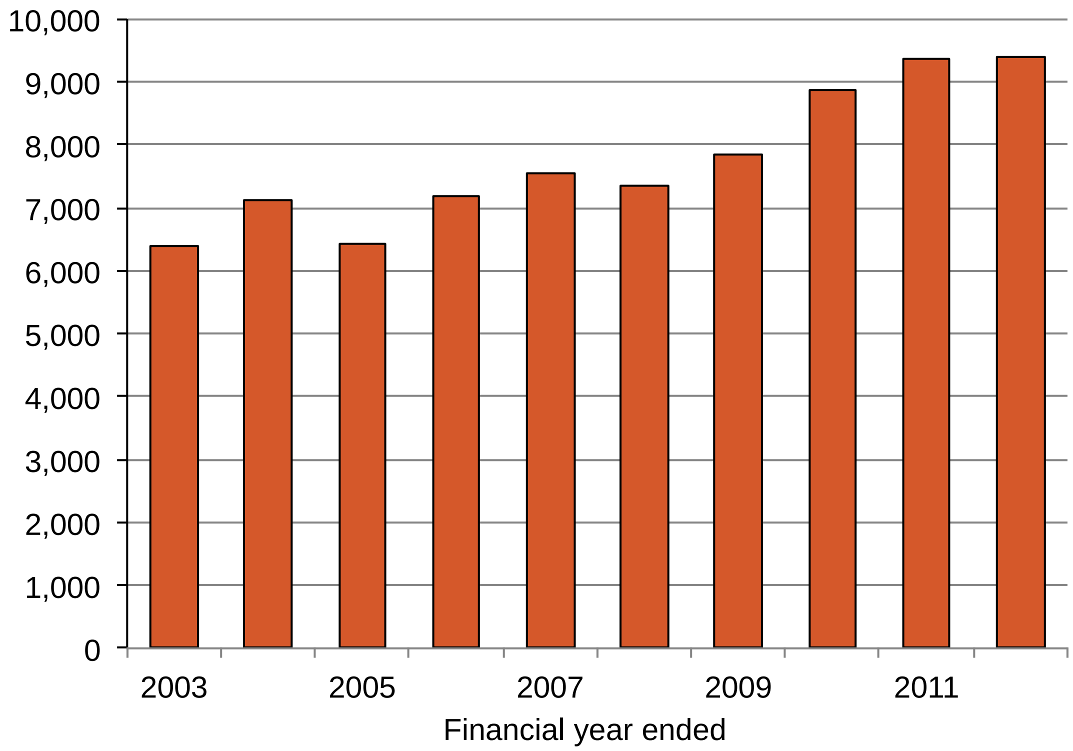
We rely upon international literature, much of which is from the OECD, and much of which utilises panel data of OECD countries, attempting to isolate the effects of government spending on innovation to increase productivity and economic growth.

The paper focuses on Commonwealth Government spending on innovation. Obtaining reliable State Government data on innovation is difficult, and is a question for another day.

1.4 Commonwealth government spending on innovation

The Commonwealth Government spends over $9 billion annually on programs under the broad category of 'innovation',[17] and spent over $77 billion (in 2012 dollars) in the last ten years.

Figure 4: Commonwealth spending on innovation
$ m, nominal



Note: 2010-11 is estimated actual; 2011-12 is budgeted.

The Commonwealth's innovation spending can be analysed in four categories, as shown in Figure 5:

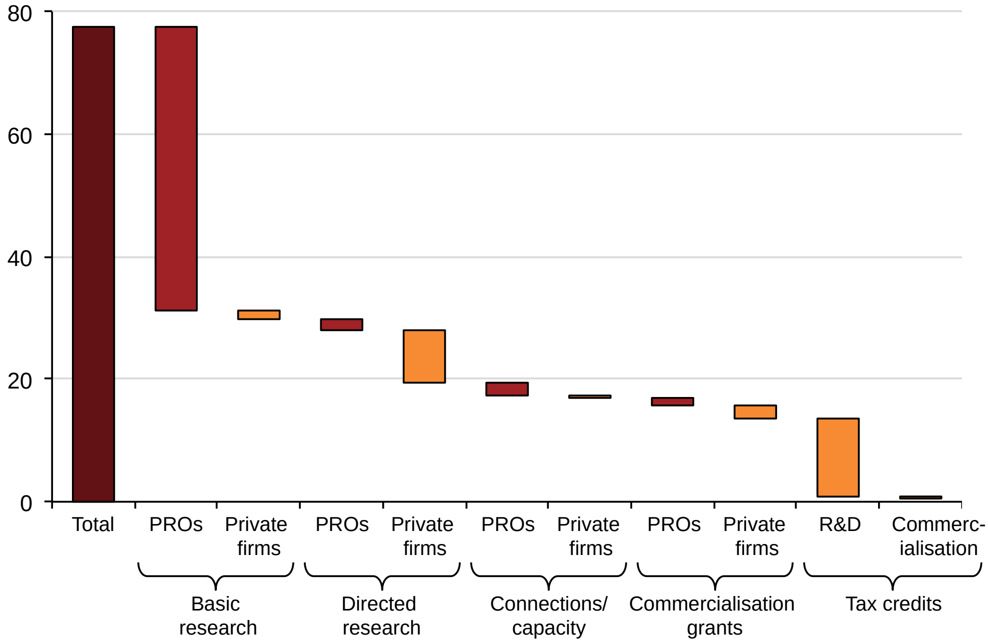
- *basic R&D*: funding for research, carried out predominantly in public research organisations (PROs) – primarily universities and the Commonwealth Scientific

[17] DIISR (2011). These data are Commonwealth only, and are self-reported by each department.

and Industrial Research Organisation (CSIRO) – where project topics are primarily driven by the researchers;

- *directed R&D*: funding for research where government specifies a particular question or problem for research;
- *connections and capacity*: funding (other than for secondary and tertiary education) to enhance connections (i.e. the movement of ideas between people), and to enhance human capital (i.e. our ability to absorb innovations) – in practice this mainly includes specialised training programs and interdisciplinary projects; and
- *commercialisation and adoption*: funding to facilitate implementation and commercialisation of ideas, particularly those generated through public research organisations.

Figure 5: Commonwealth spending by category and recipient, 2002-03 – 2011-12, 2012 $ m



The majority ($48b) of the Commonwealth's innovation spending was for basic R&D. Most of this ($44b) was spent in public research organisations. Of the $10b for directed R&D, most ($9b) was spent in private organisations. Connecting people, instilling them with the capacity to innovate, and facilitating commercialisation and adoption of innovations received relatively little funding. The other major spending was $13b of tax incentives for private sector R&D.

Over the period there were 204 separate programs. Some are very broad, such as the Australian Research Council and National Health and Medical Research Council's competitive grants programs; some very narrow, such as the Commonwealth's specific support for CSL Limited.

2. Framework conditions and innovation

The framework conditions within which the private sector operates – stability, flexibility, competitiveness, intellectual property regime, tax rates, and human capital – are among the most important determinants of innovation.[18] Framework conditions also encourage invention. In the Australian context, framework conditions are likely to have more economic impact by encouraging the adoption of innovations than inventions that are new to the world.

2.1 Stability and flexibility

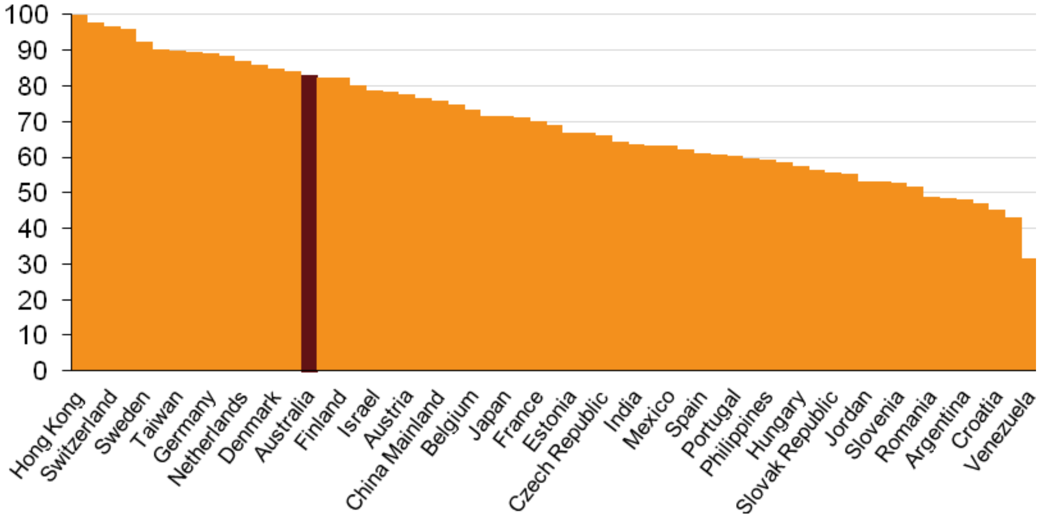
General macroeconomic stability is important, giving firms the confidence to take risks and invest.[19] Deep and stable financial systems encourage supply of the capital required to innovate. Openness to trade, entrance of international corporations and flexibility of labour all enhance movement of people and ideas.[20] "Proportional" regulation limits barriers to innovative business activity. Australia reformed its macroeconomic institutions, financial regulation, and trade policy between 1980 and 2000.[21] This resulted in large productivity gains,[22] but remaining opportunities for reform that would have a substantial impact on innovation are generally not well-defined.[23]

2.2 Competitiveness

The competitiveness of the market in which private industry operates is important – competition provides the impetus for innovation.[24] Australia reformed to improve competitiveness between 1980 and 2000. Its ranking on the *World Competitiveness Scoreboard* is shown in figure 6. Although Australia ranks relatively highly for its financial and education systems, it ranks relatively poorly for the flexibility of its industrial relations regime and the burden of government regulation.

[18] Jaumotte and Pain (2005b)
[19] OECD (2001); Box (2009)
[20] OECD (2001)
[21] See Kelly (2008)
[22] For example, the competition reforms under Keating in 1995 (Fels (1998)), and the progressive liberalisation of trade from 1973 to 1991 – e.g. Leigh (2002).
[23] Daley (2012)
[24] OECD (2003b)

Figure 6: World Competitiveness Scoreboard, 2012[25]



However, many Australian industries remain dominated by a small number of players. In part this is a result of the Australian market being relatively small, and a long way from other major markets. While there is a possibility that government policy might successfully change the conduct of these markets to increase competitiveness amongst the existing number of players, such reforms are again not well-defined.[26]

2.3 Corporate tax rate

Low corporate taxes motivate efficient use of labour and capital, rather than their substitution. Low corporate taxes also increase foreign direct investment, and therefore productivity, because more capital is invested per worker.[27] A recent meta-analysis concluded that a 1% decrease in corporate tax rate would increase FDI by 4%.[28]

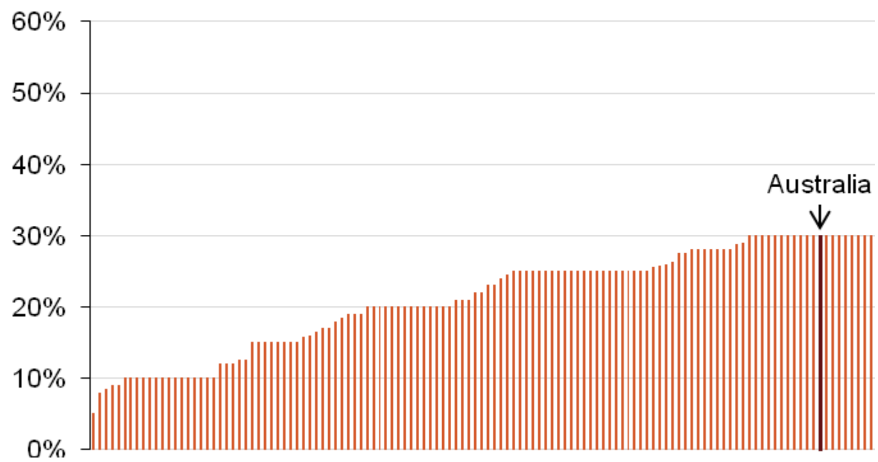
Corporate taxation also affects innovation. Foreign direct investment – particularly in the form of setting up a local subsidiary for a multinational – can substantially increase technology and knowledge transfers.[29] A study in Estonia found strong correlations between lagged FDI and direct indicators of innovation: a 10% increase in FDI increased process innovation by 3-4% and knowledge flows by 1-2%.[30] In the UK, another study found a positive correlation between sectoral FDI and the quantity of knowledge that UK firms source from their competitors.[31]

The impact of foreign direct investment on the adaptation of overseas innovations is particularly important for Australia. As discussed above, the local application of international innovations is inevitably the dominant driver of innovation in Australia.

[25] IMD world competitiveness yearbook, 2012, www.imd.org/research/publications/wcy/
[26] Daley (2012)
[27] Jaumotte and Pain (2005b)
[28] de Mooij and Ederveen (2008)
[29] Henry (2009)
[30] Vahter (2010)
[31] Crespi, *et al.* (2008)

However, Australia's headline corporate tax rate is high relative to the rest of the world, as shown in Figure 7. After progressively reducing from 49% in the mid-1980s to 30% in 2001, Australia has failed to keep up with global trends, and is now at the high end of the range.[32] Amongst developed economies, only Spain (30%), Canada (31%), France (33%), Belgium (34%) and the US (35%) have equal or higher headline corporate tax rates.

Figure 7: Headline corporate tax rates for 149 countries[33]



There is a strong case for reallocating some of the Commonwealth Government's current spending on innovation to fund a reduction in the corporate tax rate. *Australia's Tax Review* (often known as the "Henry tax review") recommended reducing the Australian company tax rate from 30% to 25%. Up to 1.5% of this reduction could be funded by redirecting a part of the Commonwealth's innovation spending.[34] As discussed below, there is limited evidence that a material portion of the Commonwealth's innovation spending makes much difference. By contrast, there is good evidence that changes to the corporate tax rate would have a material impact on innovation and therefore productivity.

2.4 Intellectual property

There is a large literature on the impact of intellectual property rights on innovation.[35] The only consensus is that a balance needs to be found that provides enough protection to encourage investment in innovation and discourage secrecy (the alternative form of protection), but not so much that incremental innovations are hampered.

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[32] Henry (2009), detailed analysis volume 1

[33] Pricewaterhouse Coopers (2012). Note: the high rates in Bahrain and UAE on the far right apply only to oil and gas corporations and foreign financial institutions. For all other corporations the rate is zero.

[34] This rough calculation does not reflect any behavioural response from companies to changing the headline rate. It is based on reducing R&D tax incentives to large firms (saving $1 billion per year, as discussed below), and reducing grants to private firms by $1.2 billion per year. Corporate tax revenues in 2009-10 were $44 billion at a rate of 30%, implying that $2.2 billion would equate to a 1.5% reduction in the corporate tax rate.

[35] See, for instance, Gould and Gruben (1996); Drahos and Maher (2004); Murray and Stern (2007); Williams (2010) Sakakibara and Branstetter (1999); Jaffe (2000); Jaffe and Lerner (2004).

2.5 Human capital

Innovation is also higher if the workforce is better educated. Human capital can be improved to increase innovation through higher quality schooling, a greater proportion of scientists and engineers in the workforce, and more skilled migration. Higher quality management can also improve innovation.

The quality of schooling substantially increases long-run economic growth.[36] A better educated workforce is more likely to be innovative. There is substantial scope for Australian governments to increase the quality of schooling by increasing the focus on learning, and creating a strong culture of teacher education, research, collaboration, mentoring, feedback, and sustained professional development.[37] In the long run the impact of school education is likely to dwarf other government interventions to increase innovation.

Countries with more workers who are scientists and engineers tend to have higher levels of business sector R&D.[38] However, it is unlikely that Australian government can intervene further to increase the supply of scientists and engineers by expanding the number of university places. Australia now has a "demand driven" system in which universities have incentives to create places in whichever disciplines there is student demand. Bachelor-degree science graduates in Australia have below-average rates of full-time employment, suggesting that supply is now outstripping demand.[39] In the long run, increased government spending on R&D will increase the number of scientists and engineers employed. In the short run, however, government spending is likely only to increase real wages given that the supply of scientists and engineers cannot increase rapidly.[40]

Migrants can also improve the quality of human capital and a country's ability to innovate. There is substantial evidence that migration increases innovation and invention.[41] Encouraging effective migrant integration, particularly by encouraging language acquisition appears to be one of the most effective ways governments can increase innovations flowing from migration.[42]

The impact of management in encouraging innovation is sometimes overlooked. A growing body of literature has demonstrated a clear link between good management and a culture of innovation, entrepreneurship and productivity.[43] However, it is not clear what interventions by government would materially improve management quality.

Similarly, general attitudes towards entrepreneurship appear to be important. Government may be able to affect these attitudes through insolvency laws, although studies are contradictory on whether debtor-friendly bankruptcy laws encourage or reduce innovation.[44]

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[36] Jensen (2010)
[37] Jensen et al (2012)
[38] Furman, *et al.* (2002); Jaumotte and Pain (2005a).
[39] Norton (2012c)
[40] Goolsbee (1998); Falk (2005); Jaumotte and Pain (2005b).
[41] See, for instance, Hunt and Gauthier-Loiselle (2008) and Ozgen, *et al.* (2011).
[42] See Smith (2011)
[43] See Green (2009); Bloom, *et al.* (2007), Bloom and Reenen (2010).
[44] Manso (forthcoming), contradicting Primo and Green (2008)

3. Basic public research

3.1 Funding for public research

Basic research funding in Australia, totalling $4.8bn in 2008-09, goes to universities and other research bodies, such as the CSIRO.[45] There is a reasonable evidence base that such funding has a positive long-run impact on innovation as measured by multi-factor productivity growth.

A large proportion of developed countries' publicly funded innovation spending supports invention through basic research in public institutions.[46] Basic research can be defined as "experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts"[47] that is "performed without thought of practical ends".[48] Basic research is also an important aspect of training skilled scientists.[49]

The type of idea-generating research that is usually undertaken at universities has a high failure rate and unpredictable outcomes. The benefits are very difficult for any institution to appropriate, but rather spill out into the public domain, making incremental advances to our knowledge, and occasionally resulting in a major disruption. Research on vision in insects led to advances in communications and aircraft technologies.[50] In Australia, research into black holes eventually formed the basis for wi-fi technology.[51] And of course public research may have social value for culture, health, or knowledge well beyond its economic impact.

Because of its unpredictable nature, its diffuse impacts and important role in advancing knowledge (often considered a public good in itself), there is a strong case for public funding of basic research. It also enjoys a high degree of public support, in Australia and many other countries.[52]

There have been many efforts to quantify the economic benefits from this type of innovation support.[53] These attempts often struggle with definitions (what exactly is and isn't basic research, as well as the link between, for instance, improvements in medical treatment and 'growth'). However, most studies find basic research and economic growth are correlated to some degree. Basic public research appears to be linked to long-run multi-factor productivity growth.[54] Public research appears to have a larger impact if there is *less* co-funding from private sources (implying that the public research agenda should be set independent of business). Research

[45] ABS (2008-09); ABS (2011)
[46] Compare OECD (2012b) and OECD (2012a)
[47] OECD (2003a)
[48] Bush (1945)
[49] Pavitt (2001)
[50] Horridge (2002)
[51] DIISRTE (2009); see also Stevens, *et al.* (2011) for discussion of the role of basic research in the creation of new drugs.
[52] In 2009, 73% of Americans said spending on basic scientific research "usually pays off in the long run"; fewer than two in ten said such spending was "not worth it." About the same percentage (74%) said spending on engineering and technology "usually pays off in the long run." National Science Foundation (2012); in a recent ANUPoll (2010) 77% of respondents agreed with the statement that "Government investment in research is essential for scientific progress".
[53] Nelson (1959); Martin (2001); Griliches (1998)
[54] Guellec and van Pottelsberghe de la Potterie (2004)

performed in universities generally has a larger impact than that performed in government research organisations.[55]

3.2 Links between business and universities

University R&D affects human capital and thus innovation indirectly. It can also have a direct affect if universities provide assistance to businesses in understanding inventions from overseas as well as their own research. This effect is likely to be largest with large firms: businesses that are themselves research active have the greatest capacity to absorb others' innovations.[56] As a result, in every OECD country, the vast majority of industry-university interactions occur with large firms and not small or medium sized businesses.

To encourage intellectual property transfer between universities and businesses, many universities have established commercialisation or technology transfer offices (TTOs). However, it is not clear that these are effective. One study reported that they do little or nothing to promote knowledge flows,[57] and another suggested that technology transfer offices hinder informal research collaborations.[58]

Further programs and mechanisms to encourage university-business interactions are important, but beyond the scope of this paper, which has focused on areas of substantial government spending.

4. Financial support for firms

4.1 Rationale for public support

The standard rationale for government support for innovation is that private firms tend to invest less than is socially optimal.[59] When private firms spend to innovate they often can't capture all the benefits when others adopt the innovation. Market failure is particularly likely for new to world inventions where the costs for the first mover are much higher than the costs for subsequent adopters.

Private sector R&D appears to be linked to the benefits of both generating inventions directly as well as helping firms to adopt the inventions of others. A study of 16 OECD countries found that countries where the private sector invests more in R&D are likely to have a private sector that is better at adopting innovations.[60] It is plausible that firms conducting R&D are more likely to be aware of leading edge developments in their field, which they then adopt. However, the causation may be more complex than this. For example, it may be that countries with an entrepreneurial culture are more likely to have businesses that both see value in conducting their own R&D and in scanning the world for innovative ideas to adopt.

However, the inability of firms to capture all the benefits of their investment in innovation do not justify public subsidy if there is sufficient private return that businesses will invest in the innovative activity anyway. Public support for innovation is only justified if:

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[55] Guellec and van Pottelsberghe de la Potterie (2004)
[56] Guellec and van Pottelsberghe de la Potterie (2001)
[57] Reiner (2010)
[58] Wright, *et al.* (2008)
[59] E.g. IC (1995) cited in Banks (2000); Sheehan and Messinis (2003)
[60] Guellec and van Pottelsberghe de la Potterie (2001)

- Innovative activity has social spillover benefits; AND
- The private returns are insufficient to motivate the activity; AND
- Any distortionary cost of the public support is less than the additional social benefits of the innovation.[61]

Consequently, not all funding for innovation is worthwhile. As Gary Banks put it:

> *The fact that there is an in-principle case for government to support R&D ... does not mean that any support will do.*[62]

It remains unclear which forms of government support for private sector innovation avoid paying primarily for activity that would happen anyway. A meta-analysis of 39 studies found a mix of situations: sometimes government funding resulted in more private sector innovation; sometimes government funding simply provided substitute funds that businesses would otherwise have paid themselves. There was no obvious pattern that explained the different results.[63]

4.2 Selecting innovative activity for public support

Government policy to support innovation ranges on a spectrum between grant schemes that support a particular innovative activity by a particular firm selected by government, and broad-based entitlement schemes that support any qualifying innovative activity.[64]

Grant schemes rely on government choosing wisely which ideas are more likely to be successfully applied. It is now accepted political wisdom in Australia that government has a poor track record of "picking winners". Those in government who personally try to pick winners neither bear the costs nor reap the benefits. Consequently they have relatively little incentive to invest in high quality selections.

Entitlement schemes, by contrast, rely on individual firms choosing projects within the parameters of the scheme, and businesses invest some of their own money alongside government. This results in the pursuit of ideas that are more likely to be successfully applied. However, it also creates a significant risk that public money is spent on activities that businesses would have undertaken anyway.

In recent decades governments around the OECD, including in Australia, have shifted innovation funding from grants towards entitlement schemes, generally in the form of tax incentives.[65] About half (51%) of the Commonwealth's support for private innovation is provided as tax incentives. Of the remaining Commonwealth innovation support, 18% is provided as direct funding for specific firms, and 30% as competitive grants for particular projects, costing $8 billion over the ten years to 2011-12, as shown in Figure 5. This involved 95 individual competitive grant or direct funding programs. There is little public documentation to show that these programs deal with genuine market failures, or that they provide a public benefit

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[61] This argument is analogous to that used in a critique of public subsidy of higher education tuition, worked through in detail in the Grattan Institute report *Graduate Winners*, Norton (2012a)
[62] Banks (2000)
[63] Garcia-Quevedo (2004)
[64] See Thomson and Webster (2011)
[65] Jaumotte and Pain (2005b) p.5-6; Box (2009)

substantially greater than their costs. A Productivity Commission review of similar programs in 2007 found that most of the supported innovation would have been undertaken anyway, questioned whether they should be continued, and noted a long-standing reluctance to evaluate them transparently and publicly.[66]

A significant portion of these grants appear to be industry policy masquerading as innovation policy.

Grants classified as "innovation" include $4 billion spent (and a further $3.5 billion committed) on the *Automotive Competitiveness and Investment Scheme* (ACIS) and $3.5 billion committed to the *Automotive Transformation Scheme* (ATS). It is not obvious that these rectify market failures that would justify government innovation support. In fact, ACIS is explicitly targeted to

> *provide transitional assistance to encourage competitive investment and innovation in the Australian automotive industry [...] in the context of trade liberalisation.*[67]

Both automotive schemes are entitlement schemes – the former provides import duty credits and the latter cash payments, at a rate of 45% (for ACIS) and 50% (for ATS) of the eligible investment in R&D.[68] Any innovations made by the three car companies that benefit from these automotive schemes will primarily benefit the car companies themselves, and are unlikely to have substantial applications outside the industry.[69]

While the ANAO has reviewed the administration of ACIS, there is no public information about its effectiveness at encouraging innovation. Indeed, the ANAO noted that "the absence of performance information has limited the transparency of ACIS."

On a smaller scale, the *Pharmaceutical Industry Investment Program* (wound down in 2004) and the *Pharmaceutical Partnerships Program* (wound down in 2009), also classified by DIISR as innovation schemes, cost the Commonwealth about $200 million. The schemes were designed to 'compensate the pharmaceutical industry, in part' for lower prices as a result of the Pharmaceutical Benefits Scheme.[70] They did so by paying more for products of successful participants in the scheme. In return successful participants were meant to undertake additional R&D and manufacturing.[71] However, nearly all pharmaceuticals companies operating in Australia are multinational, and the overwhelming proportion of their sales are researched and manufactured overseas.[72] It is unlikely that *Australian* prices had a material impact on *Australian* pharmaceutical research and development.

Not surprisingly, then, the *Pharmaceutical Partnerships Program* was found by one report to have moderately stimulated R&D, but overall the impact was either a small

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[66] PC (2007) p.414-420
[67] ANAO (2008)
[68] Investment in innovation, plant or equipment entitled an automotive producer to pay less duty on imported parts under ACIS, and to cash payments under ATS: see http://www.australiangovernmentgrants.org/Automotive-Competitiveness-and-Investment-Scheme.php and http://www.ausindustry.gov.au/programs/manufacturing/ats/Documents/ATSFactSheet.pdf
[69] Bracks (2008)
[70] PC (2003); Deloitte Insight Economics (2008)
[71] PC (2003), p 2.1
[72] Ibid., p 1.5

loss or approximately neutral. Further, the main benefits went to firms, rather than to the public in the form of increased productivity across the economy.[73]

In the absence of rigorous documentation about the purposes of these schemes, and even less evaluation, it is appropriate to question whether this money might be better spent elsewhere. As discussed above, there is a strong case that reducing corporate tax rates would have a material impact on innovation by increasing foreign direct investment. It is likely that Commonwealth money would have a larger impact on innovation if it was expended in reducing corporate tax rates than supporting innovation grants to industry that lack a strong evidence base.

4.3 Tax incentives

Tax policies to encourage innovation are increasingly popular internationally. They have been in place in Australia since 1985. Their design has been refined several times, in particular so that they also benefit companies not making a profit and thus not paying tax.

It is unclear whether such tax policies substantially change corporate behaviour. A number of studies found that tax incentives for R&D are linked to increases in reported business R&D spending.[74] One found that a 10% reduction in the cost of R&D as a result of tax incentives stimulated a 1% increase in short-run and a 10% increase in long-run R&D spending.[75]

There may be concerns that apparent increases in R&D spending may simply reflect reclassification of existing activities in order to reduce tax, rather than any substantive change in behaviour. A Canadian study provided some reassurance that firms which claim tax credits are also more likely to have higher R&D outputs such as the number of sales of new products. On the other hand, this study also found that firms spending more on R&D did *not* have substantially higher profitability within the time period of the study.[76] Another recent study across OECD countries found that additional government support for industry R&D was associated with business employing more researchers.[77]

There is some evidence that the effect of R&D tax incentives may vary depending on the size of firms. It appears that small firms increase R&D spending more in response to tax incentives.[78] This may be because small firms are more capital constrained. Because lower tax rates increase the available working capital for small firms, they can afford to innovate more. By contrast, for large firms, tax rates merely affect the cost of capital, not its availability. Consequently, it is likely that tax incentives will have less impact on innovation in large firms.

A recent study of Australian firms found no evidence that the cost of capital affects R&D spending in Australia. As the primary impact of R&D tax incentives (particularly for large firms) is to reduce the cost of capital for R&D investment, this suggests that R&D tax concessions have little impact on R&D spending.[79] R&D tax

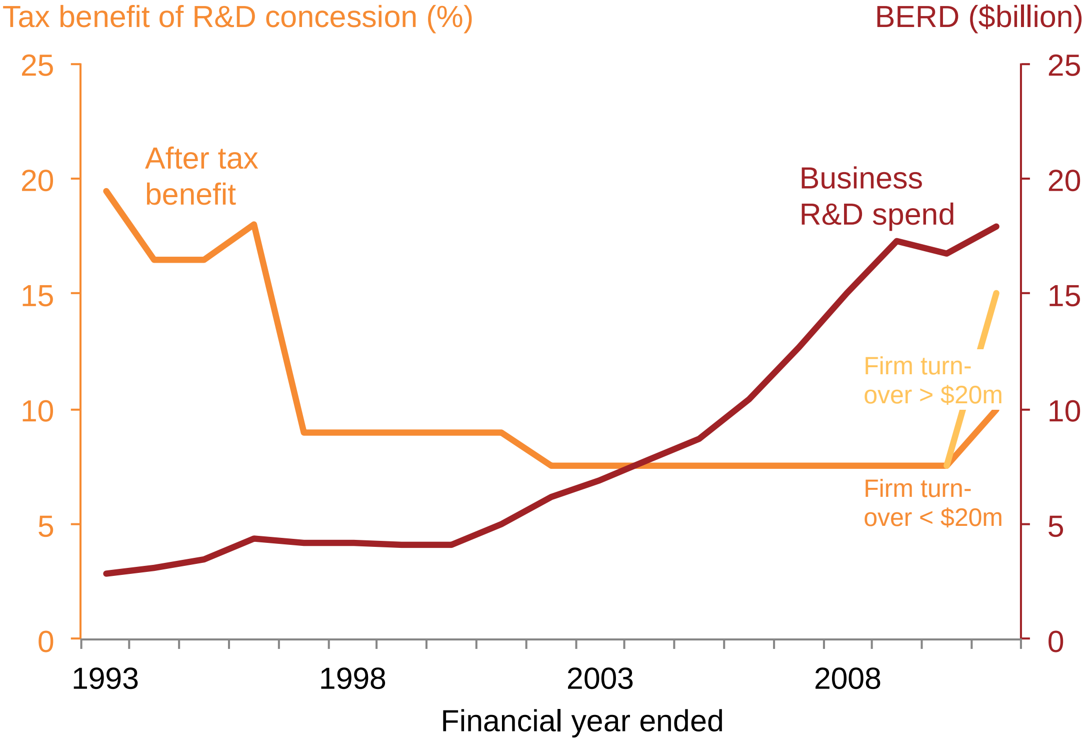
[73] Deloitte Insight Economics (2008). The 'expected' impact
[74] Falk (2005)
[75] Bloom*, et al.* (2002)
[76] Czarnitzki*, et al.* (2004)
[77] Thomson and Jensen (2010)
[78] Jaumotte and Pain (2005b)
[79] Thomson (2009)

incentives may have relatively less impact in Australia because they are "washed out" for many taxpayers by dividend imputation credits.[80]

A crude historical analysis suggests that the net tax impact of R&D tax concessions (a combination of the corporate tax rate and the R&D tax concession rate) is not the dominant driver of business R&D spending, as illustrated in Figure 8. When the effective tax benefit dropped in 1996 (primarily driven by changes in the general corporate tax rate), reported business R&D spending flattened. However, business R&D spending increased a few years later even though there was no major change in the effective tax benefit for R&D spending.

Similarly, the Productivity Commission's review in 2007 found that on balance the basic R&D tax concession did little to induce increase R&D spending, particularly by large firms.[81]

Figure 8: Corporate tax benefit of R&D tax concession and business R&D spending[82]



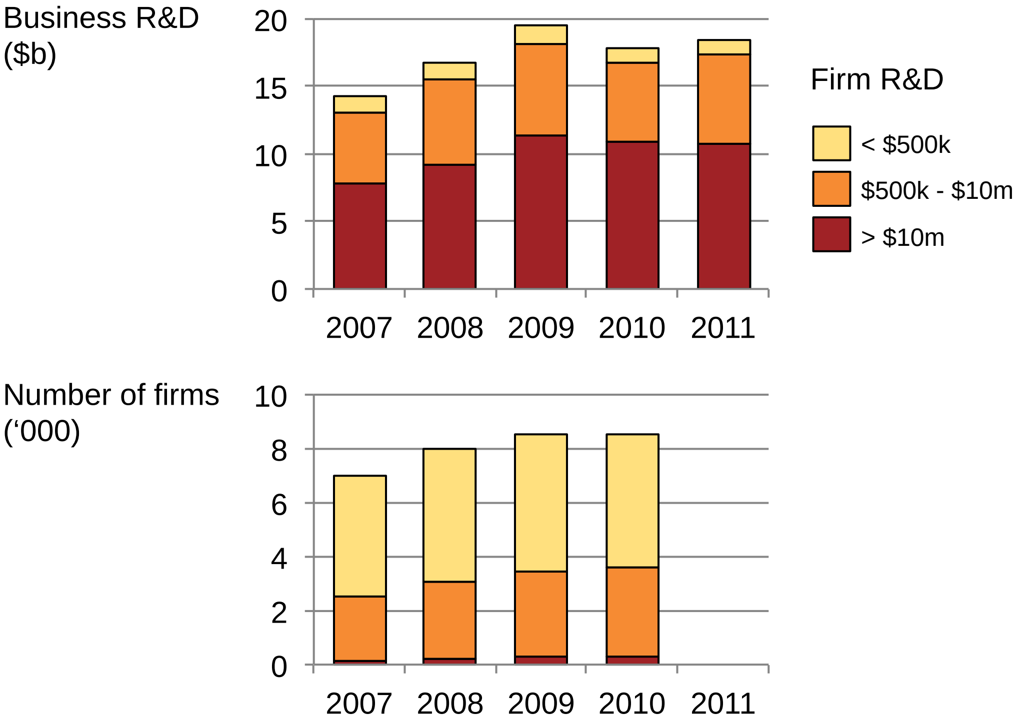
This is consistent with anecdotal evidence. Speaking on the US tax credit, Gleckman observed that:

> *In 20 years, I've never had a single corporate executive from the pharmaceutical industry or the high tech industry, or anyplace else tell me that they have done a dime's worth of research that they otherwise wouldn't have done as a result of the R&D credit. They spend lots of time and effort reallocating costs so they can take advantage of the credit, but they don't actually do any more research.*[83]

[80] Thomson and Jensen (2010); PC (2007) p.400
[81] PC (2007) p.392
[82] Economics Legislation Committee (2010); Australian Taxation Office (2012).
[83] Gleckman (2006), cited in Rashkin (2007), cited in Thomson (2009).

The general R&D tax concession and favourable tax treatments for "venture capital limited partnerships" have cost the Australian government more than $13 billion over the ten years to 2011-12, and $1.8 billion in the 2011-2012 financial year. The international evidence suggests that such schemes are probably effective for small firms, but have little impact on large firms. However, the vast majority of the cost of the Australian R&D tax incentives is for large firms, as shown in Figure 9. 60% of the benefit of the tax incentive is captured by just 3% of the registered firms.[84] This suggests that over $1 billion of tax concessions provide only marginal innovation benefits.

Figure 9: Corporate R&D spending, and number of firms claiming R&D tax credit, by firm size[85]



The Business Tax Working Group also recommended revisiting large firms' eligibility for R&D tax incentives.[86] They presented several options:

- reduce the rate of the tax credit to large firms (turnover greater than $20 million) from 40 to 37.5%, costed by Treasury to save $500 million over the forward estimates;
- impose an upper turnover threshold of $30 billion, costed by Treasury to save $150 million per year; or
- impose a cap on creditable expenditure of, for example, $100 million (uncosted).

[84] This assumes that tax revenue foregone is linearly related to reported expenditure on R&D. This is not entirely accurate: companies with turnover up to $20m receive a 150% concession; above $20m they only receive a 133% concession. Data for a more precise analysis are not publicly available.
[85] Grattan analysis based on ABS (2011); Innovation Australia (2012)
[86] Business Tax Working Group (2012b)

Even these limited proposals provoked an excited reaction. Some appear to believe that if government support should be retained if it has *any* impact on R&D.[87] However, the substantial cost of the concession does not seem justified given the apparently limited impact.

Consistently with this analysis, the Commonwealth Government recently announced that it intended to remove the R&D tax credit for firms with annual Australian turnover greater than $20b per year.[88] The evidence suggests that this would provide substantial budgetary savings of around $1 billion per year, but have limited impact on actual business R&D.

5. Conclusions

The bulk of Australia's public spending on innovation goes towards basic research in public organisations. There is reasonable evidence that this has a positive long-term impact on innovation. It also has other justifications such as the impact of medical research on longevity, and the value of knowledge for its own sake.

The Commonwealth Government also provides substantial support for specific innovation projects conducted by private firms. There is less evidence that such spending provides good value for money, and even though almost $1 billion is spent every year, there is little review of its effectiveness.

The largest form of Commonwealth Government support for innovation is the R&D tax credit. There is little evidence that this substantially increases the amount of actual R&D activity, particularly in large firms.

By contrast, there is good evidence that improving the framework conditions for innovation, particularly by reducing the corporate tax rate, would have a significant impact on innovation in the long-run. Australia would probably see more innovation – and increase living standards accordingly – if the R&D tax credit for large firms were redirected into funding a reduction in the corporate tax rate.

[87] For example, see Dalitz (2012)
[88] DIISRTE (2013)

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