

The Economic Value of Australia's Investment in Health and Medical Research:

Reinforcing the Evidence for Exceptional Returns

October 2010

A paper commissioned by Research Australia

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FOR EXCEPTIONAL RETURNS

August 2010

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ABBREVIATIONS AND DEFINITIONS

ABS	Australian Bureau of Statistics
Applied research	Original investigation undertaken in order to acquire new knowledge but directed primarily towards a specific practical aim or objective.
ASRC	Australian Standard Research Classification
Basic research	Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, with no particular application or use in view.
Burden of disease	Days lost through sickness and disability and years of life lost due to premature mortality.
CPI	Consumer Price Index
DALY	Disability Adjusted Life Year
GDP	Gross domestic product: the total market value of goods and services produced in Australia within a given period after deducting the cost of goods and services used up in the process of production but before deducting allowances for the consumption of fixed capital.
GERD	Gross Expenditure on Research and Development
Health research system	The people, institutions, and activities that act together to generate high-quality knowledge that can be used to promote, restore, and/or maintain the health status of populations. It should include mechanisms to encourage the use of research.
Grey Literature	A range of published and unpublished material that is not normally identifiable through conventional methods of bibliographic control.
Health system	The people, institutions, and resources that operate as a whole to provide health care and improve the health of the population it serves.
Health systems research	The production of new knowledge and applications to improve the way societies organise themselves to achieve health goals. It includes how societies plan, manage, and finance activities to improve health and takes into consideration the roles, perspectives,

and interests of different actors. The health system's functions of regulation, organization, financing, and delivery of services are the focal subjects. It is often understood to include health policy research.

HMR	Health and medical research
IPD	Implicit Price Deflator: such measures are obtained by dividing a current price value by its real counterpart (the chain volume measure). When calculated from the major national accounting aggregates, such as gross domestic product (GDP), implicit price deflators relate to a broader range of goods and services in the economy than that represented by any of the individual price indexes that are published by the ABS (such as the CPI).
Knowledge translation	The exchange, synthesis, and effective communication of reliable and relevant research results. The focus is on promoting interaction among the producers and users of research, removing the barriers to research use, and tailoring information to different target audiences so that effective interventions are used more widely.
NHMRC	National Health and Medical Research Council
NPV	The present value
PNP	Private Non-Profit (organisations)
Public health	The science and art of promoting health, preventing disease, and prolonging life through the organised efforts of society.
R&D	Research and development
Research synthesis	The process through which two or more research studies are assessed with the objective of summarising the evidence relating to a particular question. It is based on the principle that science is cumulative.
ROI	Return on investment
SOE	Socio-economic objective
Strategic research	Research that has been identified at the time of funding to be of evident interest to a wide range of users.
Systematic reviews	A rigorous method of identifying, appraising, and synthesizing original research using strategies that limit bias and random error.

Translational research	The process of applying ideas, insights, and discoveries generated through basic scientific inquiry to the treatment or prevention of human disease.
VSL	Value of a statistical life
VSLY	Value of a statistical life year
WHO	World Health Organisation
WTP	Willingness to pay
YLL	Years of life lost
YLD	Years of life lost to disability

KEY POINTS

- Indicative analysis by Lateral Economics supports the widely held view that the products of Australian health and medical research make a positive contribution to the Australian economy (Chapter 3 and Attachment A). Thus Australian research-related goods and services not only contribute to Australian gross domestic product but also support high skill, high paid jobs — as well as reinforcing Australia’s reputation in this field by being exported all over the world.
- This finding complements past analysis undertaken by Access Economics suggesting that there are exceptional returns from Australian health and medical research in the form of reduced mortality and morbidity in the population than would otherwise be the case (Chapter 2).
- Thus, investing in health and medical research is not only productive of income and wealth. It also promotes the health and wellbeing of the population — making such investments doubly beneficial and leading to higher-than-average rates of return. It is little wonder, then, that Australians think undertaking health and medical research in this country represents a good use of their taxes (Chapter 1).
- Given the exceptional returns to investing in Australian health and medical research, it makes sound economic and social sense for Australian governments to commit to substantially expanding such investment, and to encourage other funders to do so as well.
- One important obstacle to the security and longevity of changes in policy is the ease with which an expansion in research can be undermined at times of fiscal austerity. This is part of the larger political task of delivering our political decision-making from the various temptations it has to short-change the future.
- Economic reform is also a political project which seeks to build the political culture and institutions that can make difficult decisions and stick to them for sufficient time for them to bear fruit. But while this message is well understood in those areas which involve reducing government assistance where it is unwarranted it is somehow not seen as ‘core’ economic reform business to build the political culture and institutions capable of sustaining and building government investment in supporting R&D and protecting it from the inevitable short term political pressures to meet less important but more urgent priorities.
- It is true that the Productivity Commission has consistently offered a strong defence of government assistance for R&D in principle. Yet in the late 1990s, while it criticised various temporary reversals of tariff reform, it failed to criticise the (permanent) halving of the R&D tax concession, though it was equally *ad hoc* and budget driven in its motivations.
- One way to tackle the problem of long term political commitment would be for

policy makers to commit to long term targets to increase research, as they successfully committed to long term targets to increase compulsory superannuation contributions. Accordingly we propose that, the Australian Government enter into discussions with other funders of research to explore what would be necessary to adopt and meet a target of *doubling* health and medical research expenditure (in real terms) over, say, a decade. To achieve this, spending on health and medical research would have to grow in real (inflation-adjusted) terms by 8 per cent per annum. (Attachment B).

- The recently announced \$7.4 billion in new health spending would mean an additional \$125 million for the NHMRC to preserve its historical share of health spending. But the historical record suggests that in times of fiscal austerity research suffers (Attachment B) — so that advocates of maintaining health and medical research face an uphill battle that should be unnecessary given the evidence of the value of such research. Yet the potential returns from investing in health and medical research remain just as attractive in such times as at any other time, given their long-term nature and relatively high rates of return.
- It also means that, when decisions to increase public spending on health are made, it is important that health and medical research at least maintain its share of such increases. Otherwise, the risk is that this vital field of activity loses out in both cyclical downturns and at times when decisions are made to significantly increase resources devoted to health (Attachment B).
- A better approach would be to systematically increase public investment in health and medical research, combined with regular assessments of the extent to which such investments represent 'value for money' for the Australian community (Chapter 1).
- As Australia's peak funding body for medical research, the NHMRC should regularly report on the effects its funding decisions have on the Australian economy and the health and wellbeing of the population. Taxpayers deserve no less (Attachment B).
- Given the changing nature of the burden of disease in advanced countries like Australia, how the health and medical research dollar is spent also needs to adapt if Australians are to benefit to the maximum possible extent from scarce resources being devoted to this particular endeavour (Chapter 1).
- Although a small country like Australia will import many of the products of health and medical research it is important that Australian research focuses on what can be peculiarly local health challenges and that, in particular, efforts are made to ensure that research findings are translated into how health care is practiced on the ground (Chapter 1). This would mean some rebalancing in the pattern of investments in favour of researching Australians' actual experiences with their health system (in terms of who gets care, when, how and with what results) — and how this can be continually improved.

1 INTRODUCTION AND BACKGROUND

Of all human endeavours, health and medical research arguably offers the greatest potential to improve human life. Research discoveries have extended and enhanced our lives, reduced the burden of many diseases in our society, and are changing the shape of health care. In an era of unparalleled promise offered by genomics, bioinformatics, stem-cell technology, biomedical devices, and therapeutic vaccines, the very nature of clinical practice could shift profoundly over the coming decades. There is, however, another very positive outcome of health and medical research — with the right support from government and industry, it could hold the key to Australia's future prosperity in a global knowledge economy.

Editorial MJA 2005

Views like the above are becoming increasingly commonplace, with spending on science being seen as one of the best ways to generate jobs and spur economic growth. The field of health and medical research is much to the fore with the public, as well. 'Wars' on individual diseases have been declared (e.g. the fight against cancer). Breakthroughs in medical interventions and treatments are hailed by an enthusiastic media on almost a daily basis. Failures to meet the public's (often unrealistic) expectations of the seemingly relentless march of medical science have been the subject of bitter controversy (why haven't we won the various wars yet given the number of claimed breakthroughs?). And lurking behind all the hopes and fears is the reality that health and medical research must compete with numerous other budget priorities — in the public, private and philanthropic domains.

As is the case with other areas involving public spending, governments, other decision-makers (such as public servants), and the medical community regularly debate how much should be spent on health and medical research, how the research dollar should be apportioned among competing priorities, and how costs should be shared (e.g. as between government and industry).

This introductory chapter attempts to set the scene for a review of: how many (scarce) resources should Australia devote to health and medical research, how the research dollar should be spent, and to what extent government should contribute to the costs.

1.1 Health research systems

Clearly, a well-functioning health system (Box 1.1) is necessary to develop and deliver effective and efficient research and evidence-based health care interventions aimed at individuals, sub-populations and the population as a whole.

Box 1.1: What is a health system?

A country's health system comprises all those actors, organisations, institutions and other resources whose primary purpose is to improve health. The National Health and Medical Research Council (NHMRC) — Australia's peak funding body for medical research — is an example of one such institution in the case of Australia's health system.

As well as being guided by inputs from health 'experts' of various kinds, a country's health system should be responsive to the needs and expectations of the population it serves. In turn, responsiveness is determined by key aspects of the way the system is designed and organised — which determines, for example, who gets treated, when and where and, importantly, who pays.

Four key functions of a health system determine the way inputs are transformed into outputs that produce health outcomes that people value: resource generation, financing, service provision and stewardship. Not surprisingly, the effectiveness, efficiency and equity of national health systems are critical determinants of the health status of a country's population.

Source: Based on WHO (2004)

Though it is not hard to find sources of frustration, complication and contradiction all resulting in inefficiencies, when one moves from the ideal to the world as we experience it, that is when we compare Australia to other countries, Australia can claim with some justification to have such a well-functioning system (notwithstanding some obvious challenges — such as the continuing poor state of Aboriginal health).

Equally, a strong health research system is important to provide the knowledge needed to develop effective and efficient health interventions for the Australian community.

The two systems are complementary and interdependent in achieving the ultimate goal of improving the health of Australians. However, both systems are complex (even chaotic) — which makes them difficult to describe and challenging to manage and optimise cost-effectively.

What is a health research system?

A health research system comprises the people, institutions, and activities whose primary purpose is to generate and apply high-quality knowledge that can be used to promote, restore and/or maintain the health status of populations. Importantly, it should also include mechanisms to ensure that the products of health and medical research shape how medicine is practiced on a day-to-day basis in Australia, as well as how patients/health care consumers act on medical advice.

Thus, the main goals of a health research system are the production of scientifically validated research and the promotion of the use of research results, with the ultimate aim of improving the health status of a country's population.

Traditional approaches to using research to develop drugs, vaccines, devices and other applications to improve health are well recognised. But the concomitant need to translate and communicate research findings to inform decisions made by domestic policy makers, health care providers and the public is less well appreciated.

What is research and development?

Research and development (R&D) covers a variety of activities that range from pushing back the boundaries of knowledge (basic or pure research) through the development of the resulting insights into potential 'breakthroughs' or practical improvements right through to the commercialisation stage.¹ The ultimate products of successful R&D, then, are goods and services that consumers (including the mass purchasers of health services) want to buy.

In the case of health and medical research, it is the resulting health-related goods and services that produce the social and economic returns valued by the community, in the form of:

- reduced morbidity (illness or disability) and premature mortality experienced by the population;
- a healthier workforce; and
- increased economic activity (to the extent that those goods and services are produced in Australia).




¹ This description of the R&D process is not meant to imply that the various stages necessarily proceed sequentially (i.e. research first, followed by development, then commercialisation). In fact, as many commentators have pointed out, (e.g. a recent editorial in the 10 June 2010 issue of *Nature*), innovation is not generally the result of simple, linear processes in which basic research produces promising new ideas, which are then developed to explore their potential, with the most promising eventually developed into useful processes or products. Rather, innovation is a complex, highly non-linear series of processes, full of interdependencies and feedback loops that may or (more likely) many not eventually lead to anything of commercial value.

Thus, there is a series of activities that are gone through to produce the valued outputs of health and medical research: basic research produces lots of promising ideas and discoveries; some of these are further developed to assess their real potential; and a few commercialised to produce products that effectively and efficiently address ill-health of various kinds in the community. Economists label this a 'demand-side' effect of health and medical research. At the same time, reduced morbidity and mortality in the community means a fitter and productive workforce — a 'supply-side' effect of health and medical research. Thus, successful health and medical research is doubly beneficial (in that it leads to both demand-side and supply-side benefits).

The (1999) Wills Review into the state of health and medical research in Australia described the endeavour as follows:

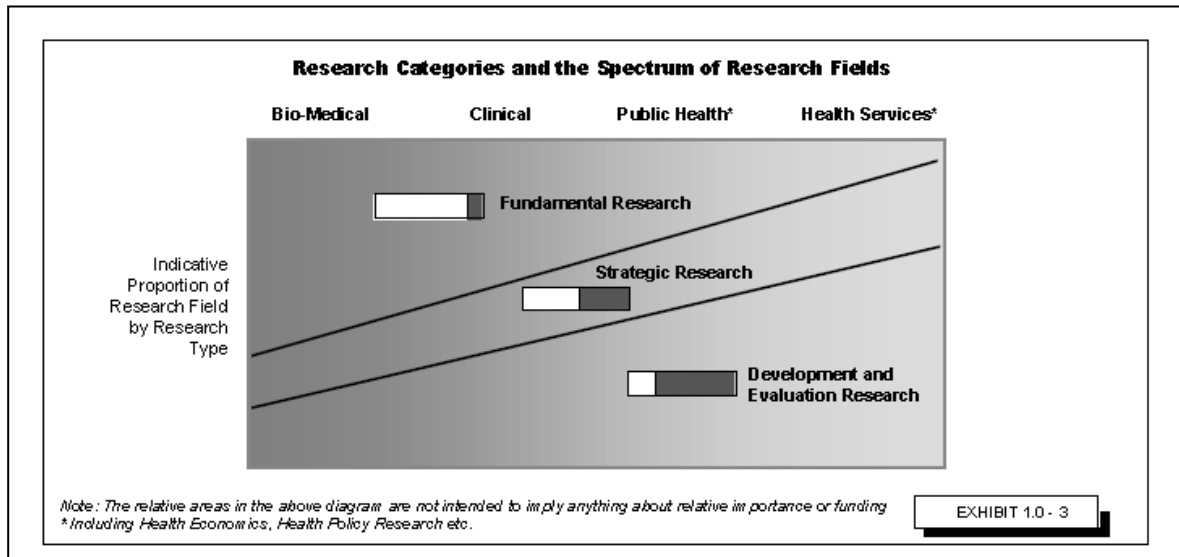
Research is a complex and multi-faceted activity that addresses a variety of objectives in the health sector. At one end of the continuum is research to advance knowledge; at the other end are applied studies such as clinical trials of new drugs or evaluations of public health interventions. Intermediate between these is a range of enquiry targeted towards specific priorities in health, health care and health services. All of these research endeavours contribute to the health of communities and complement one another.

The activities involved in health and medical research can be classified in various ways. For example, the World Health Organisation divides research in three broad categories: 'fundamental', 'strategic' and '(intervention) development and evaluation' — each striking a different balance between the advancement of knowledge and its application (see graphics below reproduced from the Wills Review). Note that each of these categories encompasses, in varying degrees, the full spectrum of health and medical research (across the biomedical, clinical, population health, health economics, health policy and health services areas).

Definitions and Purpose of Health Research and Development			
	Definition	Indicative Purpose	
		To advance knowledge	To change practice
Fundamental Research...	... generates knowledge about problems of scientific significance		
Strategic Research...	... generates knowledge about specific health needs and problems. These may be conditions, risk factors or sources of inefficiency or inequity in health systems		
Development and Evaluation Research...	... creates and assesses products (vaccines, drugs, diagnostics, prostheses or equipment), interventions (public or personal health services), and instruments of policy that improve on existing options		

Source: WHO (1996), *Investing in Health Research and Development*, p3

EXHIBIT 1.0 - 2



Health and medical research is a multidisciplinary activity which is pursued at local, national and international levels, and it generally requires large-scale public investment and support. And with public support much can be achieved. For example, the concerted efforts of public representatives and civic leaders led to the setting up of the US National Institutes of Health — which are now the biggest funders of health research in the world.

The importance of translating research findings into actual improvements in the health and wellbeing of the population argues for widespread participation in setting research agendas, in major health policy decision-making, and in the design, implementation and evaluation of health programs.

1.2 Role of government and links with other economic activity

Governments tend to play a key role in encouraging R&D (including health and medical research), particularly at the basic end of the spectrum — where it can be difficult to convince private sector investors that they can make a sufficient return on such investments to justify the risks involved.

Thus, most developed economies recognise that investment in fundamental research is a legitimate, core role of government. For example, both the Industry Commission and subsequently the Productivity Commission have offered strongly affirmed Government's role in supporting R&D:

Governments have an essential role to play. Knowledge inevitably spreads and may be used in a multitude of ways never envisaged. Its benefits are difficult to constrain or quarantine. When individuals create new knowledge, they do more good for the community than they know or can personally benefit from. Governments therefore need to underpin and supplement the processes of knowledge creation, if these wider benefits are to be adequately realised. This is among the most difficult, and important, tasks of government policy.²

The more applied the research, the easier it often becomes to attract private sources of investment in the activities involved. This is usually because, as health and medical research progresses from the basic (or pure) to more of an applied nature, many of the perceived risks and uncertainties have been resolved — so that investors start to feel more confident about risk-reward assessments of proceeding to a proof-of-concept stage, and on to full commercialisation.

This necessary involvement of both the public and private sectors in R&D ideally sets up a 'virtuous cycle', whereby the roles played by the research community, government and industry in securing improved health outcomes are interdependent (and can become self-reinforcing as success builds on success).

The Wills Review envisaged such mutually reinforcing actions by the research sector, industry and government — with community support — in such a 'virtuous cycle' resulting in:

- an effective health and medical research sector built on high impact fundamental research, and world-class workforce and infrastructure;
- priority-driven research that contributes directly to population health and evidence-based health care;
- an industry sector that mutually reinforces the research sector; and
- increased public investment in a well-managed research sector.

The final (2004) report of the Investment Review of Health and Medical Research (the Grant report) had the following to say on the potential value of sustaining this virtuous circle (p.1):

Australia has three areas of technological advantage. Two are agriculture and mining. These fields have a number of similarities:

- Both are based on “nature’s gifts” to Australia of a sparsely populated continent with favourable geology and environment.
- Both industries are also as old as civilisation itself with declining real prices for commodities and diminishing returns from productivity improvements.

² Industry Commission, *Research & Development*, 1995, p 1, Overview statement, and see also similar affirmations in Productivity Commission, 2007. *Public support for Science and Innovation*.

The third field, Health and Medical Research (HMR), is not so obvious. It is based on the creativity and intellectual curiosity of around 15,000 highly trained health and medical researchers in Australia. Although these men and women have rarely achieved substantial personal wealth from their innovations, their field of endeavour is estimated to have created benefits in longevity and quality of life of over \$5,000bn over the last 40 years, with a return on investment to the community that should excite the interest of the most sceptical investor. Moreover, this is an area of growing demand and rapid innovation that is attracting investment by governments, industry, philanthropists and financial investors around the world.

Imported or home-grown?

It is important to emphasise that — to a large degree — the various R&D activities involved in health and medical research can be undertaken domestically (i.e. within Australia) or overseas (in which case the fruits of health-related R&D are imported and so have relatively little impact on domestic economic activity). Indeed, with developments in information and communication technologies such as the Internet, international collaboration (and competition) have become much more prevalent than was previously the case. This has resulted in progressively keener competition to attract the best minds to the most promising kinds of health and medical research — so that Australia has become a small (but significant) player in a field of research that is increasingly pursued on a global basis.

Pure or applied?

It is also the case that new knowledge and 'know-how' in the health and medical research field need not arise exclusively as a consequence of original research. Rather, it may be the result of adapting existing knowledge to Australian conditions, of conducting research syntheses/reviews which draw together disparate evidence from around the world, or be arrived at on a trial-and-error basis of what works on the ground in Australia.

Indeed, there is a strong argument that much (if not most) Australian health and medical research should arise from, and relate most directly to, peculiarly Australian health problems or health issues (such as skin cancer) whose incidence is relatively high in this country.

Thus, a successful health research system needs to have a significant local component — it is simply not possible to source from overseas all the knowledge, insights and 'know-how' needed to improve the health of the Australian population.

Somewhat remarkably, there has been relatively little effort so far to research Australians' actual experiences with their health system (who has received care, for what, where, and with what result?). Clearly, much could be learned from such research in terms of continually improving Australia's health system over time. This

deficiency in Australian health and medical research could be largely remedied if an e-Health agenda — which would need to be driven by government — gains momentum in this country. The Bennett report described the advantages of putting in place such an initiative as follows (p.8):

The introduction of a person-controlled electronic health record for each Australian is one of the most important systemic opportunities to improve the quality and safety of health care, reduce waste and inefficiency, and improve continuity and health outcomes for patients. Giving people better access to their own health information through a person-controlled electronic health record is also essential to promoting consumer participation, and supporting self-management and informed decision-making.

Workforce

Because they are major funders of the sector, Australian governments significantly influence the health and medical research workforce in this country (e.g. its size, composition, and terms and conditions of employment).

There are around 15,000 health and medical researchers in Australia, according to the Grant Report. Analysis presented in Attachment A suggests that, as a group, they are relatively highly paid (earning some 25 per cent more than the average worker based on value added per worker estimates) — in recognition of the generally highly skilled nature of the work. Nevertheless, there remains room for improvement.³

The Commonwealth Government's response to the Wills Review and the subsequent Grant Report has seen not only increased resources being devoted to health and medical research but also a change in how those resources are applied in a changing world. This is reflected, for example, in the NHMRC's latest strategic plan (for 2010 through 2012) (NHMRC 2010) with its support for:

³ According to the Grant Report (p. 9):

The implementation of the Wills Review has improved the ability of the HMR sector to attract and retain highly skilled staff. There have been a number of elements to this:

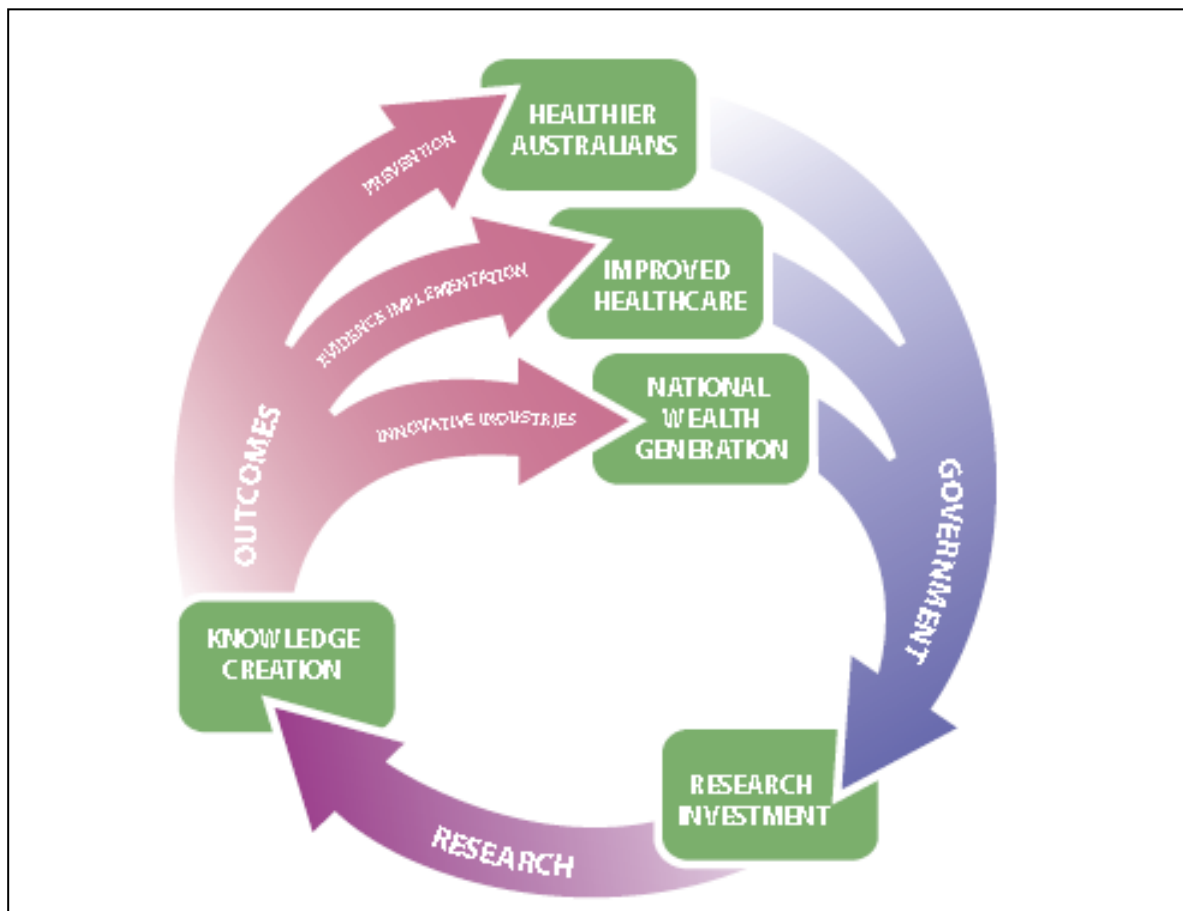
- Talented individuals, such as Professor Peter Doherty and Professor Tony McMichael, have been brought back to Australia by Burnet Awards.
- The expanded, more openly competitive fellowship scheme has opened opportunities to younger researchers (the percentage of junior positions available has increased from 44% in 2002 to 48% in 2004).
- The increased rate of commercialisation is opening new career paths in start-ups for entrepreneurial researchers.

Despite these improvements, many in the sector argue that there is tremendous room for improvement in providing realistic career paths.

- the best research and researchers and improving the translation of new knowledge into evidence-based public health policy and clinical practice; and
- an increased emphasis translational research, on multidisciplinary approaches and on multinational research collaborations.

As part of its strategic plan, the NHMRC updated the Wills-inspired 'virtuous cycle' concept as follows.

NRMRC's take on Wills' 'Virtuous Cycle' concept



Its strategic plan now describes the NHMRC research strategy as:

- **creating knowledge** — by investing in research most likely to yield new knowledge through independent research initiated by talented, well-trained researchers;
- **translating knowledge** — by supporting funding schemes that help ensure research findings flow into improved policy and practice;
- **building capacity to undertake research** — by supporting, renewing and

widening Australia's pool of talented new researchers, from early training through to their most productive years;

- **being a good international citizen** — contributing to the development of health knowledge worldwide and improving health in our region through international research activities; and
- **evolving peer review** — seeking to achieve the highest quality decision making through peer review.

1.3 Health and medical research in the context of the Australian health care environment

Health and medical research does not happen in a vacuum: rather its conduct in a small economy such as Australia's is significantly influenced by the local environment in which it is pursued. The Wills Review described this setting under the following headings: the health environment; research and education; government and community; and industry, and this section presents a brief summary of each by way of background.

The health environment

Real (inflation-adjusted) spending on health in Australia tends to grow more quickly than gross domestic product (GDP). This is typically the case in high per capita income countries, so that the share of resources devoted to health as a proportion of aggregate economic activity rises over time. Thus, based on Australian historical experience, whereas GDP takes 21 years to double, it only takes (real) health spending 15 years to double.⁴

In this environment, the presumption would be that health and medical research effort would also expand to (at least) keep pace with increased health spending. Indeed, if as many believe — and the evidence suggests — that investing in health and medical research leads to above-average returns compared with alternatives, then spending on Australian health and medical research should consistently *exceed* growth in health spending overall.⁵

⁴ These figures are based on average GDP growth for the period 1962-63 to 2009-09 of 3.66% p.a. (see ABS 2010), and on average growth in (inflation-adjusted) health spending over the period 1997-98 to 2007-08 of 5.2% p.a. (see AIHW 2009) — see Attachment B.

⁵ Accordingly, the analysis of health and medical research in Australia presented in Attachment B compares growth in such spending with growth in overall health spending — to reveal whether or not there has been 'excess' growth (over time) in resources devoted to this type of research.

However, spending on health and medical research in Australia at least keeping pace with overall health spending is not inevitable for at least a couple of reasons. The first is that normal market forces are not determining health and medical research investments: to a large degree governments do — so that the level of health and medical research activity is as much a political decision as it is the result of private-sector investment decisions. Understandably, politicians are attracted to potential medical breakthroughs, or where extra resources will make the biggest immediate impact — so that areas such as researching how the health system is performing and other less glamorous topics tend to get short shrift.

Second, as already referred to, uncertainties about the risk-reward equation — particularly as it applies to early-stage R&D — tends to deter private sector investment (which is why government have to get involved to ensure sufficient R&D gets done).

Hence the need for advocacy when it comes to health and medical research, backed by assessments of the potential rewards for investment of taxpayer dollars in this particular area (as compared with other candidates jostling for public support). This is particularly the case 'at the margin', that is, when governments make decisions about incremental spending, as happened recently with the Commonwealth Government's \$7.4 billion response to the Bennett Report.

The health environment is also changing rapidly, and is likely to continue to do so at an increasing rate — with significant implications for the health and medical research agenda (and the priorities that underpin it). The Bennett Report described the changing health landscape thus (p.65):

The dramatic decline in infectious disease and the steady increase in diseases of the 'affluent', such as cancer, diabetes and heart disease, appear to be reliable trends for health planning purposes. However, as we are acutely aware, influenza pandemics and other infectious diseases such as HIV can suddenly arise and cause much suffering and ill health before a treatment can be found. Breakthroughs in research and technology may also considerably alter the prevalence of certain diseases and, therefore, radically change the way health resources are deployed. As an example, consider the development of a vaccine to prevent dementia or a treatment to mitigate its effects. It has been predicted that there will be a 200 per cent increase in the numbers of people with dementia over the next 30 years.⁷⁷ Such an innovation would dramatically reduce the need for a myriad of dementia related home and residential support services in the future. . . .

The mapping of the human genome, completed in 2003, opened up numerous avenues of research with the potential to identify health risk factors and personalise treatment depending upon an individual's genetic make-up. The field of 'personalised medicine' — the capacity to predict disease development and influence decisions about lifestyle choices or to tailor medical practice to an individual — holds enormous possibilities for the future.

Research and education

Under this head, the Wills Review expressed concern that, notwithstanding Australia's proud tradition in health and medical research — with 0.3 per cent of the world's population we produce about 2.5 per cent of the world's health and medical research output — continued eminence in this field was threatened “by the relative decline in financial support and scientific impact over the past five years.” Such a threat remains current because of the fiscal pressures governments around the world continue to operate under (now exacerbated by the global financial crisis). The evidence assembled in Attachment B confirms that, when times are tough, health and medical research tends to be an area where governments cut back.

The Bennett Report regarded knowledge-led continuous improvement, innovation and research as an important lever for reforming Australia's health care system.⁶

Government and community

Under this head, the Wills Review pointed to Australia's underperformance compared with other OECD nations in terms of the percentage of GDP devoted to health and medical research (for example, in 1995, Australia devoted just 0.115 per cent of GDP to health and medical research compared with an OECD weighted average for developed nations which was 50 per cent higher). According to Research Australia (RA 2009), this situation has improved, although the proportion continues to significantly lag the situation in the US.

The (2004) Grant Report was also able to report some progress on this front (p.11):

The recommended increase in investment was provided by the Commonwealth Government.

⁶ According to the report (p.9):

We believe that our future health system should be driven by a strong focus on continuous learning and the implementation of evidence-based improvements to the delivery and organisation of health services. Our reforms seek to embed continuous improvement, innovation and research through actions targeted at both the national level and at the local level of individual health services, including by:

- making the Australian Commission on Safety and Quality in Health Care a permanent national organisation;
- strengthening the role of the National Institute of Clinical Studies in disseminating evolving evidence on how to deliver safe and high quality health care;
- investing in health services, public health, health policy and health system research, including ongoing evaluation of health reforms;
- funding clinical education and training through dedicated ‘activity-based’ payments; and
- establishing clinical research fellowships across hospitals, aged care and primary health care settings so that research is valued and enabled as a normal part of providing health services.

In 1998, Australia invested 0.11% of its GDP in HMR and this increased to 0.12% by 2001. In 2006, when the increased investment from the Wills Review completely phases in, this will reach 0.17%. Despite this increase in investment, it is still lower than the OECD average, which has increased from 0.14% in 1998 to 0.20% in 2002, driven largely by increased investment by USA and France.

However, in relation to the NHMRC the Grant Report was less sanguine post-Wills (p.11):

The overall goal for a well-resourced, professional NHMRC has not been realised. Most of the proposed actions have been implemented, but the manner in which some of these were done has impeded progress. This is not to say there has been no progress; rather the institutional arrangements have meant this has been slower and less complete than planned. Both the excellence and potential of HMR in Australia demand a better structured and resourced peak organisation.

The Commonwealth Government responded to the Grant Report by announcing the allocation of “an additional \$905 million for Australian health and medical research as a major investment in our future health” (Minister for Health and Ageing 2006). The funding package included:

- a \$500 million boost the NHMRC;
- \$170 million for new research fellowships;
- \$22 million for stem cell research;
- additional funding for the Walter and Eliza Hall Institute of Medical Research; and
- grants for the development and expansion of medical research facilities.

Subsequent budgets contained significant funding for research infrastructure. In 2007, the Commonwealth Government announced \$436 million for medical research facilities grants for development and expansion. In 2008, the government announced \$326 million to create the Future Fellowships scheme for top researchers. (across a range of disciplines, including health), while in 2009 Commonwealth budget \$430 million from the Health and Hospitals Fund was earmarked to build and upgrade health and medical research and training facilities across Australia (which included new cancer and other health facilities that would facilitate and integrate research as a component of health care service delivery).

The Bennet Report expressed similar concerns to the Grant Report about NHMRC resourcing from the Commonwealth, recommending that a further \$100 million per year was needed to reach what it regarded as an adequate level of finding.⁷

⁷ Specifically, recommendation 105 reads as follows (p.281):

While the Commonwealth Government may yet respond to that plea, responses to government-commissioned reports tends to be ad hoc — in the sense that in economic downturns spending on health and medical research tends to suffer (Attachment B), while when decisions are made to increase health spending (e.g. in response to the Bennet Report) health and medical research can fail to maintain its share of the health dollar. A more consistent approach to what is a long-term investment in the future health of Australians is arguably a better approach, especially if it incorporates periodic, systematic assessments on the extent to which such investments represent value for money.

The Wills Review pointed to the continuing strong support for health and medical research by the Australian community, citing a Newspoll survey that suggested 89.5 per cent of Australians viewed medical research as very important to improving quality of life — with half of those surveyed believing that there was too little medical research done in Australia, and nearly three-quarters believing medical research to be important in keeping health care costs down. As already mentioned, health and medical research findings are among the most heavily covered news stories. Recently, Research Australia's (RA 2010) polling found that:

- An overwhelming majority (98%) of voters see 'increasing funding for health and medical research' as important for the Federal Government to be focusing on in the next few years (with 40% of them regarding it as *extremely* important);
- More than 4 in 5 voters (82%) believe it is unacceptable that Australians are suffering from diseases that could be treatable with more investment in health and medical research (with 85% wanting to see increased funding for health and medical research, and 77% believing that 2% of the health care budget spent on health and medical research as too low).

To promote research and uptake of research findings in clinical practice, we recommend that clinical and health services research be given higher priority. In particular we recommend that the Commonwealth increase the availability of part-time clinical research fellowships across all health sectors to ensure protected time for research to contribute to this endeavour.

Additional cost \$100 million

Costing Assumptions The NHMRC's planned funding commitments for health and medical research in Australia over the Budget and forward estimates is expected to rise to over \$880 million in 2010 and then stabilise at around \$780 million over the next three years, with 63 per cent of funding supporting research projects, 25 per cent supporting capacity building fellowships and scholarships, and 12 per cent supporting the translation of health and medical research into evidence-based practice.

NHMRC funding has been around 1.3 per cent of all Health and Ageing portfolio in recent years. Using departmental estimates for spending to 2011–12 and then projecting portfolio and NHMRC spending forward based on those growth rates, NHMRC funding should reach \$890 million by 2014–15. A further \$100 million per year is needed to reach this level of funding.

Charitable support for health and medical research is also solid in Australia (see Attachment B), although the Wills Review pointed out that, despite this, major philanthropy is at much lower levels than in the UK or the US.

Industry

The Wills Review pointed to industry funding of health and medical research in Australia being very low by OECD standards, despite government support in the form of industry-specific government programs (such as *Factor (f)* — subsequently transformed into the Pharmaceuticals Industry Investment Program, and now withdrawn — pitched at the pharmaceutical industry) and tax breaks (e.g. the 150 per cent tax deductibility for R&D which under recent changes are being transformed into tax credits).

The follow-up Grant Report (on progress with implementing the Wills Review) found some encouraging signs on the industry front. On new business formation the report was able to say (p.10) that:

There has been a substantial cultural shift among researchers. Commercial exploitation of new knowledge, once viewed as potentially limiting science or slightly distasteful, is now readily accepted. Scientists understand that Intellectual Property (IP) protection and new company formation is a crucial part of bringing innovations to consumers and an exciting adjunct to research. This cultural shift has led to a substantial increase in the rate of patenting and new company formation. The next challenge is to ensure that a good number of these new businesses are internationally linked, have access to the resources necessary to grow into substantial enterprises that deliver great technology to clinicians and consumers, create jobs and reinvest in more research.

The report also had some encouraging things to say on the vexed issue of access to capital (p.10):

A range of Commonwealth Government and private initiatives have addressed the problem of access to capital identified in 1998. This has led to rapid growth of the venture capital industry as a whole, and several investment funds now focus on early stage funding for biotechnology companies. While there is now, based on the views and plans of the venture capital industry, significant capital for investments of up to \$5m, preseed, proof-of-concept risk capital and the skills to evaluate commercial opportunities remain scarce. Australia also faces a structural problem that the size of our capital market means that later stage funding for unlisted companies, typically requiring funding of over \$5m per venture, is typically not available to fuel the growth of the most promising companies. To allow embryonic companies to capitalise more effectively on the commercial potential of their underlying technology, we need to attract different types of investors. These could be patient, larger international venture capital firms, international pharmaceutical or biotech companies who have the resources and networks to properly assess global commercial prospects and the ability to provide ongoing finance.

Biomedical and clinical research is increasingly being funded and controlled by 'big pharma', with clinical trials increasingly being conducted in developing countries because of perceived ethical and informed consent problems making conducting such trials in developed countries comparatively (even prohibitively) expensive.

In 2008, the Commonwealth Government announced a Review of the National Innovation System. The review panel, chaired by Dr Terry Cutler, was asked to identify gaps and weaknesses in Australia's innovation system and recommend ways to correct them. The review panel's report, *Venturous Australia: Building Strength in Innovation*, was released on 9 September 2008. It identified several problems with Australia's innovation system and recommended that the Australian Government:

- Develop innovation priorities to ensure that scarce public resources are directed to areas of competitive advantage and strategic importance, and that progress is properly monitored and evaluated.
- Improve the governance of the innovation system to provide clear leadership and coordination across government, business, research centres, and educational institutions.
- Allocate research funding in ways that drive excellence, collaboration and diversity, within a framework that improves the links between funding, national priorities, and the diverse research missions of Australia's universities.
- Establish a business environment conducive to innovation, including through support programs to maintain the recent growth in R&D, and measures to encourage knowledge partnerships and networks.
- Develop the skills and capabilities of workers and managers to promote cultural change and creativity in Australia's workplaces.
- Promote innovation within government and the community sector, with the emphasis on whole-of-government approaches to innovation and the use of public procurement to build world-competitive capabilities in Australian organisations.
- Introduce measures to increase domestic and international collaboration between businesses and researchers, to maximise knowledge flows and value-creation.

Also in 2008, the Pharmaceutical Industry Strategy Group (the McNamee Report) mapped out a 10-year plan for the Australian pharmaceutical industry recommending (*inter alia*):

- Implementation of measures proposed by the Cutler Review;
- Streamlining the regulatory and operating environment for clinical trials; and
- A co-investment scheme for strategic projects.

The Government's response was *Powering Ideas: An innovation agenda for the 21st century* (2009) — a ten-year reform agenda predicated on the thesis that (p.iv):

Increasing our capacity to create new knowledge and find new ways of doing business is the key to building a modern economy based on advanced skills and technologies. It is the key to success in this, the global century.

On 12 May 2009 the Commonwealth Government announced its intention to replace the existing R&D tax concession with a new R&D tax credit which followed the recommendations of the Cutler Review. The new tax credit provides assistance to R&D without the long delays, uncertainties and inconsistencies involved in the old tax concession.

The proposed tax credit was to be a broad-based and market driven incentive package. The two core components of the package are:

- a 45 per cent refundable tax credit (the equivalent to a 150 per cent concession) for eligible entities with an aggregated turnover of less than \$20 million per annum; and
- a non-refundable 40 per cent R&D tax credit (the equivalent of a 133 per cent deduction) for all other eligible entities.

However to meet the additional costs that would otherwise arise and in line with suggestions in the recent Productivity Commission report on *Public Support for Science and Innovation (2008)* the assistance was focused less on development expenditure than the previous tax concession. The intended start date of the new tax credit was 1 July 2010. However, parliament adjourned before the Senate could vote on the legislation, and parliament was prorogued on 19 July 2010.

1.4 Some impediments to the conduct of health and medical research

Time lags

Given the often substantial time lags between the R&D and full commercialisation phases for items like medical devices and diagnostic tests, and the typically very long time frames for therapeutic and preventive agents to be approved for human

consumption, health and medical research-related wealth generation often occurs years or decades after the original conception. Such delays exceed the (relatively short) time frames of politicians (or even of health and medical research funding bodies). This can be problematic if publicly financed resources are necessary for the health and medical research process to succeed in producing goods and services valued by health care consumers.

On the other hand, increasing industry funding of health and medical research conducted by universities and other public institutions, academic pressures to “publish or perish”, and a lack of proper accountability have led some commentators to question whether the system can be relied on to regulate itself in the public interest. And growing interdependencies between science, government and industry in shaping the health and medical research landscape have raised troubling questions about how trade-offs among ethical concerns, scientific values, profits and personal gain are struck in practice.

In turn, such tensions raise concerns about how health and medical research is funded, the integrity of the peer review process, scientific transparency, the ownership of knowledge produced by health and medical research, and how the fruits of research are to be shared equitably among potential beneficiaries.

Complicating matters further is the confusion that arises when the experts cannot agree on the meaning and implications of research findings. Science does not have all the answers and uncertainty often characterises the research process.

Debates in these various areas would benefit from more proactive management in order to acknowledge the often divergent view points of various constituencies, as well as to minimise adverse events or health-threatening behaviours. In Australia, the Chief Medical Officer (and his/her State and Territory counterparts) play an important role in this regard — with, for example, the CMO of Australia occasionally being called upon to pronounce on health and medical research matters, particularly as they affect the health of the population.

A focus on illness at the expense of wellness

It is no mystery that illness — particularly involving hospital-based acute care — acts as a magnet for politicians’ largesse when it comes to spending the health dollar. After all, when politicians visit hospitals it is crystal-clear how applying extra funding will save lives and reduce suffering in society.

Less graphically demonstrable is the worth of investing in health and medical research aimed at prevention rather than cures.⁸

⁸ The Bennett Report described the problem in the following terms (p.51):

Developing the political institutions to support R&D.

Greater assistance for research was one part of the 'political settlement' that Industry Minister John Button brought to industry policy in the 1980s and 90s. It had an obvious appeal in winning the political argument for lower protection to use both carrots and sticks to bring about a painful adjustment. But, at least as far as R&D is concerned, the positive assistance was also economically justified. Further there are aspects of the politics of R&D that resemble the politics of protection.

For moving to better policy is likely to be painful. In the case of lowering protection the pain is concentrated in the industries that are being (less) protected. In the case of increasing government support of R&D the pain is felt on the government's budget. And given the vigour of scrutiny that budgets receive each and every year and the additional scrutiny they receive in times of fiscal austerity, the security of assistance delivered through the budget is well known to be more precarious than for instance tariff assistance was until the advent of economic reform.

Further, to a substantial extent that which is new must come into existence in competition with the old. And as economists and political theorists since Adam Smith have noted, incumbent business interests are typically well represented in the political process whereas that which is new and experimental may have minimal political visibility let alone support. Thus in the election just held, the ALP Government diverted \$448 million it had previously earmarked for innovative government IT programs (as part of the Gershon reforms) to enable spending on higher political priorities. The Coalition likewise took funding earmarked for the introduction of e-health. These are simple illustrations of an enduring dilemma around the political culture of innovation.

As research provides us with more and more answers to the causes of disease, we are becoming increasingly aware that aspects of our modern lifestyle may be detrimental to our health. But it is difficult for many Australians to make healthy choices in the way they live their lives because of their socioeconomic circumstances or their living environment. In 2006–07, Australians spent about \$94 billion on health. However, the proportion of this spent on preventing illness was estimated to be less than two per cent of this total. Chronic diseases are common. In 2004–05, 77 per cent of Australians had at least one long term condition. In previous years, chronic conditions were estimated to consume about 70 per cent of the sector's spending and yet the emergence of many of these chronic conditions is influenced by potentially modifiable lifestyle or risky behaviours. In essence, we commit less than two per cent of the health budget to a problem which consumes a major proportion of health expenditure.

We have a health system skewed to managing sickness rather than encouraging wellness. There is no nationally coordinated mechanism to deliver prevention and health promotion services on the scale required to impact significantly on the cost of chronic disease. And the structure of the Medicare Benefits Schedule principally subsidises one-off visits to manage and diagnose health problems, rather than looking after a patient over a time period or keeping the patient well.

However it appears that this problem does not loom large for many economic reformers and that removing unjustified assistance is closer to their hearts than ensuring the adequacy and stability of incentives for activities like R&D which are increasingly important as an issue relative to special assistance for specific industries as the level of such assistance falls.

As one of Australia's best recognised economists observed "there can be little doubt that purely from a public relations point of view specific positive measures such as export subsidies are helpful in bringing about reductions in protection against imports.⁹ However the Productivity Commission and its forerunners have typically been hostile to such ideas.¹⁰ Further, as has been noted the PC typically defends R&D assistance in principle, and its empirical work typically supports this inclination. However it will often argue that some unusually high level of assistance to R&D should be 'levelled down', not because the PC's empirical research has determined that the level of assistance is excessive, but ostensibly on equity or competitive neutrality grounds. Of course the alternative would be to increase the lower rates of assistance rather than lower the high ones. When it comes to industry assistance, including assistance for which there is strong theoretical and empirical support, Levelling down is a decidedly more frequent refrain from the PC than levelling up.

The policy decisions of 1996 offer the closest we have to a controlled experiment in testing the contrasting reaction of Australia's 'reform establishment' to different *kinds* of deviations from good policy practice. Seeking to move faster towards balancing the budget, the Australian Government introduced a three percent temporary revenue duty on Australia's duty free imports. It also permanently halved the research and development tax concession a policy which had been seen as broadly worthwhile in a recent Productivity Commission (then Industry Commission) report.¹¹

The Productivity Commission's 1996-7 Annual report offered this not very veiled criticism of the former policy introducing a revenue duty (p. 11).

Debate has been stimulated further by perceptions of confusion and inconsistency in the approaches of governments to industry assistance. The decision to levy a 3 per cent duty on business inputs previously imported duty free under the tariff concession system is one example.

⁹ Corden, W. M., 1980. "Comments on Anne Krueger's 'How to Best Move towards Freer Trade - Some International Perspectives'", Centre for Economic Policy Research, Discussion Paper Number 9, Australian National University, June, p. 27

¹⁰ See below, and also Industries Assistance Commission, Annual Report, 1986-87: iv, cf IAC, Annual Report, 1988-89: 4.

¹¹ Industry Commission 1995, *Research and Development*, report no. 44, available at: <http://www.pc.gov.au/ic/inquiry/44randd>

By contrast the PC's reaction to the reduction in the R&D tax concession was much more equivocal.¹²

We have tackled such problems in our political culture before. Thus for instance aware of the inequities in access to superannuation, and the inadequacy of Australians' household savings an Australian Government committed to increase compulsory superannuation and on account of the political success of that policy compulsory superannuation continued to be increased for many years notwithstanding a change of government. We should aspire to something similar in the area of innovation generally, and in the area under discussion here, in health and medical R&D.

We suggest building a consensus around some desirable long term outcome and then seeking some pre-commitment to track progress and deliver that outcome over some appropriate time-frame. There is no science to such endeavours, but we suggest for consideration the target of doubling real expenditure on medical and health related R&D as a proportion of all medical and health related expenditure over a period of ten years with annual milestones and independent public reports on progress.

¹² Soundly-based and well implemented business programs can make a contribution to improving national productivity. The Commission (IC p. 26, 1997a) has argued that, where business programs effectively overcome market failure, they can increase economic growth and community welfare. For example, there is a strong case for government support for business R&D to the extent that such assistance can generate significant additional spillover benefits to the community (IC 1995a). At the same time, the justification for parts of the Commonwealth's \$3.4 billion business support program is questionable. For example, there is little evidence of widespread and significant spillover benefits to other firms from export market development activity which would be required to justify continuing firm-specific export assistance." P. 27

2 RESEARCH AND IMPROVED HEALTH

Estimating the economic value to societies of health research is a complex but essential step in establishing and justifying appropriate levels of investment in research. The practical difficulties encountered include: identifying and valuing the relevant research inputs (when many pieces of research may contribute to a clinical advance); accurately ascribing the impact of the research; and appropriately valuing the attributed economic impact.

Buxton *et al* (2004)

People hope to enjoy long lives as free as possible from pain, illness or disability. The widespread enjoyment of good health confers social and economic benefits on individuals, their families and friends, and the wider community. To secure these benefits, society is prepared to devote significant resources in health-related activities, including investing in health and medical research.

The link between health and medical research and improved health — in the form of reduced morbidity and premature mortality — has been extensively researched in the international and Australian literature. As the above quote above suggests, the proper attribution and valuation of economic and social benefits can help justify and an appropriate level of expenditure on health research and, hopefully, indicate ways to increase the yield from future investments in this vital field of research.

2.1 Valuing health gains

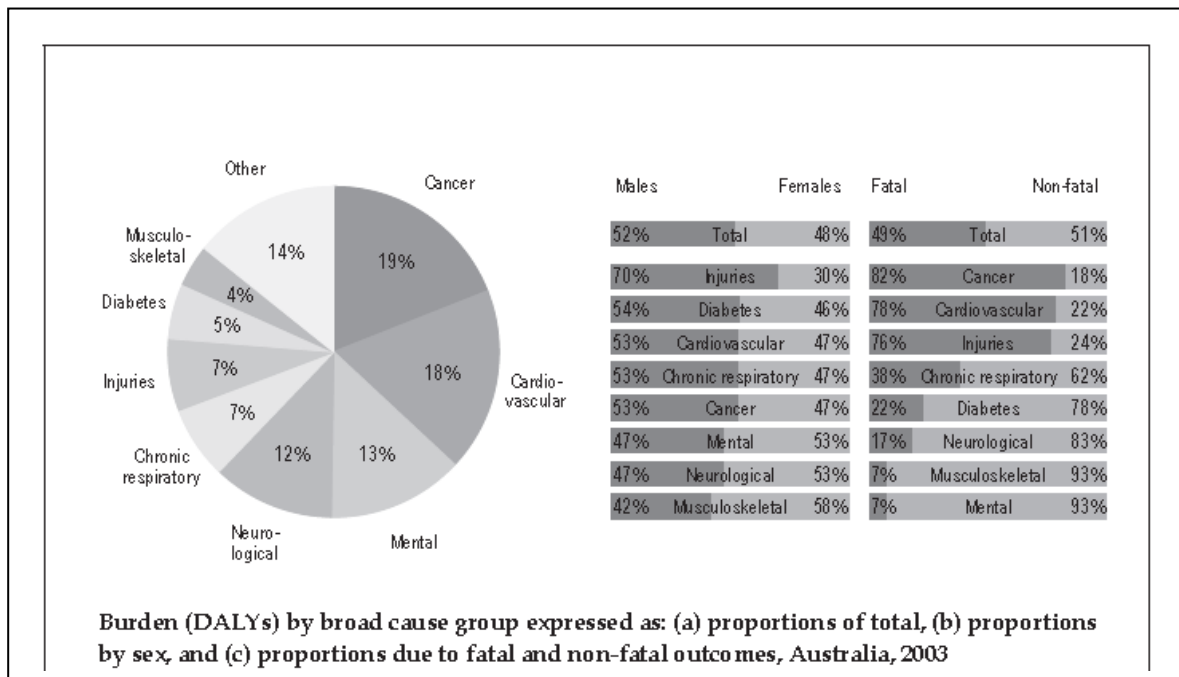
Before attempting to quantify (i.e. put a dollar value on) the value of health gains, it is important to appreciate what has been happening to human longevity, and why. Australia (in common with many other countries) are living longer, healthier lives, and these trends have been evident for a long time (Box 3.1 and Chart 2.1).

Box 2.1: A revolution in health

David M. Cutler of Harvard and Srikanth Kadiyala of the National Bureau of Economic Research analysed increases in life expectancy in America, and found that health has improved fairly steadily since the middle of the 18th century. Life expectancy at birth in 1900 was less than 50 years, while today it is 77. And morbidity has been falling in concert. But this relatively steady improvement obscures sea changes in the causes of improved health. Reduction in infant mortality, presumably linked to improved diet, sanitation, housing and education and the introduction of effective pharmaceutical weapons against infectious disease, largely explains the gain prior to the middle of the 20th century. Since then, the gains are closely associated with declining mortality among the elderly, where chronic degenerative diseases are the primary culprits.

Source: Funding First (2000).

Chart 2.1: Total burden of disease and injury, Australia, 2003



Source: AIHW (2007).

The evolving situation in Australia has been described by the Australian Bureau of Statistics (ABS 2002) as follows:

Increases in life expectancy occurred over most of the twentieth century, and resulted in an increase of 20 years of life for both men and women. Much of the improvement in the first part of the century was because of a decline in deaths from infectious diseases. This was associated with improvements in living conditions, such as cleaner water, better sewerage systems and improved housing, coupled with rising incomes and improved public health care, including initiatives like mass immunisation. These changes were particularly beneficial to infants, women who were pregnant or in childbirth, and older people; official statistics show that rapid declines in deaths among infants were the main reason that life expectancy increased in the first half of the century. Increases in life expectancy slowed in the middle of the twentieth century, and then plateaued in the 1960s, largely because of increases in cardiovascular disease.

Substantial improvements in the life expectancy of older people have been a feature of the second half of the twentieth century, particularly since the 1970s. According to the ABS, between 1982 and 2001 life expectancy at age 70 increased by about three years for men and two and a half years for women. (Over the same period, life expectancy at birth increased by six years for men, and just over four years for women.)

Progress has been associated with a decline in deaths from chronic diseases — such as heart disease, cancer and strokes — which have replaced infectious diseases as the main causes of death. Greater attention to living healthier lifestyles, continued improvements in living standards, together with ongoing medical advances (including improvement in illness prevention, screening and diagnosis and treatment) have supported this transition.

Thus, many factors have contributed to observed long-term trends of increasing life expectancies and reduced morbidity, including medical advances attributable to health and medical research conducted both in Australia and overseas.

2.2 Establishing a link between health and medical research and improved health

Several approaches to establishing a link between health and medical research and subsequent observed improvements in the health of a population have been pursued, and attempts made to quantify the relationship in particular countries, including in Australia.

Principal approach

The conventional starting point in the literature on the link between health and medical research and the health of a population is to attempt to operationalise the concept of 'wellbeing' in measurable form. Such measures need to be able to take

account of changes in both mortality and morbidity (illness and disability) over time — so that proposed measures would record an increase (or gain) in the wellbeing of a population as premature mortality and/or morbidity fall over time.

If asked, most people would say that it is not possible (and perhaps unethical) to place an economic value on human life. Notwithstanding the conceptual and practical difficulties involved, it nevertheless remains the case that, given the scarcity of resources for public undertakings (and the consequent need for their allocation between competing priorities), if such valuations are not made explicitly then they will be made implicitly through decisions about which initiatives receive public support (and the extent of such support) and which do not.

The World Bank and the World Health Organisation gave considerable impetus to systematic analyses of gains in wellbeing in their Global Burden of Disease and Injury study (WHO 1996) — which set out to quantify the health effects of more than 100 diseases and injuries for eight regions of the world in 1990.¹³

The DALY

WHO's original study generated comprehensive and internally consistent estimates of mortality and morbidity by age, sex and region and introduced a new metric – the Disability-Adjusted Life Year (DALY) – as a single measure to quantify the burden of diseases, injuries and risk factors. The DALY is based on years of life lost from premature death and years of life lived in less-than-full health.

An estimated dollar value of a DALY can be applied to DALYs saved in a population to derive an economic value associated with premature mortality and morbidity avoided by a health 'intervention' (attributable, for example, to health and medical research, investing in population measures such as potable water and sewerage systems, etc.).¹⁴

¹³ The huge burden of communicable diseases is well known, but as populations age and risk exposures shift, non-communicable diseases are rapidly becoming a leading cause of disability and premature death — even in developing nations. WHO estimates that, by 2020, non-communicable diseases will account for about two thirds of the global disease burden.

¹⁴The mechanics of calculating and valuing DALYs is described by Access Economic (AE 2008:4) as follows:

The DALY extends the concept of potential years of life lost due to premature death to include equivalent years of 'healthy' life lost by virtue of being in states of poor health or disability. In brief, DALYs for a disease or health condition are calculated as the sum of the years of life lost due to premature mortality (YLL) in the population and the years of healthy life lost due to disability (YLD) for incident cases of the health condition. This can be represented by:

$$\text{DALY} = \text{YLL} + \text{YLD}$$

Because the calculations involve averages, by implication the estimates are conventionally referred to as 'statistical lives'. As well, an unavoidable element of subjectivity enters the figuring because of inevitable variations in 'severity weight' assessments by individuals of various kinds of disease and disability (which is again usually addressed via averaging over the assessments of many individuals). For these and other reasons (e.g. other necessary assumptions of the analyses), the results are often subjected to 'sensitivity testing' (where alternative values for key variables are canvassed to see how sensitive the results are to plausible variations in parameters and other key assumptions).

Valuing 'statistical' lives and DALYs

The Value of a Statistical Life (VSL) can be measured in various ways, including adopting traditional *productivity* approaches, and '*willingness to pay*' (WTP) alternatives.

Productivity approaches to measuring a VSL or VSLYs are usually based on the prospective earnings associated with 'lost' production of individuals suffering premature mortality or preventable morbidity.

However, the loss of human life (or its curtailment in terms of ability to work) is usually valued at more than just forgone earnings — so that productivity approaches typically incorporate both the value of unpaid work and the utility value of leisure. Thus, the human capital valuation approach (narrowly based on forgone earnings) places a lower bound on the VSLY.

To take account of the value of both unpaid work and leisure, a hybrid or 'mark-up' approach is usually applied, whereby the sum of these additional components are typically assumed to translate into an additional value of between 30 and 40 per cent of the value of earnings (see literature review by Buxton 2004).

As a DALY incorporates loss of life (YLL) and loss of non-fatal healthy life (YLD), it is a summary measure of the loss of 'perfect health' from different diseases and injuries. The life lost due to premature mortality is calculated by subtracting age at death as a result of the disease or injury from the life expectancy under perfect health (which is 82.5 years in females and 80 years in males). Calculating the loss of healthy life due to non-fatal health conditions (YLD) requires estimation of the incidence of the health condition (disease or injury) in the specified time period. For each new case, the number of years of healthy life lost is obtained by multiplying the average duration of the condition (to remission or death) by a 'severity weight' that quantifies the equivalent loss of healthy years of life due to living with the health condition. The severity weight is based on a social value and ranges between zero and one, with one being the most severe disability.

Thus, for example, with Australian average weekly earnings at around \$1200 (or \$62,400 per annum), applying the above factors would put a VSLY at between \$81,120 and \$87,360, translating into a VSL of between \$2.9 million and \$4.1 million (assuming a working age range of 18 to 65).

As an alternative back-of-the-envelope calculation using a purely human capital approach, per capita gross domestic product (GDP) in Australia is around \$50,000 per annum. This would translate into a VSL of \$4 million based on a life expectancy at birth of 80 and to between \$5.2 million and \$5.6 million taking into account the 30% to 40% extra to allow for non-economic aspects of this valuation method.

Willingness to pay (WTP) approaches to valuing human life have been the focus of the literature on the economics of life-saving since the 1960s. WTP assumes that people's utility depends on their income and health (although the complexities of the interactions are not always taken into account). People's WTP to avoid certain risks to life and limb can then be translated mathematically into an estimate of their VSL or VSLY. There are two empirical methods of determining VSL/VSLY using WTP approaches:

- stated preference valuation (contingent valuation or choice modelling) methods; and
- revealed preference (hedonic) valuation methods.

Stated preference methods do not infer values from actual real world decisions, but are hypothetical. Revealed preference studies are generally considered superior to measure individual WTP as they are based on real world empirical, binding market transactions. Compensating (hedonic) wage studies, for instance, use information on people's job choices to estimate WTP for job risk changes.

Thus, if a worker voluntarily switched from a job inherently involving less risk to life and limb to a more risky one – say from an office job to one in the mining industry involving operating heavy machinery under hazardous conditions – then it is possible to infer VSL/VSLY values from the risk-reward profiles of the two types of jobs. For example the office job may involve voluntarily assuming a 1 in a million (i.e. 0.000001) chance that such a worker would be killed in the job during his or her working life, while in the case of the mining job the risk of death might increase 1000 fold (i.e. to 0.001) – in return (say) for earning an additional \$10,000. In this example, the implied VSLY would be \$213,400, with a VSL of \$10.0 million.

Thus even simple calculations adopting productivity and WTP methods in the Australian context generate VSL estimates ranging from \$3 million to \$10 million.

Such simple figuring can be made more sophisticated in various ways. For example, statistical measures such as average weekly earnings, per capita GDP and risk premiums attaching to inherently dangerous occupations tend to grow in real (i.e. inflation adjusted) terms over time. For example, long-term growth in Australia's GDP is some 3.66 per cent per annum (see Attachment B). The other correction usually applied to, say, a stream of annual VSLs is to calculate their net present value (NPV) — involving discounting each estimate back to some base year using an agreed discount rate to approximate the 'time value of money' (i.e. to correct for the fact that \$1 to be paid in the future is worth less than \$1 today). Thus, the Australian Institute of Health and Welfare (AIHW) uses a discount rate of 3 per cent per annum for these purposes. To the extent that one correction offsets the other (e.g. a 3 per cent discount rate will offset measures growing in real terms by the same rate per annum), the above estimates would remain unaffected by these complications (see section 2.4, however, for Australian estimates which take these kinds of adjustments into account).

Disentangling cause and effect

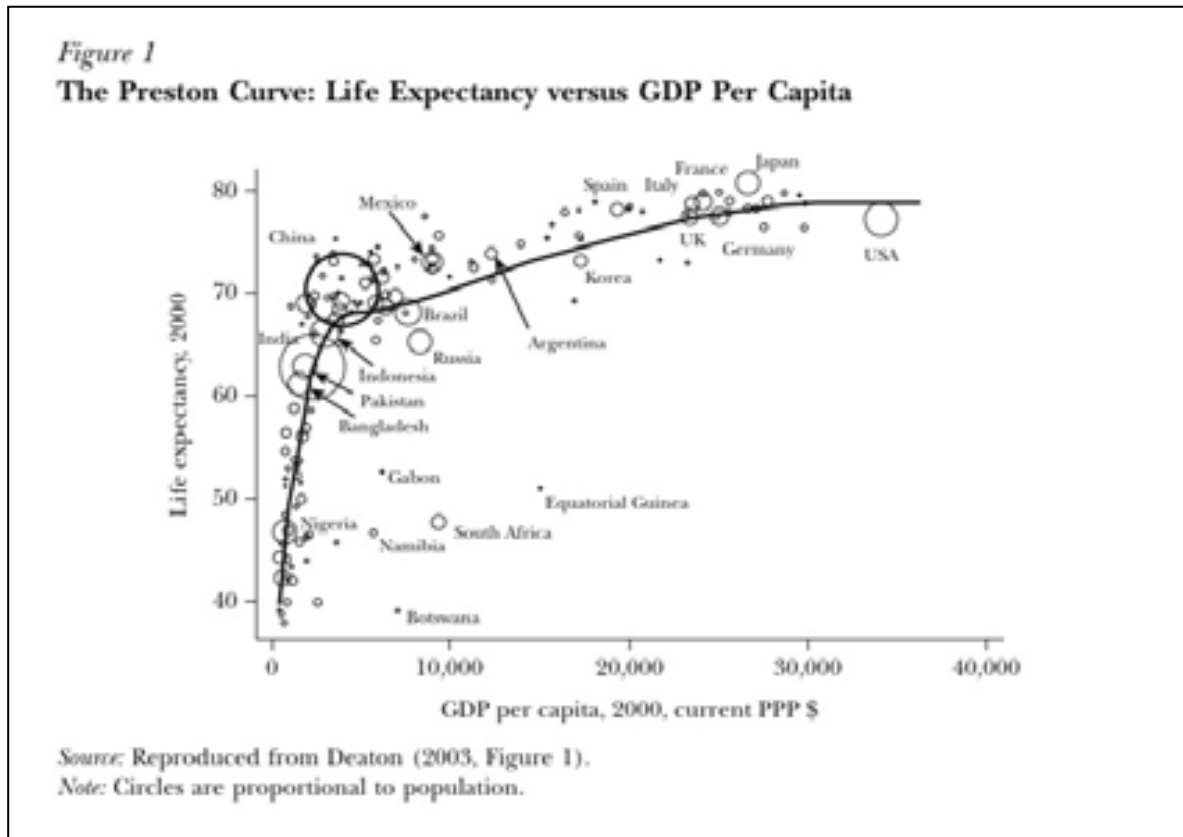
As discussed, many factors play a role in observed reductions in mortality and morbidity rates over time, of which applying the fruits of health and medical research is but one.

The simplest examples occur where causation is clear, as when the deaths of young infants are avoided, for instance as a result of a life-saving vaccination. In such cases effectively a whole VSL can be attributed to the health and medical research processes that led to the availability of the vaccine. There are many such examples where the link between health and medical research and reduced mortality and morbidity is clear-cut — so that it is relatively straightforward to count the VSLs and DALYs saved.

It is more difficult to generalise. However, it is reasonable to presume that in the early stages of a country's development sanitary engineers saved more lives than doctors, whereas once countries reach more advanced stages of development gains are more incremental, and more likely to be attributable to new knowledge and other products of health and medical research.

Some support for this kind of broad attribution of cause and effect comes from the following graphic of the relationship between life expectancies at birth and per capita GDP (the Preston curve). Here, significant gains in life expectancies tend to be made when incomes are rising from very low levels and significant inroads are being made in less-developed countries to provide basics such as potable water and sewerage systems. But as incomes increase it becomes more difficult to secure increases in life expectancies as the incidence of premature mortality and morbidity due to communicable diseases yield to the challenges involved in addressing increasing incidence of chronic disease. Thus, one interpretation of the Preston curve is that the

role played by health and medical research in achieving reductions in mortality and morbidity in advanced countries (such as Australia) becomes increasingly the dominant causative explanation.



However, disentangling cause and effect in a completely unequivocal way is quite a challenge, as the following quote from a recent article titled *What science is really worth* (Nature 2010) makes clear:

Whatever method economists have used ... , measuring the ROI [return on investment] from research has proved tough, and has produced a wide range of values. Some look at the 'micro' level, asking things such as: what contribution did a dozen neuroscience grants received by the University of Cambridge in 1972 eventually make to drug development? Such efforts are complicated, however, by the difficulties of attributing credit for any given drug to the numerous research teams involved over time. Policy-makers are more interested in the 'macro' question, measuring the effect of combined research activities on a country's economic growth.

Other approaches to quantifying the link between health and medical research and improved health

Direct cost savings to the health care system

Self-evidently, health and medical research can save on health care costs. This can happen, for example, when new therapies reduce either the number of patients needing treatment (as happens, for example, with the introduction of a new vaccine) or the per capita costs of treatment (as happens, for example, when generic versions of medicines become available).

Many instances of direct cost savings can be identified. For example, Weisbrod (1983) conducted a classic cost-benefit analysis for the development of the polio vaccine and described the benefits in terms of a rate of return. Calculations were also made about tuberculosis in the USA. As another example, Jacob & McGregor (1997) examined various assessments of health technology that were undertaken in Quebec, Canada, and found that several had directly influenced policy and contributed to health-care cost savings through reduced costs per patient. As a final example, a methodologically important set of studies from the National Institutes of Health (NIH 1993) estimated the monetary value of examples of research that they had funded. In these studies, estimates were generally made on the basis of expert opinion concerning the likely uptake of the research findings, rather than actual observation of changes in practice, and included, but were not restricted to, estimates of savings for the health-care system.

But even in cases of estimating direct cost savings problems of attribution occur. Thus, difficult judgements arise with regard to which research was essential to a particular development, and in some cases this is exacerbated by national claims to the key research. For example, NIH suggest that large savings resulted from its research related to the discovery of the role of *Helicobacter pylori* in the development of stomach ulcers. This discovery had a considerable impact on the need for long-term treatment. The Australian Society for Medical Research, however, emphasised that the original work related to this discovery was undertaken in Australia, and in its description of the history of this research and cost savings in Australia, makes no reference to funding from NIH. In the field of mental health, large savings (in terms of hospital costs avoided) have resulted from improvements in treatments, such as the use of lithium to treat manic-depressive illness. This example provides the third-highest savings out of a list of 36 examples of returns in the USA to investment in research by the US. Again, however, others note that basic Australian research made a key contribution to this field.

Direct cost savings (or reduction on claims on resources) may accrue more widely than to the health-care system alone. Research-based approaches that result in shorter and/or more effective treatments may also result in savings in non-medical direct costs, such as custodial care, transportation, special equipment, and community support programs run by governments and voluntary agencies.

Benefits to the economy from a healthy workforce

Rather than narrowly focusing on direct cost savings within the health system attributable to health and medical research, another approach in the literature involves casting the net somewhat more widely to include indirect savings and benefits. An example of an indirect saving would be avoidance of being unable to work because of morbidity which the results of health and medical research can obviate. An example of an indirect benefit would be the ability to enjoy one's non-working time more fully because the products of health and medical research have avoided some disability or illness.

The case of polio is instructive here, to take just one example. Thus, Fudenberg (1983) estimated that the initial cost savings to the health-care system in the US were lower than the combined costs of the research and the costs of purchasing and applying the vaccines, but that the main benefit was the avoidance of lost production.

The advantages of a fit and healthy workforce are obvious to all (and the value of production lost to sickness and disability can be systematically estimated). For example, if each worker takes one week per year off because of illness or disability that would translate into a potential of around 2 per cent in forgone production. With Australian GDP now of the order of \$1.25 trillion, this would mean forgone production of around \$24 billion annually. And with spending on health and medical research likely to be of the order of around \$3.3 billion¹⁵ if the fruits of health and medical research could reduce the incidence of such absences from work by 13.75 per cent then this economic saving alone would justify Australia's annual spend on health and medical research. Given the high rates of estimated returns to investing in health and medical research documented elsewhere in this report, the products of health and medical research could plausibly produce such a reduction in workforce absences.

Benefits to the economy from commercial development

Many commentators have emphasised the potential contribution health and medical research can make to wealth-creation, as the fruits of research are progressively manifest in the production of health-related goods and services that are included in measures of aggregate economic activity such as GDP.

A review by Salter & Martin (2001) identified a range of benefits to an economy from publicly funded basic research. While finding that none of the included studies provided a simple and comprehensive model, it commended the progress made by Mansfield (1998) in measuring the benefits resulting from basic research. Mansfield

¹⁵ This estimate was arrived at by adding 10% to the \$3 billion estimated of health and medical research spending reported in Table B2.1 for 2006-07 (with the 10% uplift intended to roughly cover inflation since then).

surveyed large corporations covering seven industries in the USA for data concerning the proportion of firms' new products and processes that could not have been developed, without substantial delay, in the absence of recent academic research. Using figures for the value of sales of research-based products, and knowledge of the level of spending on basic research in developed countries, Mansfield estimated a worldwide social rate of return of 28 per cent for research conducted in 1975-78. Of the industries considered, the pharmaceutical industry was the most dependent on basic academic research.

As part of a wider account of the economic value of research in the medical and life sciences, Silverstein *et al.* (1995) listed 10 biomedical discoveries that, it was claimed, had led to industrial applications outside the health sector which were worth US\$92 billion in sales. A report on NIH, from the United States Senate (2000), cited several studies that show the importance of publicly funded research in the development of significant new drugs. In one study, 15 of the 21 drugs identified as having had most impact on therapeutic practice were shown to have been developed with input from the public sector, but the complex interaction between public and privately funded research prohibited any attempt to calculate a social rate of return.

Many studies have identified employment opportunities resulting from research-attributable product development, including start-up companies, but few have linked estimates of employment to specific (costed) bodies of research. An exception is Rosenberg (2002) who suggested that the estimated 500,000 jobs in the biopharmaceutical industry in the USA "would not exist if industry wasn't standing on the shoulders of public funding and academic performance".

2.3 International evidence

There are numerous overseas studies that have attempted to quantify the link between health and medical research and improved health. For example, the Macroeconomic Commission on Health (WHO 2001) concluded that the evidence is overwhelming that investments in health pay off in controlling disease, improving productivity, speeding economic growth and fostering social and political stability. As another example, Kirschner *et al* (1994) reported that the discovery of lithium treatment for manic-depressive disorders had saved the US over \$145 billion in hospital costs alone.

Using the human capital approach, which essentially values health gains in terms of the value of production that is no longer lost due to morbidity and premature mortality, Mushkin (1979) attempted to calculate the economic benefits to the USA of all health research. In a series of calculations, Mushkin estimated the economic value of the total reduction in mortality and morbidity in the USA between 1930 and 1975, estimated the value of the share caused by biomedical research, and, after taking away the cost of the research, produced a rate of return of 47 per cent.

As another example, Haskell & Wallis (2010) — investigating public support for innovation in the UK — looked for evidence of market sector 'spillovers' from intangible investments and from public R&D. The authors found:

- no evidence of spillover effects from intangible investment at the market sector level, including from R&D;
- strong evidence of market sector spillovers from public R&D spend on research councils; and
- no evidence of market sector spillovers from public spending on civil or defence R&D.

The authors concluded that, for maximum market sector productivity impact, government innovation policy should focus on direct spending on research councils.

One study that attracted considerable attention when it was released was the *Exceptional Returns: The economic value of America's investment in medical research* (sometimes referred to as the Funding First report). Funding First commissioned research from prominent economists from the University of Chicago, Harvard, Yale, Stanford and Columbia universities to quantify the value of medical research in terms of its impact on the length or quality of life in the US. The principal academic publication to emerge was authored by Murphy and Topel (1999).

The report made impressive claims, for example that:

- Increases in life expectancy in just the decades of the 1970s and 1980s were worth \$57 trillion to Americans — a figure six times larger than the entire output of tangible goods and services last year. The gains associated with the prevention and treatment of cardiovascular disease alone totalled \$31 trillion.
- Improvements in health account for almost one-half of the actual gain in American living standards in the past 50 years.
- Medical research that reduced deaths from cancer by just one-fifth would be worth \$10 trillion to Americans — double the national debt.
- While it is not always possible to pin down cause and effect, the likely returns from medical research are so extraordinarily high that the payoff from any plausible 'portfolio' of investments in research would be enormous.

Some of the flaws in *Exceptional Returns* type of approach were addressed in *Medical Returns: What's it worth* report by the Wellcome Trust (2008). The work suggested that the health (using QALYs) and economic (GDP) gains to the UK attributable to public and charitable funding of research (and 'spillovers' to the private sector) represent a substantial rate of return. For example, the researchers estimated that for each £1 invested by the taxpayer or charity donor in cardiovascular disease and

mental health research, a stream of benefits is produced equivalent to earning 39 pence and 37 pence respectively each year 'in perpetuity'. They also estimated that the (typical) time lag between research expenditure and eventual health benefits is around 17 years.

2.4 Australian evidence

In 2003, Access Economics (AE 2003) reported that the estimated return on Australia's investment in health and medical research implied a benefit-cost ratio of 2.4 (with a minimum of 1 and a maximum of 5), concluding that "investment in health research and development surpasses every other source of rising living standards in our time".

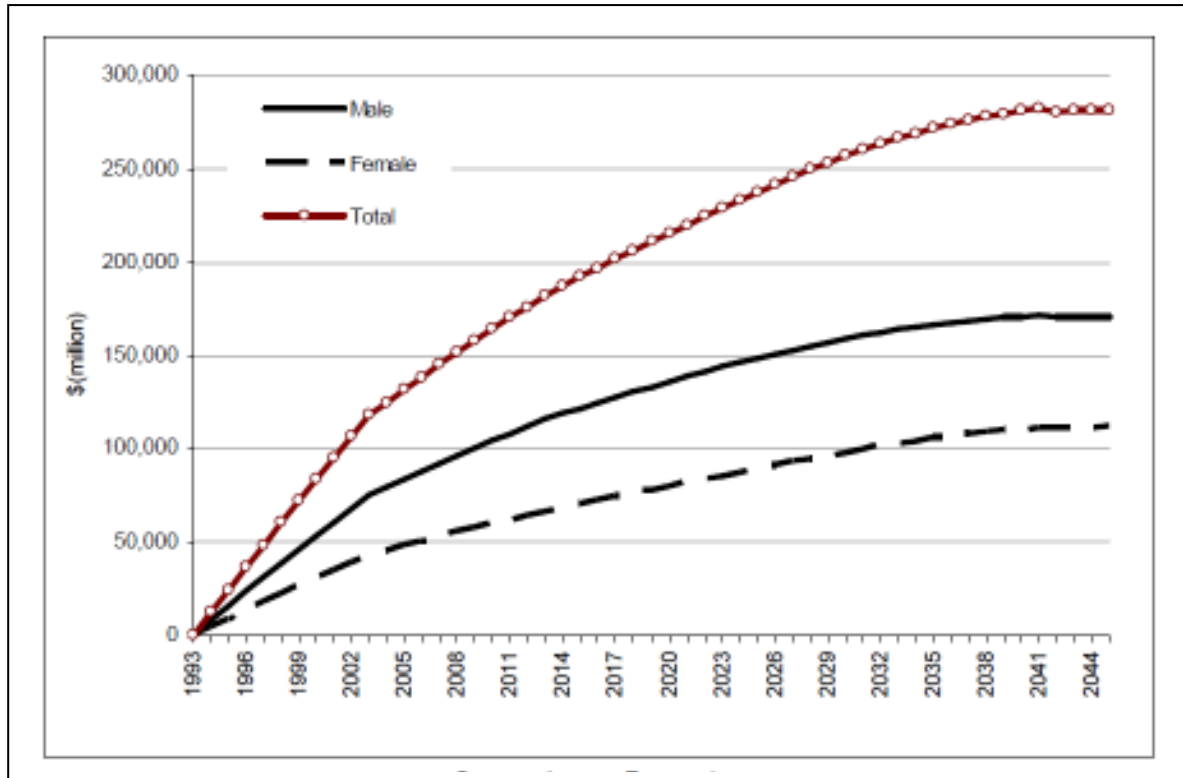
In a subsequent follow-up study, a literature search conducted by Access Economics (2008) identified VSL estimates from 244 'western' studies (17 Australian and 227 international studies) between 1973 and 2007. Estimates were analysed by sector, country, methodology and age of study, with simple analysis as well as meta-analysis performed. Converted into 2006 Australian dollars, VSL estimates ranged from \$0.1 million to \$117 million, with a mean of \$9.4 million and a median of \$6.6 million. Sector-specific medians ranged from \$3.7 million to \$8.1 million. The meta-analysis yielded an average VSL of \$6.0 million, with a suggested range of between \$5.0 million and \$7.1 million.

Based on its review of international literature, Access Economics (2008) recommended a VSL of \$6 million for Australia. Using a real discount rate of 3 per cent (which aligns generally with discount rates used in Australian and international studies discounting healthy life and the current AIHW practices) over an estimated 40 years remaining life expectancy, this equates to an average VSLY in 2006 dollars of \$252,014. Inflating the 2006 VSLY value to 2008 dollars by multiplying it by two years of inflation (2.9% in each year, from the Access Economics Macroeconomic model) results in a base case of \$266,843 with lower and upper bounds of \$164,553 and \$360,238.

Applying the VSLY to the total number of DALYs averted per year and discounting the values back to 2008 levels (using 3%) results in the total value of gains in wellbeing in Australia between 1993 and 2045 shown in Chart 3.2. Importantly, they are the annual value of gains in wellbeing expected to result from all impacts on health, not just Australian R&D.

The chart shows that the annual estimated value of gains in wellbeing is larger for males than for females. This is primarily due to the expected larger decrease in the burden of disease for cardiovascular disease, malignant neoplasms, chronic respiratory disease, and injuries for males when compared to females. The larger increase in DALYs results from a larger rate of decrease for males from a larger DALY base for these causes.

Chart 2.2: Annual value of discounted gains in wellbeing, by sex, 1993-2045



For both males and females the annual value of discounted gains in wellbeing increase at a decreasing rate. This is because total gains in wellbeing increase close to a linear rate (especially after 2023 where a linear growth was used to project DALYs out to 2045) while the discount rate means the increase in the VSly is non linear.

Getting from estimates of the value of increased wellbeing enjoyed by Australians attributable to all causes (of observed decreases in mortality and morbidity over time) to that proportion attributable to Australian health and medical research involves a number of steps. Access Economics got there in two-steps:

- By estimating the proportion of increased wellbeing that can be attributed to health and medical research (irrespective of whether conducted in Australia or overseas) — which Access Economics puts at 50 per cent (with a plausible range of between 30% and 70%); and
- By estimating the proportion of increased wellbeing that can be attributed to Australia's own health and medical research — which Access Economics put at 3 per cent.

Access Economics' reasoning and supporting evidence for these key parameters is as follows (2008:iii):

Naturally, not all the potential future gains in wellbeing as estimated by the AIHW are due to Australia's own R&D. The methodology estimates the proportion due to research as opposed to other factors (eg, public health awareness and preventive programs such as 'Slip Slop Slap' or 'Quit', screening and early intervention initiatives, the public subsidy of drugs and interventions through the Pharmaceutical Benefits Scheme and the Medicare Benefits Schedule, and so on). Based on the factors identified in Access Economics (2003), this proportion is re-estimated as 50% (30% to 70%) for R&D.

The other important parameter is the proportion of wellbeing gains due to R&D that can be attributed to Australia's own R&D rather than that outside our borders. In Access Economics (2003) this was estimated as 2.5% for Australian health R&D, reflecting that Australia 'punches above our weight' given our world population share of 0.3% (Wills, 1998). In this report the estimate is 3.04%, based on recent bibliometric evidence from the Department of Education, Science and Training (DEST). This higher global contribution seems reasonable given that Australia's expenditure on health R&D has increased in recent years.

Access Economics summarised their results of their research and analysis in the abstract to their 2008 report as follows:

Economic benefits of health and medical research

- Australian health R&D expenditure between 1992-93 and 2004-05 is estimated to have returned a net benefit of approximately \$29.5 billion. That is, for the average dollar invested in Australian health R&D, \$2.17 in health benefits is returned (with a minimum of \$0.57 and maximum of \$6.01).¹⁶
- The annual value to Australians of gains in wellbeing (from all sources, not just Australian R&D) are over \$100 billion for females and over \$270 billion for males by 2045.
- Australian health R&D expenditure is estimated to be 1.1% of the global expenditure on health R&D. The proportion of world health returns attributable to Australian R&D is approximately 3.04%.

¹⁶ That is, as compared with the analysis reported in its 2003 report — where the implied benefit-cost ratio was 2.4 (with a minimum of 1 and a maximum of 5), Access Economics' 2008 report updated these estimates to 2.17 (with a minimum of 0.57 and a maximum of 6.01).

Gains in wellbeing

- Australia is becoming a healthier nation with life expectancy one of the highest in the world.
- For Australia, approximately 1.34 million Disability Adjusted Life Years (DALYs are a measure of a year of healthy life lost) will be averted in 2023 relative to 1993 levels, 839,000 by males and 497,286 by females.

Focus

- The greatest burden of disease currently is from cancer (19% of Australia's total), followed by cardiovascular disease (18%). The major burden is from mortality associated with these two diseases. Non-fatal diseases also play a significant and increasing role in the burden of disease and the years of healthy life lost due to disability. An emphasis for the future should be reducing disability within the population.
- The composition of burden of disease changes across age with greatest burden up to age 40 years from mental disorders and injuries; after age 40, cancer is the leading cause until age 75 where cardiovascular disease takes over.

Like the overseas approaches described in the previous section, the Access Economics' analysis is subject to the same methodological and parametrisation caveats:

- disentangling cause and effect remains problematic (ie it is difficult to be unequivocal about the role played by health and medical research in observed increases in longevity and reduced morbidity in populations); and
- debate will continue on the relative merits of 'macro' versus 'micro' approaches to quantifying such contributions (e.g. Access Economics took a macro approach, while the Wellcome Trust — see above — adopted a micro approach).

The area will doubtless await further analytic contributions before a firm quantitative answer can be given on the role played by health and medical research in preventing premature deaths and reducing population morbidity. In the meantime the Access Economics' analysis and the Lateral Economics analysis (see Attachment A) arguably represent the best that can be done at the moment to shed light on the subject.

3 VALUING AUSTRALIA'S HEALTH AND MEDICAL RESEARCH

Applying Access Economics' estimate of \$2.17 in health benefits for every health and medical research dollar spent in the decade and a half to 2006-07 (some \$25 billion valued in 2006-07 prices) yields an estimated return to the Australian community of its historical investments in health and medical research of some \$54.2 billion. This represents a handsome return by any yardstick, and reinforces the case for 'exceptional' returns from investing in Australian health and medical research. If health and medical research spending were to at least keep pace with historical (real) growth of health spending (of 5.2 per cent per annum) for the decade and a half to 2021-22 — by which time it would total some \$70.2 billion over the 15-year period (valued in 2006-07 prices) — then the estimated yield in terms of health benefits to the Australian community will have been worth some \$152 billion (in 2006-07 prices) — again representing the prospect of continued exceptional returns to the Australian community in the form of health and wellbeing gains. Indicative modelling by Lateral Economics along more conventional cost-benefit analysis lines reinforces the case that Australia's health and medical research efforts produce goods and services that make a positive contribution to the Australian economy, as well as providing high value-added jobs for health and medical researchers.

An intuitively obvious way to value past investments in health and medical research is to focus on successful examples of Australian health and medical research and try to establish whether the benefits generated at least covered the costs (including the costs of less- or un-successful health and medical research undertaken in Australia).

Section 3.1 reviews some of the evidence that suggests that, historically at least, the fruits of Australian health and medical research have more than justified the investments involved.

A more systematic consideration of costs and benefits could focus (narrowly) on the contribution Australian health and medical research has made to wealth-generation in Australia, as reflected in Australia's gross domestic product (GDP). Such an evaluation is attempted in section 3.2. Alternatively (see above), analysis can focus on supply-side benefits taking the form of a fit and healthier population than would otherwise be the case. Estimates of this kind were reviewed in Chapter 2 and applied in the head quote to value historical and prospective investments in this vital field.

3.1 Some Australian research achievements

Clearly, just a few Australian 'breakthroughs' could more than justify the totality of Australia's historical investment in health and medical research. Examples of the fruits of Australian health and medical research that have been commercialised locally include the cochlear ear implant and devices for treating obstructive sleep apnoea. Box 3.1 provides a more comprehensive list.

Box 3.1: Notable achievements of Australian health and medical research

- **Electronic Pacemaker** — the heart pacemaker was developed at Sydney's Crown Street Women's Hospital in 1926
- In the 1930s Sister Elizabeth Kenny, a bush nurse working in country New South Wales and Queensland, developed a radically new and controversial method of treating children with polio. Her work went on to be internationally acclaimed and is regarded as providing important foundations to the discipline now known as **physiotherapy**.
- The **life saving application of penicillin** was developed by Howard Florey and his team. Penicillin has saved millions of lives world wide.
- In 1948 Dr John Cade, a Melbourne psychiatrist, discovered the use of lithium carbonate (usually just referred to as **lithium**) in the treatment of bipolar and similar disorders.
- Many firsts associated with in vitro fertilisation, including the birth of the first frozen embryo baby at the Queen Victoria Medical Centre in Melbourne 1984.
- **The Bionic Ear** — the cochlear implant was invented by a team led by Professor Graeme Clark at The University of Melbourne and in 1978 the first person received the implant at the Royal Victorian Eye and Ear Hospital. The Bionic Ear has brought hearing to more than 50,000 people in over 80 countries.
- **Aspro** — Aspro was invented by the chemist George Nicholas as a form of Aspirin in a tablet. The product was developed in Melbourne between 1915 and 1917, and George's brother Alfred Nicholas together with Henry Woolf Smith were key to its manufacturing and marketing success. By 1940 it had become the world's most widely used headache treatment.
- **Begg Orthodontics** — During the 1940s and 1950s Percy Begg of Adelaide developed a system of using relatively cheap and lightweight stainless steel braces on teeth to replace the expensive and painful systems which had been earlier used for 'training' and straightening teeth. Begg's technique soon spread throughout the world.

- **The Humidicrib**, a portable and inexpensive alternative to the 'iron lung' made from plywood, was invented and manufactured by the brothers Edward and Don Both in Tasmania in the late 1930s as a response to the poliomyelitis epidemic of the time. The invention soon spread across the world and has helped to save the lives of millions of premature babies.
- Australian surgeon Professor Earl Owen not only designed (in association with optical company Zeiss) the initial suite of instruments used for **microsurgery**, he has also pioneered numbers of the microsurgical techniques. He is regarded as probably the most important pioneer of microsurgery.
- **Relenza** — the world's first anti-flu drug was developed at several institutions in Victoria and released onto the market in 1996.
- **Spray-on-skin** for burns victims developed by Dr Fiona Wood and used to great effect after the 2002 Bali terrorist bombings.
- Discovery of the *Helicobacter pylori* **bacterium which causes stomach ulcers and gastritis** leading to its successful treatment. Barry Marshall and Robin Warren made this discovery in 1982 and received the Nobel Prize in 2005 for their work.
- The world's first **vaccine to prevent cervical cancer** with the potential to save hundreds of thousands of lives was developed by Professor Ian Frazer and others at the University of Queensland during the 1990s and eventually approved for use in USA in 2006. The vaccine does not act against cancer but against the virus that causes cervical cancer. It was released onto the market in 2006 under the name Gardasil.

*Source: The White Hat Guide to Australian Inventions, Discoveries & Innovations*¹⁷.

To place its modelling of health and wellbeing gains in perspective, Access Economics reviewed a number of case studies based on Australian health and medical research, one of which was Gardasil. Its analysis and conclusion of just this one product of Australian health and medical research was as follows (AE 2008:viii-ix):

Using an average lifetime cost per incident and actively prevalent case of cancer averted of \$1.63 million, 1,701 such cases per annum in Australia, 50% of benefits attributable to R&D, 60% coverage by the vaccination program and 13% of the R&D component due to Australian (as opposed to overseas) research based on royalty attribution, yields an attributable benefit of \$63 million per annum, which (compared to \$8.5 million per annum in costs) yields a B/C ratio of 7.5:1. Taking into account that benefits occur 37 years in the future are valued at less than a third of the value of an event occurring now, in NPV terms, the B/C ratio may be closer to 2.5:1 than 7.5:1. The calculation does not take account the cost of the immunisation program or the availability of alternatives, and another caveat is that cervical cancer vaccines have yet to demonstrate long term efficacy. That said, the potential benefits worldwide are the saving of 225,000 lives each year worldwide.

¹⁷ See their website <http://www.whitehat.com.au/australia/Inventions/InventionsA.html>.

3.2 Conventional assessment of the net benefits of Australian health and medical research

A conventional approach to cost-benefit analysis (CBA) of the contribution Australian health and medical research has made to the Australian economy would compare costs with revenues from successful goods and services sold in the marketplace (rather than estimated health benefits) — with the difference between benefits and costs contributing to Australian GDP. Thus, a conventional CBA is an example of a demand-side analysis (that is, it assesses the estimated increase in the demand for goods and services attributable to successful Australian health and medical research and compares it with the associated costs). By contrast, a CBA of the type undertaken by Access Economics is an example of a supply-side analysis (that is, it assesses the estimated increase in the supply of goods and services that has been contributed by an Australian workforce whose morbidity and mortality has been reduced by the fruits of Australian health and medical research).

It is difficult to undertake either kind of CBA in a wholly convincing way, primarily because the ultimate outcomes of Australian health and medical research can take years to manifest themselves in the form of Australian-produced goods and services that would be routinely included in estimates of GDP on the one hand, or expressed in the form of reduced morbidity or mortality among the Australian population on the other.

In order to illustrate the difference between the type of CBA whose results were reviewed in the previous chapter and the conventional kind routinely undertaken by economists, this chapter summarises the results of an indicative simulation model of the health and medical research and commercialisation processes whose results would feed into a conventional CBA — with a health-benefits-based CBA included as an extension (see Attachment A for a detailed description of the model).

Without having been parameterised with any given data set in mind, Lateral Economics' indicative model seeks to encapsulate the following stylised facts about the nature of health and medical research and the goods and services that it spawns, with a particular focus on Australia:

- The whole process — from basic research (which suggests promising lines of inquiry) through the development phase (where promising ideas are progressed to a 'proof-of-concept' stage through a commercialisation phase (where 'proof-of-concept' progresses to actual goods and services that consumers are prepared to buy — can take a very long time;
- A small player in this game — such as Australia — cannot, in general, hope to be a significant player beyond the development stage of the overall process in cases where the result is a product that costs a lot to prove its safety and efficacy for human consumption, not only because of the risks involved in trying

to progress a necessarily modest portfolio of potential products through all stages but also because of the considerable costs typically involved in undertaking the commercialisation phase; and

- While the potential rewards of making it to the commercialisation phase may be large, those rewards can take a long time to be realised, so that bringing the various costs and revenues to proper account (via calculation of their net present value using an appropriate discount rate) can take the gloss of what might otherwise appear like a pot of gold at the end of the rainbow.

Thus, our own indicative CBA is intended to reflect a very conservative assessment of the value of health related R&D. The CBA methodology itself leaves out many of the benefits of improvements in health as discussed above. In addition the parameterisations we use have been chosen to give us confidence that they do not look at the industry's worth through 'rose coloured glasses'. Our simulation had the following characteristics:

- against a background of Australia accounting for 0.3 per cent of world population and 1.22 per cent of world GDP, the modelling assumed that Australia conducts:
 - (a more-than-proportionate) 2 per cent of the world's research (the R part of R&D) — reflecting the fact that Australia 'punches above its weight' when it comes to health and medical research (particularly basic research);
 - (a slightly less-than-proportionate — compared with its share of GDP) 1 per cent of the world's development activities (the D part of R&D) — reflecting the fact that the development phase of health and medical research can start to get costly;
 - (a slightly less-than-proportionate — compared with its share of GDP) 1 per cent of the world's subsequent commercialisation activities — reflecting the fact that the commercialising health and medical research can be quite costly;
 - In line with its share of commercialisation costs, revenues equivalent to 1 per cent of world-wide revenues of the final products of health and medical research;
- that, because of its disproportionate research contribution, Australians enjoyed 1.02 per cent of subsequent health/wellbeing benefits (in the form of reduced mortality and morbidity) — with this input parameter to the simulation adjusted to achieve a Benefit/Cost ratio of 2.17 for Australia (to accord with the results of the Access Economics' analysis of health/wellbeing benefits enjoyed by Australians attributable to Australian health and medical research);

- that the 'portfolio' of R&D projects at any time — both in the case of Australia and the rest of the world — comprises a mix of those with a short-term, medium-term and long-term focus (which conform to the cost relativities described in the last dot point below).
 - R&D projects with a 'short-term' focus comprise a research phase of one year, a development phase of one year, a commercialisation phase of one year and a revenue phase of five years — all following sequentially one after the other (with the latter two phases only being pursued if the initial R&D phases prove promising).
 - R&D projects with a 'medium-term' focus are assumed to be characterised as comprising a research phase of two years, a development phase of three years, a commercialisation phase of five years and a revenue phase of 10 years — all following sequentially one after the other (with the latter two phases only being pursued if the initial R&D phases prove promising).
 - R&D projects with a 'long-term' focus are assumed to be characterised as comprising a research phase of six years, a development phase of 11 years, a commercialisation phase of 14 years and a revenue phase of 20 years — all following sequentially one after the other (with the latter two phases only being pursued if the initial R&D phases prove promising).
- Health benefits (in the form of lower morbidity and mortality than would otherwise be the case) are assumed to coincide with the revenue phases of (successful) R&D projects (i.e. irrespective of whether individual projects which comprise the R&D portfolio have a short-, medium- or long-term focus);
- For each R&D project, (annual) research costs, development costs and commercialisation costs are in the ratio 1:10:100; while (annual) revenue to commercialisation ratios are 32:100 for short-term projects, 85:100 in the case of medium-term projects, and 127.5:100 in the case of long-term projects; and with (annual) benefits to commercialisation ratios of 41.4:100 for short-term projects, 110.5:100 in the case of medium-term projects, and 165.75:100 in the case of long-term projects.

Adopting these assumptions (any or all of which could be varied), and applying a (real) discount rate of 3 per cent, yields the results reported in Table 3.1.

Table 3.1: Cost benefit analyses of Australian health and medical research
(Ratios)

<i>Item</i>	<i>Australia</i>	<i>Rest of World</i>	<i>World</i>
Revenue/Costs ratio	1.05	1.06	1.06
Benefits/Costs ratio (a)	2.17	2.14	2.14

Notes: (a) Simulation inputs adjusted to accord with Access Economics' estimate of this ratio for Australia.

Source: Lateral Economics simulation (Attachment A).

The main result to flow from this analysis is that, if the indicative assumptions taken as reflective of reality, a conventional CBA would report the 1.05 ratio for Australia (rather than the 2.17 ratio based on health/wellbeing gains rather than estimates of revenues generated less costs). Even so, even not counting many of the most important benefits and with conservative assumptions about those we do count, the fact that this ratio still exceeds unity means that the fruits of Australian R&D would be making a positive contribution to Australian GDP. This is important given the current emphasis on Australia commercialising its share of the ultimate products of the health and medical research process.

However, the simulation model also highlights the potential for the economic implications to diverge from the health/wellbeing results. For example, at the extreme, the health/wellbeing conclusions could remain virtually intact (because the mortality and morbidity-reducing fruits of health and medical research could conceivably be sourced from overseas), while Australian GDP could remain unaffected (or even contract) if, for example, domestically pursued health and medical research led to *no* subsequent income-producing activities locally to offset the costs of undertaking health and medical research in this country. Indeed, if the *only* health and medical research that was done in Australia was of the strictly basic kind (i.e. the kind whose results are published in the public domain in the interests of all), then the wellness-based benefit-cost ratio would actually rise. This is because Australians would still benefit (from the fruits of now exclusively overseas-produced health and medical research) — the numerator — while costs would actually fall — the denominator. In such (extreme) circumstances, Australia would in effect be completely 'free-riding' on the products of overseas health and medical research. But while there will always be a large element of free-riding — since Australia will only ever represent a small player in a much larger game — the reality is that Australia has a track record of world-class health and medical research, and manages to turn at least some of this knowledge into the kinds of money-making activities that contribute to growth in economic activity (see previous section). The trouble is, typically many years can elapse between conception of a great idea on the part of a researcher in the field of health and medical research and its application within the health system to reduce morbidity or mortality and to yield saleable products.

Note that prospective health/wellbeing benefits associated with health and medical research need not coincide with the generation of revenues attributable to (successful) R&D projects. Indeed, there is no reason why health benefits should not continue to be enjoyed indefinitely once R&D projects prove to be of some worth — in contrast to subsequent commercialisation and revenue phases whose benefits can easily be subsequently eroded by emerging competition from alternative products. In fact, successful R&D projects may confer health benefits even if there are no associated commercial products. This could be the case, for example, with widespread patient adherence to NHMRC guidelines on what constitutes 'best practice' in Australia in addressing a health issue affecting some segment of the population. Here, the research phase (the R part of R&D) might comprise a (world-wide) review of the relevant evidence on possible responses to some health issue, the development phase (the D part of R&D) determining what would constitute best practice in the Australian setting, the 'commercialisation' phase might involve fashioning appropriate 'messages' to practitioners and their patients such that there is a high level of conformance among the target (sub-)population. In such a case there would be no 'revenue' phase, but there would be a health benefits phase that could potentially be open-ended in terms of ongoing benefits. These kinds of circumstances would explain why benefit-cost ratios in terms of health benefits in relation to R&D costs may far exceed traditional benefit-cost ratios based on comparing economic revenues to R&D (plus commercialisation) costs.

To summarise the material presented in this chapter, based on arguably conservative assumptions of the role played by Australian health and medical research on the world stage, investing in Australian health and medical research likely makes us richer, as well as significantly enhancing our health and wellbeing. This underscores the exceptional returns potentially available from investing in Australian health and medical research. Investing in Australian health and medical research also provides high value-added jobs for health and medical researchers (see Attachment B).

A A SIMULATION MODEL FOR ASSESSING RETURNS TO AUSTRALIAN HEALTH AND MEDICAL RESEARCH

The principal purpose of this attachment is to develop a simulation model using a standard cost-benefit analysis (CBA) framework that could be used to assess the returns to Australian health and medical research — either retrospectively or prospectively. A secondary purpose is to extend the standard framework to take account of health/wellbeing benefits in the form of reduced morbidity and mortality of the kind estimated by Access Economics in their 2008 report titled *Exceptional Returns II: The value of investing in health R&D in Australia* (AE 2008).

Use of the framework to analyse past spending on health and medical research in Australia would represent a considerable challenge because of the difficulty of identifying the various separate streams of costs and benefits attributable to individual R&D projects that together constitute the historical record. In other words, it would be necessary to disaggregate each total spending estimate (in what is a time series of annual observations) into components attributable to individual R&D projects — noting that most R&D projects take more than one year to complete (or be abandoned). Perhaps more than half of total spending in any particular year would be attributable to research projects that were started in prior years, with the balance of estimated outlays attributable to projects in their first year of R&D. The same exercise would have to be done on the benefits/revenue side of the equation — arguably an even more difficult job (since, for example, the Australian Bureau of Statistics does not even seek to collect such statistics). The complications involved in disentangling the historical record give some inkling of why it is so difficult to isolate the role played by R&D in spurring economic growth and boosting productivity.

Mobilising the framework to assess current or proposed health and medical research projects — either individually or as a 'portfolio' of such projects — is also not without its challenges (although the process of having to disaggregate cost data into individually attributable components may be avoided).

As an alternative, what is done in this attachment is to analyse a 'representative' portfolio of health and medical research projects in order to illustrate the difference between conventional CBA and the kind of (non-traditional) CBA undertaken by Access Economics (AE 2008:i) in arriving at its estimate that:

For the average dollar invested in Australian health R&D, \$2.17 in health benefits is returned, with a minimum of \$0.57 and maximum of \$6.01.

That there are tangible benefits from successful Australian health and medical research is attested to by the fact that investors value Australia's listed *Health care and biotechnology sector* at in excess of \$50 billion (comprising more than 50 publicly listed companies) — albeit that only a fraction of this amount/these companies would trace their roots to Australian health R&D that has been successful in the sense that it has produced goods and services that command a price in the marketplace. Thus, products attributable to Australian health and medical research contribute to Australian GDP, exports (e.g. the Cochlear implant), and provide relatively highly paid jobs to 15,000 or so Australian researchers.

The portfolio of projects chosen to approximate this situation comprises a mix of R&D with a short-, medium- and long-term focus (with each assumed to account for one-third of the overall portfolio). Many other assumptions have had to be made, with a view to producing results which would be widely recognised as conservative in making claims for the productiveness of R&D. Even so, it should be stressed that the model is indicative. It makes no claim to being parameterised according to measurements of the quantities involved on account of the resources available in this project and the difficulty of such an exercise.

A1 The simulation model

The core of the simulation model is to compare R&D cost and benefits — in the form of revenues generated from the fruits of research — so that a traditional cost-benefit analysis can be undertaken (where benefits take the form of revenues for the products of successful R&D that command a price in the marketplace).

Broadly, this involves, specifying the time profile of costs and benefits (revenues) — both of which can be spread out over years because of the various lags involved between research, development, commercialisation and the eventual stream of revenues received. Conventionally, costs and benefits (revenues) are estimated in constant-price terms (to abstract from the effects of inflation), and discounted back to a base year (to make all values comparable) using a suitable (real) discount rate. In reckoning costs, the costs of un- and less-successful R&D are included along with the successes, while the revenues are those generated by R&D projects that go through the commercialisation phase to produce sales.

At the same time, and as an extension of the conventional CBA framework, the simulation model includes estimates of benefits of the kind estimated by Access Economics attributed to valuing reduced morbidity and mortality flowing from Australian health and medical research. It is to be noted that these 'health' benefits — based as they are on reduced morbidity and mortality among Australians attributable to Australian health and medical research — are not the same as the benefits (in the form of revenues from saleable products) attributable to that very same R&D. In effect, health benefits boost available labour inputs to the production

process (due to reduced morbidity and mortality), while the standard CBA framework focuses only on those 'benefits' that express themselves as revenues for goods and services traded in the marketplace that arise from successful (Australian) health and medical research. This 'double' benefit (revenues from sales and health benefits from reduced morbidity and mortality) is an attribute of health and medical research that differentiates this type of investment from competing claims for taxpayers' dollars — and is arguably the reason why returns to health R&D tend towards the 'exceptional'.

A2 Simulation inputs

In undertaking such calculations, many assumptions have to be made (all of which can be varied in sensitivity testing). Against a background of Australia accounting for some 0.3 per cent of world population and 1.22 per cent of world GDP it has been assumed that:

- Australian health-related research (the R part of health R&D) accounts for some 2 per cent of the corresponding figure for the world (reflecting the fact that Australia more than pulls its weight in this regard);
- Australia accounts for 1 per cent of the D part of world health R&D;
- Australia bears 1 per cent of world commercialisation costs and, as a result, captures 1 per cent of world revenues for (successful) health R&D; and
- Because of its disproportionate contribution to world health R&D the Australian population enjoys 1.04 per cent of health benefits in the form of reduced morbidity and mortality (than would otherwise be the case).

Other assumptions underpinning results presented here include:

- A (real) rate of 3 per cent per annum has been used to discount all constant-price estimates back to base year values (to make them comparable).
- An analysis period of 50 years (the time horizon) has been used.
- The 'portfolio' of R&D projects at any time comprises a mix of those with a short-term, medium-term and long-term focus (which conform to the cost relativities described in the last dot point below).
 - R&D projects with a 'short-term' focus are assumed to be characterised as comprising a research phase of one year, a development phase of one year, a commercialisation phase of one year and a revenue phase of five years — all following sequentially one after the other (with the latter two phases only being pursued if the initial R&D phases prove promising).

- R&D projects with a 'medium-term' focus are assumed to be characterised as comprising a research phase of two years, a development phase of three years, a commercialisation phase of five years and a revenue phase of 10 years — all following sequentially one after the other (with the latter two phases only being pursued if the initial R&D phases prove promising).
- R&D projects with a 'long-term' focus are assumed to be characterised as comprising a research phase of six years, a development phase of 11 years, a commercialisation phase of 14 years and a revenue phase of 20 years — all following sequentially one after the other (with the latter two phases only being pursued if the initial R&D phases prove promising).
- Health benefits (in the form of lower morbidity and mortality than would otherwise be the case) are assumed (for the sake of simplicity)¹⁸ to coincide with the revenue phases of (successful) R&D projects (i.e. irrespective of whether individual projects which comprise the R&D portfolio have a short-, medium- or long-term focus);
- For each R&D project, (annual) research costs, development costs and commercialisation costs are in the ratio 1:10:100; while (annual) revenue to commercialisation ratios are 32:100 for short-term projects, 85:100 in the case of medium-term projects, and 127.5:100 in the case of long-term projects; and with (annual) benefits to commercialisation ratios of 41.4:100 for short-term projects, 110.5:100 in the case of medium-term projects, and 165.75:100 in the case of long-term projects.

Choice of these particular relativities — in combination with the other assumptions described above — results in a (traditional) benefit-cost ratio of 1.06 based on discounted net present values of the various streams of costs and revenues. At the same time the benefit-cost ratio based on 'health' benefits is 2.17 — to align with the Access Economics (central) estimate (see below).

A3 Simulation results

Based on the above assumptions and parameter settings, Table A1 shows the time profiles of costs, revenues and estimated health benefits (over the 50-year analysis time horizon) in constant-price (base year) terms for Australia versus the rest of the world such that:

¹⁸ This need not be the case — see discussion of the simulation results below.

- The entries in Column 2 report research costs (the R part of R&D) for the specified mix of short-, medium- and long-term health and medical research projects for Australia — with Column 3 entries reporting the corresponding figures for the rest of the world (RoW).
- The entries in Column 4 report development costs (the D part of R&D) for the specified mix of short-, medium- and long-term health and medical research projects for Australia — with Column 5 entries reporting the corresponding figures for the rest of the world (RoW).
- The entries in Column 6 report commercialisation costs for the specified mix of short-, medium- and long-term health and medical research projects for Australia — with Column 7 entries reporting the corresponding figures for the rest of the world (RoW).
- The entries in Column 8 report revenues attributable to the specified mix of short-, medium- and long-term health and medical research projects for Australia — with Column 9 entries reporting the corresponding figures for the rest of the world (RoW).
- The entries in Column 10 report health benefits attributable to the specified mix of short-, medium- and long-term health and medical research projects for Australia — with Column 9 entries reporting the corresponding figures for the rest of the world (RoW).

Summary measures (based on the constant-price estimates) can be derived from the Totals reported in the final row of Table A1. Thus:

- Australian research costs represent some 2 per cent of world research costs (equal to 14.4 divided by 14.4 plus 705.6) — an assumption on which the analysis has been based (see above);
- Australian development costs represent some 1 per cent of world development costs (equal to 127 divided by 127 plus 12573); — an assumption on which the analysis has been based (see above) — so that
- Australian health and medical research costs represent some 1.05 per cent of world health-related R&D costs (equal to 141.4 divided by 141.4 plus 13278.6);
- Australian commercialisation costs represent some 1 per cent of world commercialisation costs (equal to 1670 divided by 1670 plus 165330) — an assumption on which the analysis has been based (see above);
- Australian revenues represent some 1 per cent of world revenues (equal to 3006.9 divided by 3006.9 plus 297680.6) — an assumption on which the analysis has been based (see above);
- Australian health benefits attributable to the fruits of health and medical

research represent some 1.02 per cent of world revenues (equal to 6097.6 divided by 6097.6 plus 591707.4) — an assumption on which the analysis has been based (see above);

These results yield the following ratios — based on the constant-price estimates reported in Table A1 and summarised above. The (conventional — albeit based on constant-price rather than discounted net present values) benefit cost ratio (in this case revenue cost ratio) is 1.66 (equal to 3006.9 divided by 141.4 plus 1670), while the health-based benefit cost ratio for Australia is 3.37 (equal to 6097.6 divided by 141.4 plus 1670).

An important point to make with respect to prospective health benefits associated with health and medical research is that they need not coincide with the generation of revenues attributable to (successful) R&D projects. Indeed, there is no reason why health benefits should not continue to be enjoyed indefinitely once R&D projects prove to be of some worth — in contrast to subsequent commercialisation and revenue phases whose benefits can easily be subsequently eroded by emerging competition from alternative products.

In fact, successful R&D projects may confer health benefits even if there are no associated commercial products. This could be the case, for example, with widespread patient adherence to NHMRC guidelines on what constitutes 'best practice' in Australia in addressing a health issue affecting some segment of the population. Here, the research phase (the R part of R&D) might comprise a (world-wide) review of the relevant evidence on possible responses to some health issue, the development phase (the D part of R&D) determining what would constitute best practice in the Australian setting, the 'commercialisation' phase might involve fashioning appropriate 'messages' to practitioners and their patients such that there is a high level of conformance among the target (sub)population. In such a case there would be no 'revenue' phase, but there would be a health benefits phase that could potentially be open-ended in terms of ongoing benefits.

These kinds of circumstances would offer a powerful explanation of why benefit-cost ratios in terms of health benefits in relation to R&D costs may far exceed traditional benefit-cost ratios based on comparing revenues to R&D (plus commercialisation) costs. This is, in fact the situation with the simulation results reported in this attachment (albeit in this case it is the greater projected magnitude of the health benefits compared with expected revenues that produces the result).

Table A1: Time profile of costs, revenues and benefits attributable to health and medical research (constant prices): Australia versus the Rest of the World

(\$ m base year prices)

Year	(R)&D - Aust	(R)&D - RoW	R&(D) - Aust	R&(D) - RoW	C phase - Aust	C phase - RoW	Rev phase - Aust	Rev phase - RoW	Benefits - Aust	Benefits - RoW
0	3.4	166.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	3.0	147.0	2.0	198.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.0	98.0	5.0	495.0	20.0	1980.0	0.0	0.0	0.0	0.0
3	2.0	98.0	5.0	495.0	0.0	0.0	6.4	631.1	8.5	820.3
4	2.0	98.0	5.0	495.0	0.0	0.0	6.4	631.1	8.5	820.3
5	2.0	98.0	0.0	0.0	50.0	4950.0	6.4	631.1	8.5	820.3
6	0.0	0.0	10.0	990.0	50.0	4950.0	6.4	631.1	8.5	820.3
7	0.0	0.0	10.0	990.0	50.0	4950.0	6.4	631.1	8.5	820.3
8	0.0	0.0	10.0	990.0	50.0	4950.0	0.0	0.0	8.5	820.3
9	0.0	0.0	10.0	990.0	50.0	4950.0	0.0	0.0	8.5	820.3
10	0.0	0.0	10.0	990.0	0.0	0.0	42.5	4207.5	64.8	6288.9
11	0.0	0.0	10.0	990.0	0.0	0.0	42.5	4207.5	64.8	6288.9
12	0.0	0.0	10.0	990.0	0.0	0.0	42.5	4207.5	64.8	6288.9
13	0.0	0.0	10.0	990.0	0.0	0.0	42.5	4207.5	64.8	6288.9
14	0.0	0.0	10.0	990.0	0.0	0.0	42.5	4207.5	64.8	6288.9
15	0.0	0.0	10.0	990.0	0.0	0.0	42.5	4207.5	64.8	6288.9
16	0.0	0.0	10.0	990.0	0.0	0.0	42.5	4207.5	64.8	6288.9
17	0.0	0.0	0.0	0.0	100.0	9900.0	42.5	4207.5	64.8	6288.9
18	0.0	0.0	0.0	0.0	100.0	9900.0	42.5	4207.5	64.8	6288.9
19	0.0	0.0	0.0	0.0	100.0	9900.0	42.5	4207.5	64.8	6288.9
20	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
21	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
22	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
23	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
24	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
25	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
26	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
27	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
28	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
29	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
30	0.0	0.0	0.0	0.0	100.0	9900.0	0.0	0.0	64.8	6288.9
31	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
32	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
33	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
34	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9

35	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
36	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
37	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
38	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
39	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
40	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
41	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
42	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
43	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
44	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
45	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
46	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
47	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
48	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
49	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
50	0.0	0.0	0.0	0.0	0.0	0.0	127.5	12622.5	233.9	22694.9
Totals	14.4	705.6	127.0	12573.0	1670.0	165330.0	3006.9	297680.6	6097.6	591707.4

Source: LE simulation.

The results reported in Table A2 present the corresponding figures to those reported in Table A1 now converted to net present value terms using a (real) discount rate of 3 per cent per annum. The entries in each column are now the present value equivalents of those reported in Table A1. However, the summary measures (now based on present values in the base year) have changed.

Thus:

- Australian research costs represent some 2 per cent of world research costs (equal to 13.5 divided by 13.5 plus 663.0) — an assumption on which the analysis has been based (see above);
- Australian development costs represent some 1 per cent of world development costs (equal to 95.5 divided by 95.5 plus 9453.2) — an assumption on which the analysis has been based (see above) — so that
- Australian health and medical research costs represent some 1.07 per cent of world health-related R&D costs (equal to 109 divided by 141.4 plus 10116.2);
- Australian commercialisation costs represent some 1 per cent of world commercialisation costs (equal to 926.2 divided by 926.2 plus 91697.4) — an assumption on which the analysis has been based (see above);

- Australian revenues represent some 1 per cent of world revenues (equal to 1086.9 divided by 1086.9 plus 107599.2) — an assumption on which the analysis has been based (see above);
- Australian health benefits attributable to the fruits of health and medical research represent some 1.02 per cent of world revenues (equal to 2248.8 divided by 2248.8 plus 218221.2) — an assumption on which the analysis has been based (see above);

The properly calculated benefit cost ratios (now based on estimated discounted back to base year equivalents) are now:

- The conventional benefit cost ratio for Australia is 1.05 (equal to 1086.9 divided by 1035.2); while
- The health-based benefit cost ratio for Australia is 2.17 (equal to 2248.8 divided by 1035.2) — to reflect the estimate obtained by Access Economics (AE 2008).

A fuller picture of the results of the analysis is presented in Table A3.

Table A2: Time profile of costs, revenues and benefits attributable to health and medical research (discounted prices): Australia versus the Rest of the World

(\$ m base year prices)

Year	(R)&D - Aust	(R)&D - RoW	R&(D) - Aust	R&(D) - RoW	C phase - Aust	C phase - RoW	Rev phase - Aust	Rev phase - RoW	Benefits - Aust	Benefits - RoW
0	3.4	166.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2.9	142.7	1.9	192.2	0.0	0.0	0.0	0.0	0.0	0.0
2	1.9	92.4	4.7	466.6	18.9	1866.3	0.0	0.0	0.0	0.0
3	1.8	89.7	4.6	453.0	0.0	0.0	5.8	577.6	7.7	750.7
4	1.8	87.1	4.4	439.8	0.0	0.0	5.7	560.7	7.5	728.8
5	1.7	84.5	0.0	0.0	43.1	4269.9	5.5	544.4	7.3	707.6
6	0.0	0.0	8.4	829.1	41.9	4145.5	5.3	528.6	7.1	687.0
7	0.0	0.0	8.1	805.0	40.7	4024.8	5.2	513.2	6.9	667.0
8	0.0	0.0	7.9	781.5	39.5	3907.6	0.0	0.0	6.7	647.5
9	0.0	0.0	7.7	758.8	38.3	3793.8	0.0	0.0	6.5	628.7
10	0.0	0.0	7.4	736.7	0.0	0.0	31.6	3130.8	48.2	4679.6
11	0.0	0.0	7.2	715.2	0.0	0.0	30.7	3039.6	46.8	4543.3
12	0.0	0.0	7.0	694.4	0.0	0.0	29.8	2951.1	45.5	4410.9
13	0.0	0.0	6.8	674.1	0.0	0.0	28.9	2865.1	44.1	4282.5
14	0.0	0.0	6.6	654.5	0.0	0.0	28.1	2781.7	42.8	4157.7
15	0.0	0.0	6.4	635.4	0.0	0.0	27.3	2700.6	41.6	4036.6
16	0.0	0.0	6.2	616.9	0.0	0.0	26.5	2622.0	40.4	3919.1
17	0.0	0.0	0.0	0.0	60.5	5989.7	25.7	2545.6	39.2	3804.9
18	0.0	0.0	0.0	0.0	58.7	5815.2	25.0	2471.5	38.1	3694.1
19	0.0	0.0	0.0	0.0	57.0	5645.8	24.2	2399.5	37.0	3586.5
20	0.0	0.0	0.0	0.0	55.4	5481.4	0.0	0.0	35.9	3482.0
21	0.0	0.0	0.0	0.0	53.8	5321.7	0.0	0.0	34.8	3380.6
22	0.0	0.0	0.0	0.0	52.2	5166.7	0.0	0.0	33.8	3282.2
23	0.0	0.0	0.0	0.0	50.7	5016.2	0.0	0.0	32.8	3186.6
24	0.0	0.0	0.0	0.0	49.2	4870.1	0.0	0.0	31.9	3093.7
25	0.0	0.0	0.0	0.0	47.8	4728.3	0.0	0.0	31.0	3003.6
26	0.0	0.0	0.0	0.0	46.4	4590.6	0.0	0.0	30.1	2916.1
27	0.0	0.0	0.0	0.0	45.0	4456.9	0.0	0.0	29.2	2831.2
28	0.0	0.0	0.0	0.0	43.7	4327.1	0.0	0.0	28.3	2748.8
29	0.0	0.0	0.0	0.0	42.4	4201.0	0.0	0.0	27.5	2668.7
30	0.0	0.0	0.0	0.0	41.2	4078.7	0.0	0.0	26.7	2591.0
31	0.0	0.0	0.0	0.0	0.0	0.0	51.0	5048.8	93.5	9077.7
32	0.0	0.0	0.0	0.0	0.0	0.0	49.5	4901.8	90.8	8813.3
33	0.0	0.0	0.0	0.0	0.0	0.0	48.1	4759.0	88.2	8556.6
34	0.0	0.0	0.0	0.0	0.0	0.0	46.7	4620.4	85.6	8307.3

35	0.0	0.0	0.0	0.0	0.0	0.0	45.3	4485.8	83.1	8065.4
36	0.0	0.0	0.0	0.0	0.0	0.0	44.0	4355.2	80.7	7830.5
37	0.0	0.0	0.0	0.0	0.0	0.0	42.7	4228.3	78.3	7602.4
38	0.0	0.0	0.0	0.0	0.0	0.0	41.5	4105.2	76.1	7381.0
39	0.0	0.0	0.0	0.0	0.0	0.0	40.3	3985.6	73.8	7166.0
40	0.0	0.0	0.0	0.0	0.0	0.0	39.1	3869.5	71.7	6957.3
41	0.0	0.0	0.0	0.0	0.0	0.0	37.9	3756.8	69.6	6754.6
42	0.0	0.0	0.0	0.0	0.0	0.0	36.8	3647.4	67.6	6557.9
43	0.0	0.0	0.0	0.0	0.0	0.0	35.8	3541.2	65.6	6366.9
44	0.0	0.0	0.0	0.0	0.0	0.0	34.7	3438.0	63.7	6181.4
45	0.0	0.0	0.0	0.0	0.0	0.0	33.7	3337.9	61.8	6001.4
46	0.0	0.0	0.0	0.0	0.0	0.0	32.7	3240.7	60.0	5826.6
47	0.0	0.0	0.0	0.0	0.0	0.0	31.8	3146.3	58.3	5656.9
48	0.0	0.0	0.0	0.0	0.0	0.0	30.9	3054.6	56.6	5492.1
49	0.0	0.0	0.0	0.0	0.0	0.0	30.0	2965.7	54.9	5332.2
50	0.0	0.0	0.0	0.0	0.0	0.0	29.1	2879.3	53.3	5176.9
Totals	13.5	663.0	95.5	9453.2	926.2	91697.4	1086.9	107599.2	2248.8	218221.2

Source: LE simulation.

Table A3: Cost benefits analyses of health and medical research: Australia versus the Rest of the World
(\$ m base year prices and ratios)

<i>Item</i>	<i>Australia</i>	<i>Rest of the World</i>
Health benefits: of which	2249	218221
attributable Aust HMR	237(a)	6568(b)
attributable RoW HRM	2012	211653
Revenues	1087	107599
Costs: of which	1035	101814
HMR	109	10116
Commercialisation	926	91697
Revenue/cost ratios	1.05	1.06
Benefit/cost ratios	2.17	2.14

Notes: (a) Equal to 2.17 times 109 (b) Equal to 3.01% of 218221 Both the 2.17 and 3.01 estimates come from Access Economic research (AE 2008) — see Chapter 2. HMR stands for health and medical research while RoW stands for the rest of the world.

Source: LE simulation.

Based on the figures reported in Table A3, some 10.5 per cent of the health benefits enjoyed by Australians are attributable to Australian health and medical research (with the remainder attributable to successful health R&D done in the rest of the world). And according to Access Economics' research some 3.01 per cent (equal to 6568 divided by 218221) of health benefits enjoyed by the rest of the world are attributable to successful Australian health R&D. It should be noted that figures reported in levels throughout this attachment are scale-dependent, whereas reported ratios are scale-independent (and thus should form the focus of attention).

A4 Employment

The simulation results reported in Table A3 underline the contribution health-and-medical-research-related goods and services make to the Australian economy, since value added by the sector (equal to revenues minus costs) is positive — and GDP is merely an aggregation of the value added contributed by the various sectors that make up the Australian economy.

According to the Grant Report (2004:15), in 2006 the health and medical research sector was estimated to have accounted for some 0.17 per cent of GDP. According to a recent Treasury Briefing Paper for the Senate Inquiry into the Economic Stimulus Package (Treasury 2010), for every 1 per cent increase in GDP employment expands by around 0.75 per cent. This would imply employment in the health and medical research sector of some 14,025, which accords with the 15,000 estimate appearing in the Grant Report (p.1).

Further, with Australian GDP now around the \$1 trillion mark, estimated value added per health and medical research worker would be around \$133,000 — some 25 per cent above the equivalent economy-wide figure (based on a workforce of 11 million). Thus, health and medical research jobs are relatively highly paid by average standards, consistent with the relatively highly skilled nature of much of the work performed in this sector.

A5 Conclusions

Thus, based on arguably realistic assumptions of the role played by Australian health and medical research on the world stage, investing in Australian health and medical research likely makes economic sense, as well as significantly enhancing the health and wellbeing of Australians. To the extent that the above scenario is realistic for the circumstances of Australian health and medical research today, the simulation results reported in this attachment serve to underscore the exceptional returns potentially available from investing in Australian health and medical research.

B SPENDING ON HEALTH AND MEDICAL RESEARCH IN AUSTRALIA

More than \$27 billion has been spent on health and medical research in Australia in the decade and a half to 2006-07, with a significant proportion directed to the basic end of the R&D spectrum of activities. Of those financing health and medical research (governments and private for-profit businesses and not-for-profit organisations) only the Commonwealth has consistently failed to increase its own efforts on health and medical research in line with the growth in overall health spending — although it is an important funder of health and medical research performed by the higher education sector (whose spending on health and medical research has more than kept pace with overall health spending). This track record is based on ABS figures for Health as one of a number of socio-economic targets for R&D investments in Australia. Turning to Health and medical sciences as a research field, only State and Territory governments have consistently failed to increase their spending in line with growth in overall health spending. Further, all levels of government under-performed relative to this yardstick for most of the period from 1997-98 to 2006-07 — with boosts to funding only occurring from 2003-04 onwards following the release and consideration by government of the Wills review. When it comes to funding the National Health and Medical Research Council, however, the Commonwealth Government has a much better track record — with growth in NHMRC funding/spending only failing to keep pace with overall growth in health spending in 2000-01 and 2007-08.

B1 Measuring health and medical research effort

R&D activity is defined for statistical purposes by the Australian Bureau of Statistics (ABS 2006) as:

Systematic investigation or experimentation involving innovation or technical risk, the outcome of which is new knowledge, with or without a specific practical application, or new and improved products, processes, materials, devices or services. R&D activity extends to modifications to existing products/processes. R&D activity ceases and pre-production begins when work is no longer experimental.

The definition used by the ABS is consistent with the Organisation for Economic Cooperation and Development definition of R&D (OECD 1994) 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.

Classification of research in this study is based on the Australian Standard Research Classification (ASRC) (ABS 1998), which in turn is based on OECD guidelines for member nations for both R&D measurement and data collection. R&D expenditure refers to gross expenditure on R&D (known as GERD). Under the ASRC, expenditure on health and medical research undertaken by both public and private for-profit and non-profit organisations is classified by the ABS in various ways, including:

- by socio-economic objective (SEO), a classification which includes *Health*;
- by research field, a classification which includes *Medical and health sciences*;
- by sector (*Business, Higher education*,¹⁹ *Private non-profit*²⁰ and *Government* — with Government disaggregated into *Commonwealth* and *State and Territory* components);
- by source of funds (*Business, Commonwealth government, State & local government, Other Australian* and *Overseas*); and
- by type of activity (Pure basic research, Strategic basic research, Applied research and Experimental development).

Spending estimates summarised here concentrate on the former two classifications (i.e. by *Health* as a socio-economic objective, and *Medical and health sciences* as a research field).

R&D expenditure data compiled by the ABS cover all areas relating to health, including prevention, screening, diagnosis, treatment and epidemiological research — with much of Australian health and medical research being classified as basic research.

¹⁹ The *Private non-profit* (PNP) classification includes all private or semi-public incorporated organisations in Australia which are established with the intention of not making a profit and carried out R&D. If an organisation is considered as private non-profit but was established to serve the business sector then it is included in the business sector. An example would be the Cancer Council of Australia.

²⁰ The OECD definition of the *Higher education* sector encompasses universities and other institutions of post-secondary education regardless of their source of finance or legal status. The scope of the ABS R&D survey is based on the OECD definition, but excludes colleges of Technical and Further Education. (For the 2008 survey, 40 Australian higher education institutions were in scope and data collected from each.). An example would be the Walter and Eliza Institute of Medical Research.

The following section draws on statistics compiled for the 2008 Access Economics' report. Although dated (it covers the period 1992-93 to 2004-05), the reason the section is included is that the ABS ran special tabulations to widen the definition of Health (as an SOE) to include *Human pharmaceutical products*. The ABS also disaggregated some of the cross-classifications to provide increased detail in particular cases.

B2 Estimates of health and medical research spending: 1992-93 to 2004-05

The following statistical estimates of health and medical research spending in Australia come from the most recent Access Economics' report on health and medical spending titled *Exceptional Returns II: The value of investing in health R&D in Australia* (AE 2008). This report updated a previous one (also undertaken for the Australian Society for Medical Research) titled *Exceptional Returns: The value of investing in health R&D in Australia* (AE 2003).

Health and medical research by sector

In 2004-05, an estimated \$2.8 billion was spent undertaking health R&D (on an SEO basis) in Australia by business, government, higher education facilities and private non-profit (PNP) organisations. Chart B1 shows that higher education institutions performed the highest portion of health and medical research of around \$1.2 billion (or 44% of the total). Private business and PNP organisations performed around \$0.7 billion (26%) and \$0.4 billion (16%) respectively, while State/Territory and Commonwealth performed around \$0.3 billion (11%) and \$0.08 billion (3%) respectively. Consequently, 58 per cent of health R&D was performed by the public sector and 42 per cent by the private sector. Non-business R&D amounted to some \$2.1 billion.

Since 1992-93, expenditure on health R&D had grown from around \$800 million to \$2.8 billion, involving an average annual growth rate of 12 per cent. Chart B2 shows the trend in R&D performed by sector to 2004-05.

Chart B1: Health and medical research performed (SEO basis), by sector, 2004-05

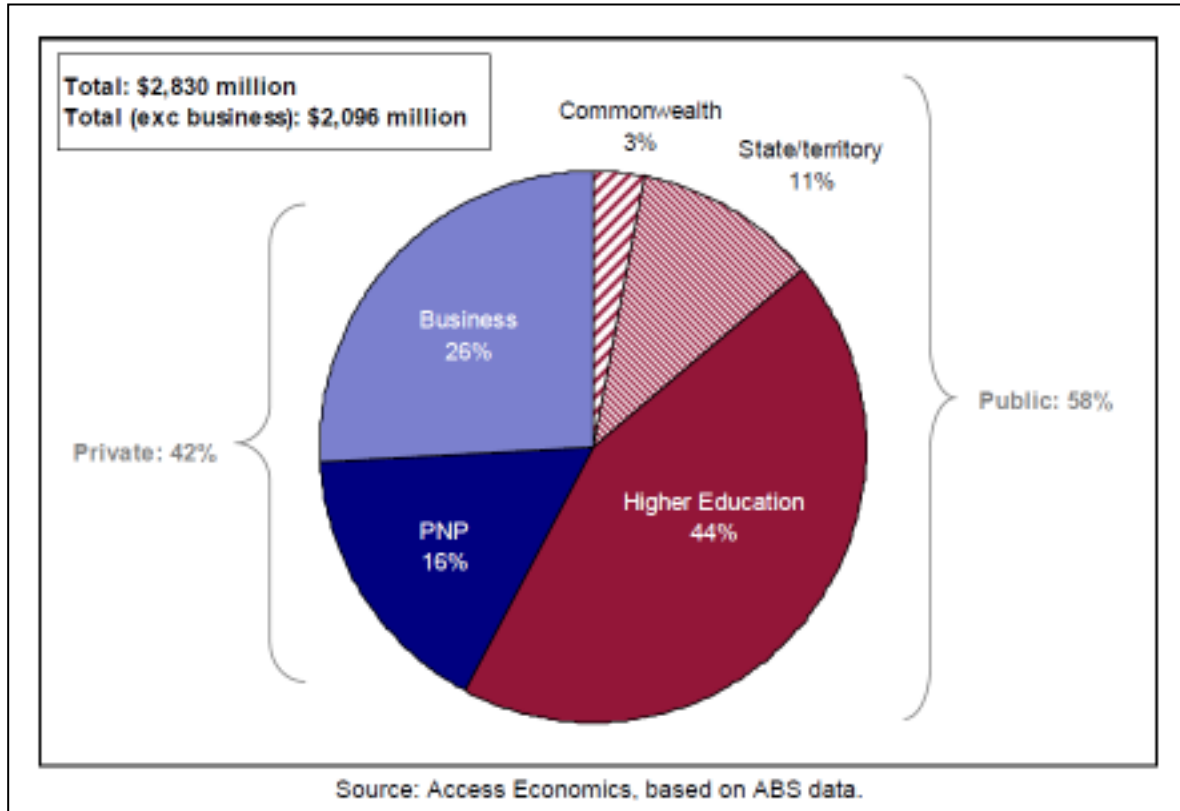
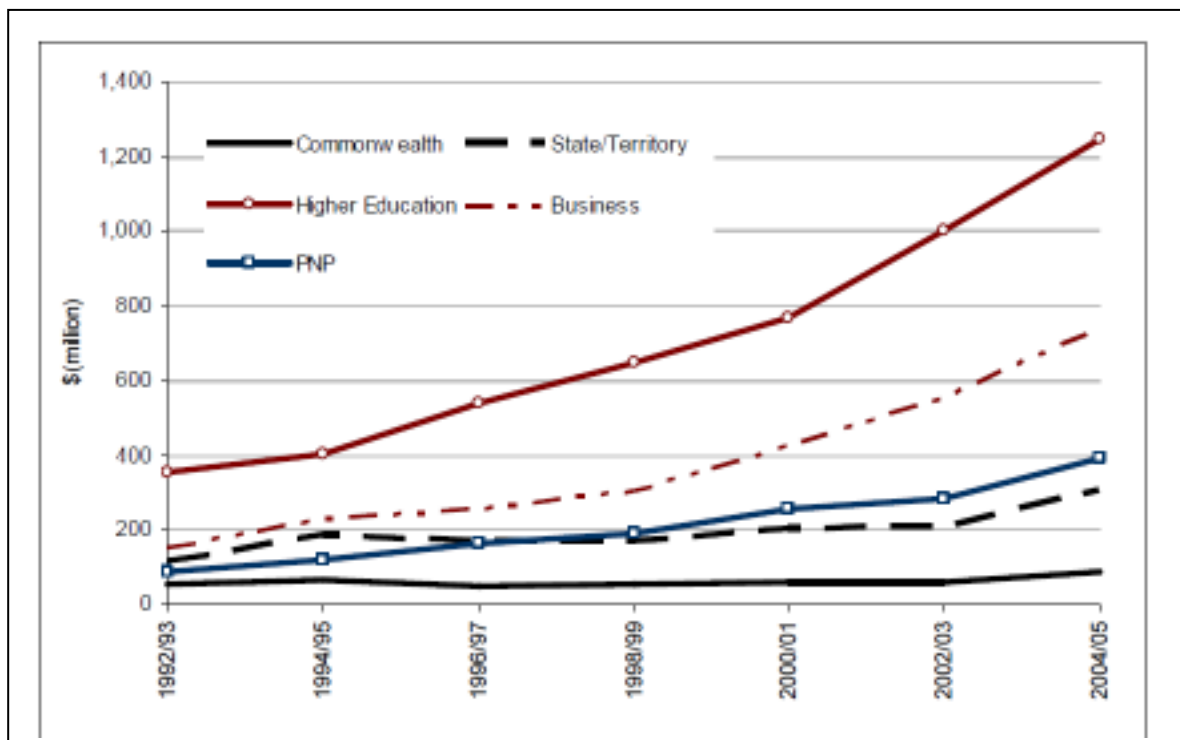


Chart B2: Trends in health and medical research performed (SEO basis), by sector, 1992-93 to 2004-05

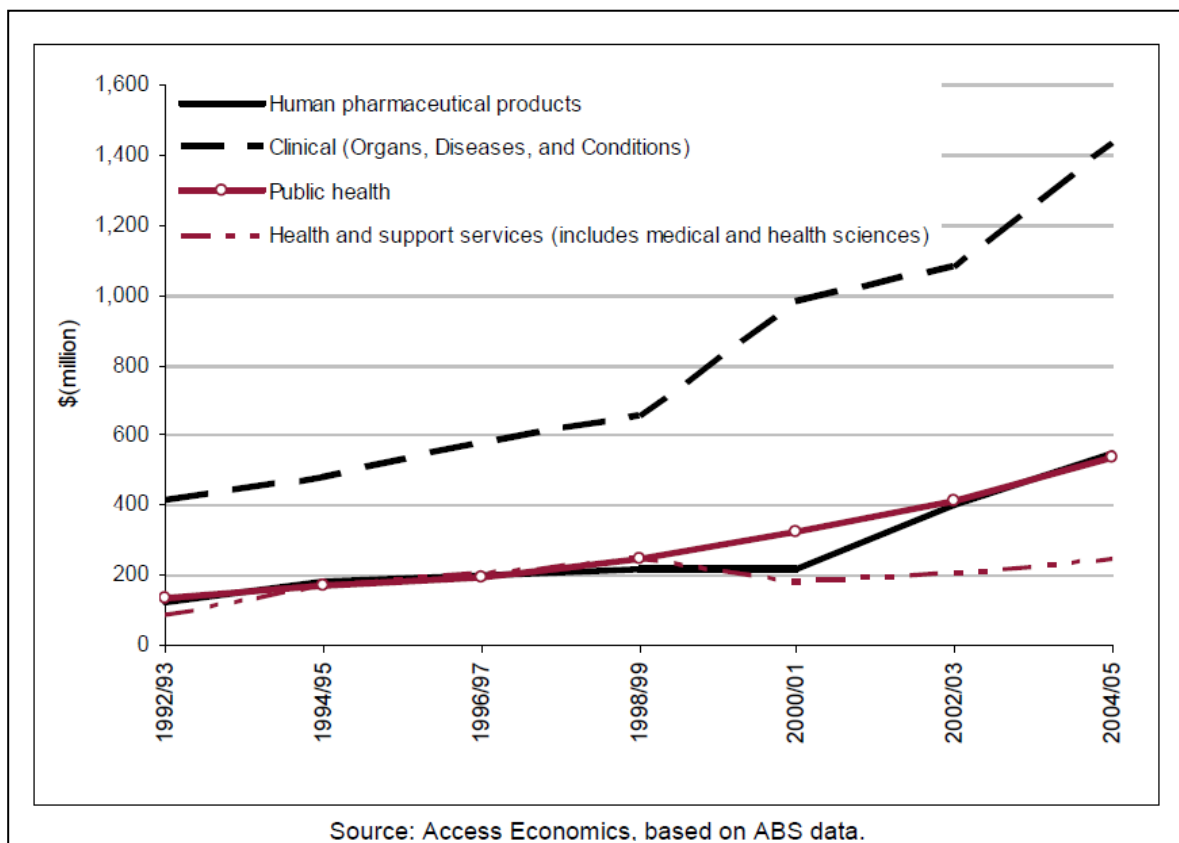


The average growth rate of health R&D performed by Business was the highest, at around 15 per cent per year. This was closely followed by PNP (15%), Higher Education (12%), State/Territory (10%) and the Commonwealth (4%). In 2004-05, Australian non-business health R&D accounted for the equivalent of 0.23 per cent of GDP — equivalent to some \$103 per person. By comparison, non-commercial health R&D was only 0.14 per cent of GDP (or around \$35 per person) in 1992-93.

Health and medical research by purpose

Chart B3 shows the trend in health R&D expenditure by purpose between 1992-93 and 2004-05. The majority of health and medical research outlays since 1992-93 had been directed towards clinical research, which increased from around \$413 million to \$1.43 billion (at an average annual growth rate of 12%). R&D expenditure on human pharmaceutical products and population health had similar expenditures in 2004-05 with \$548 million and \$536 million spent respectively, although the average annual growth rate for the former was larger at 15 per cent compared to 12 per cent. Health and support services (which includes medical and health sciences prior to 2000-01) recorded the lowest expenditure in 2004-05, at \$250 million and the lowest average annual growth rate, at 12 per cent.

Chart B3: Trends in health and medical research spending (SOE basis), by purpose, 1992-93 to 2004-05



CLINICAL NON-BUSINESS SPENDING BY CLASS

Focusing on clinical R&D, and disaggregating expenditure by class, showed that cancer and related disorders accounted for the most expenditure in 2004-05 within the non-business sector. Around \$233 million was spent on cancer, which was nearly double the expenditure for cardiovascular disease (at \$120 million). The smallest class of expenditure in 2004-05 was for skin and related conditions, at around \$8 million.

This picture had changed since 1992-93, due to variable growth in spending by class. Growth was highest for arthritis, bone and joint disorders (at around 17%), while infectious diseases recorded the second highest growth rate (at around 13%). Growth in R&D expenditures for cardiovascular diseases, and cancer and related disorders, ranked in the middle (with both at around 11%). The lowest growth rate was for reproductive medicine (at around 5%).

Health and medical research by source of funds

Although the Commonwealth Government performs the least amount of health R&D, most health and medical research funding comes from the Commonwealth. In 2004-05, it contributed around \$1.4 billion of funds across all five sectors. The majority of this spending went to Higher Education facilities (79%), while Business received the lowest amount of funding (2%). The business sector spent the second highest amount of funds on health R&D and, not surprisingly, most of these funds were spent on R&D undertaken by business. Overseas funding accounted for around \$121 million (4%) of Australian health R&D spending, of which the majority was performed by the PNP sector.

B3 Updating estimates of health and medical research spending: 1992-93 to 2006-07

Since Access Economics wrote its most recent (2008) report, the ABS has run further surveys of R&D in Australia. Thus, it is possible to update the estimates reported in the previous section. Unfortunately, the spending estimates are not comparable, since (as mentioned above) Access Economics got ABS to combine *Health* (Subdivision 730000) with *Human pharmaceutical products* (Group 670400), whereas the longer time series (through to 2006-07) reported below are restricted just to *Health*. In order to provide the maximum comparable information in this section of the report, estimates are provided covering the 15-year period 1992-93 through 2006-07 (the latest year for which ABS has run the R&D surveys).

Health and medical research related statistics compiled by the ABS can be presented in a variety of ways. Here, the focus is on trends in research spending by sector (i.e.

Business, Higher education, Private Non-Profit and Government) over the decade and a half to 2006-07 focusing on the following questions:

- Compared to growth in overall health spending which sectors are (more than) keeping up when it comes to health and medical research spending?
- How is the sectoral composition of health and medical research spending changing over time? and
- How is the priority accorded to health and medical research changing over time, compared with other targets for R&D spending, by sector?

Health and medical research by sector

Estimates of R&D spending coded to the socio-economic objective *Health* are presented in Table B1 for the period 1992-93 through 2006-07, by sector. The figures are graphed in Chart B4.

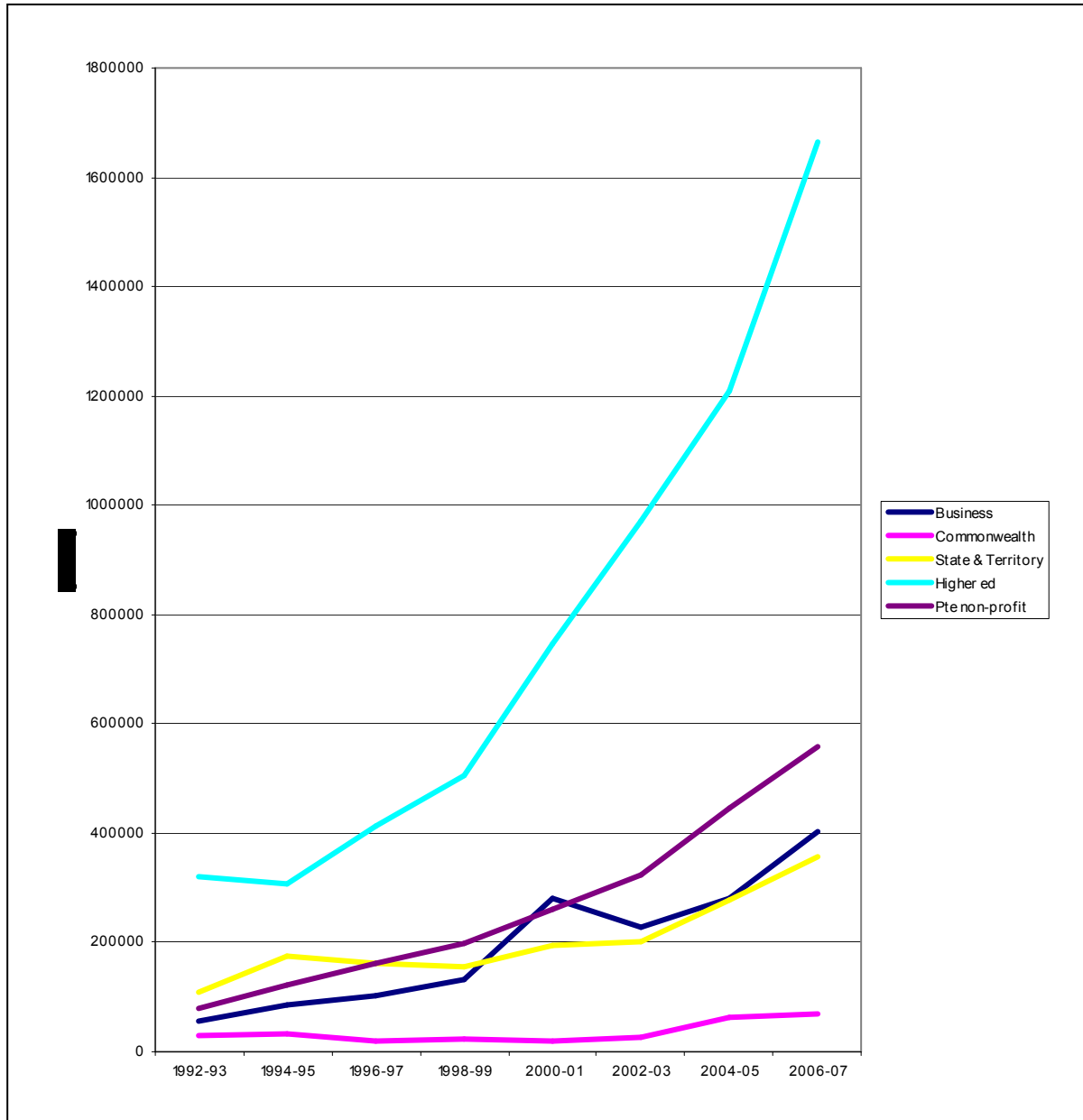
Table B1: Health and medical research performed (SOE basis), by sector, 1992-93 to 2006-07

(\$'000)

<i>Year</i>	<i>Business</i>	<i>Commonwealth</i>	<i>State & Territory</i>	<i>Total govt</i>	<i>Higher education</i>	<i>Private non-profit</i>	<i>Total</i>
1992-93	57250	29349	110071	139420	318975	78760	594405
1994-95	86387	33772	173732	207504	305748	121755	721394
1996-97	103998	19659	163120	182780	413458	161678	861914
1998-99	131953	24051	155366	179417	504733	196843	1012946
2000-01	279205	19302	196420	215722	747357	262280	1504564
2002-03	226451	24943	203046	227989	970399	323956	1748795
2004-05	281971	61265	278553	339818	1208160	444439	2274387
2006-07	401977	68127	355510	423637	1663046	558558	3047217

Source: ABS Cat. No. 8112.0

Chart B4: Trends in health and medical research performed (SOE basis), by sector, 1992-93 to 2006-07



Interpolating *Health* R&D spending for the missing (alternate) years in Table B1 as the average of the prior and subsequent financial year figures (ABS runs its R&D surveys every 2 years) produces an estimate of some \$21.7 billion spent on health and medical research over the decade and a half to 2006-07.

The Australian Institute of Health and Welfare (AIHW health expenditure database) publishes estimates of total spending on health in current (nominal) and constant (inflation-adjusted or real) prices covering the period 1997-98 to 2007-08 (Table B2).

Table B2: Total health expenditure, current and constant prices(a), and annual rates of change, 1997-98 to 2007-08

Year	Amount (\$ million)		Change from previous year (%)	
	Current	Constant	Nominal change ^(b)	Real growth ^(b)
1997-98	44,802	62,305
1998-99	48,428	65,679	8.1	5.4
1999-00	52,570	69,637	8.6	6.0
2000-01	58,269	74,321	10.8	6.7
2001-02	63,099	77,886	8.3	4.8
2002-03	68,798	82,020	9.0	5.3
2003-04	73,509	84,657	6.8	3.2
2004-05	81,060	89,634	10.3	5.9
2005-06	86,685	92,191	6.9	2.9
2006-07	94,938	97,720	9.5	6.0
2007-08	103,563	103,563	9.1	6.0
			Average annual change	
1997-98 to 2002-03			9.0	5.7
2002-03 to 2007-08			8.5	4.8
1997-98 to 2007-08			8.7	5.2

Notes: The difference between average annual nominal growth in health spending (of 8.7% over the 1997-98 to 2007-08 period) and the corresponding figure for real growth (of 5.2%) is a measure of 'health' inflation.

(a) Constant price health expenditure for 1997-98 to 2007-08 is expressed in terms of 2007-08 prices.

Refer to Appendix E for further details.

(b) Nominal changes in expenditure from year to year refer to the change in current price estimates. Real growth is the growth in expenditure at constant prices.

Source: AIHW health expenditure database.

Over the period 1997-98 to 2006-07 (the closest approximation to the 1992-93 to 2006-07 period covered by Table B1 above), nominal spending on health grew, on average, by 8.7 per cent annually. Table B3 subtracts this figure from the year-on-year growth rates implicit in the estimates reported in Table B1 above to indicate

which years *Health* spending grew by more than this average growth rate for overall health spending.

Table B3 also reports to what extent *Health* spending by *Business, Government* (at both the Commonwealth and State/territory levels), *Higher education* and *Private non-profit* organisations exceeded (or in some cases fell short of) this average annual increase in health spending — what are referred to in the table as 'Excess' growth rates. Excess growth rates were calculated on grounds that — in line with the thrust of this report (that investing in health and medical research leads to higher-than-average returns for the community) — health and medical research spending should at least keep pace with health spending more generally.

Table B3: Nominal growth in health and medical research performed (SOE basis), by sector, 1993-94 to 2006-07, compared with average growth in health spending

('Excess' growth rates %)

<i>Year</i>	<i>Business</i>	<i>Commonwealth</i>	<i>State & Territory</i>	<i>Total govt</i>	<i>Higher education</i>	<i>Private non-profit</i>	<i>Total</i>
1993-94	16.7	-1.2	20.2	15.7	-10.8	18.6	2.0
1994-95	11.6	-1.7	13.7	10.9	-10.8	12.7	0.9
1995-96	1.5	-29.6	-11.8	-14.7	8.9	7.7	1.0
1996-97	0.5	-35.1	-11.9	-15.0	6.3	5.4	0.2
1997-98	4.7	2.5	-11.1	-9.6	2.3	2.2	0.1
1998-99	3.1	1.3	-11.1	-9.6	1.2	1.1	-0.7
1999-00	47.1	-18.6	4.5	1.4	15.3	7.9	15.6
2000-01	27.1	-19.7	3.0	0.5	10.7	5.5	10.8
2001-02	-18.2	5.9	-7.0	-5.9	6.2	3.0	-0.6
2002-03	-19.1	4.0	-7.1	-5.9	4.3	1.8	-1.2
2003-04	3.5	64.1	9.9	15.8	3.5	9.9	6.3
2004-05	2.2	33.4	7.0	11.0	2.2	7.0	4.4
2005-06	12.6	-3.1	5.1	3.6	10.1	4.1	8.3
2006-07	8.8	-3.4	3.4	2.3	7.1	2.7	5.8
Average	7.3	-0.1	0.5	0.0	4.0	6.4	3.8

Notes: Table entries obtained by subtracting 8.71 (the average annual growth in health spending in nominal terms over the 1997-98 to 2006-07 as estimated by the AIHW) from the year-on-year increases calculated from the entries in the preceding table.

Source: ABS Cat. No. 8112.0

Of the sectors shown in Table B3, only the Commonwealth has consistently failed to increase its own spending on health and medical research in line with the growth in overall health spending — with its health and medical research spending growing, on average, by 8.6 per cent per annum in nominal terms over the 1992-93 to 2006-07 period compared with the 8.7 per cent per annum average annual increase overall increase in health spending, as estimated by the AIHW (admittedly over the somewhat shorter period 1997-98 to 2006-07). Indeed, its record would have been far worse if the catch-up years (of 2003-04 and 2004-05) were excluded — in which case the average annual growth in its health and medical research spending would have deteriorated to (minus) 8.2. However, as noted in the Access Economics' analysis (see above), although the Commonwealth sector performs the least amount of health R&D itself, most of the funding comes from the Commonwealth. In particular, the Commonwealth is an important funder of Higher education, whose 'excess' average growth rate (4.0%) is exceeded only by the Business sector (7.3%) and Private non-profit (PNP) organizations (6.4%).

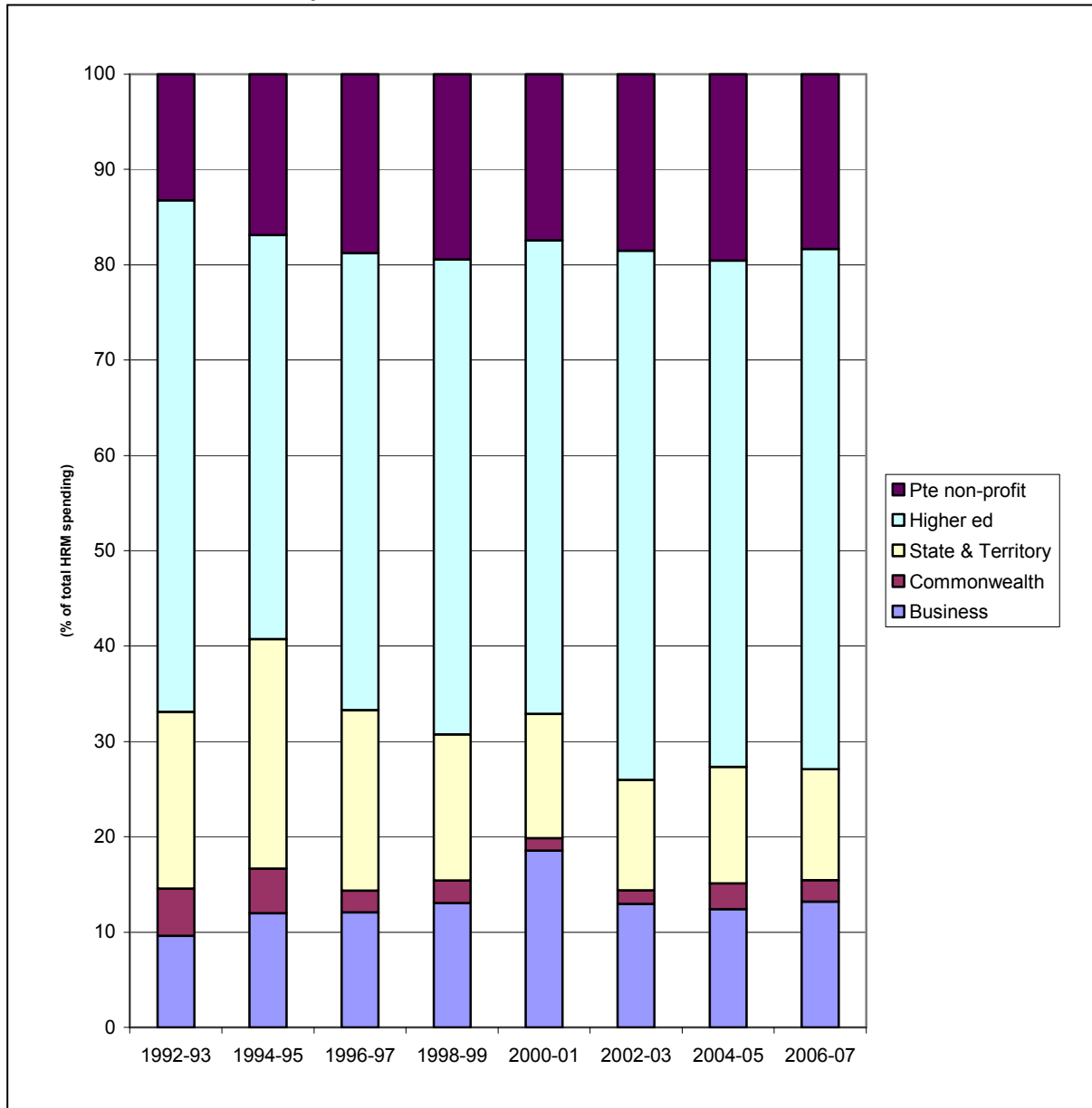
Table B4 reports the composition of *Health* research spending by sector in terms of sectoral contributions towards the total, while Chart B5 displays this information in graphical form.

Table B4: Health and medical research performance (SOE basis), by sector, 1992-93 to 2006-07: % of total Health

<i>Year</i>	<i>Business</i>	<i>Commonwealth</i>	<i>State & Territory</i>	<i>Total govt</i>	<i>Higher education</i>	<i>Private non-profit</i>	<i>Total</i>
1992-93	9.6	4.9	18.5	23.5	53.7	13.3	100.00
1994-95	12.0	4.7	24.1	28.8	42.4	16.9	100.00
1996-97	12.1	2.3	18.9	21.2	48.0	18.8	100.00
1998-99	13.0	2.4	15.3	17.7	49.8	19.4	100.00
2000-01	18.6	1.3	13.1	14.3	49.7	17.4	100.00
2002-03	12.9	1.4	11.6	13.0	55.5	18.5	100.00
2004-05	12.4	2.7	12.2	14.9	53.1	19.5	100.00
2006-07	13.2	2.2	11.7	13.9	54.6	18.3	100.00

Source: ABS Cat. No. 8112.0

Chart B5: Composition of health and medical research spending (SOE basis), by sector, 1992-93 to 2006-07



Looking at the figures reported in Table B4 (and graphed in Chart B5), the following trends in the composition of health and medical research spending, by sector, are apparent:

- Business spending on Health R&D has been trending upwards over time (from accounting for 9.6% of overall health and medical research spending in 1992-93 to 13.2% by 2006-07) — with the 18.6 per cent figure for 2000-01 representing an outlier (possibly explained by governments cutting back on health-related R&D during a downturn in economic activity);
- Commonwealth Government spending on health and medical research has been trending down over time (from accounting for 4.9% of overall health and

medical research spending in 1992-93 to 2.2% by 2006-07) — with the 1.3 per cent for 2001-02 and 1.4 per cent for 2002-03 seeming to confirm that governments tend to cut health and medical research spending in difficult times;

- State and Territory Government spending on *Health* R&D has also been trending down over time (from accounting for 18.5% of overall health and medical research spending in 1992-93 to 11.7% by 2006-07) — with the 24.1 per cent figure for 1994-95 representing an outlier;
- Total government spending on *Health* R&D has been trending downwards over time (from accounting for 23.5% of overall health and medical research spending in 1992-93 to 13.9% by 2006-07) — with the 28.8 per cent figure for 1994-95 representing an outlier (attributable to the spike in that year due to State and Territory Government spending), and with spending levels seemingly stabilising in the 13 to 15 per cent range from 2000 onwards;
- Apart from the relatively low 42.4 per cent figure for 1994-95, Higher education health and medical research spending exhibits no trend; while
- Health and medical research spending by the Private non-profit (PNP) sector has been trending upwards over time (from accounting for 13.3% of overall health and medical research spending in 1992-93 to 18.3% by 2006-07).

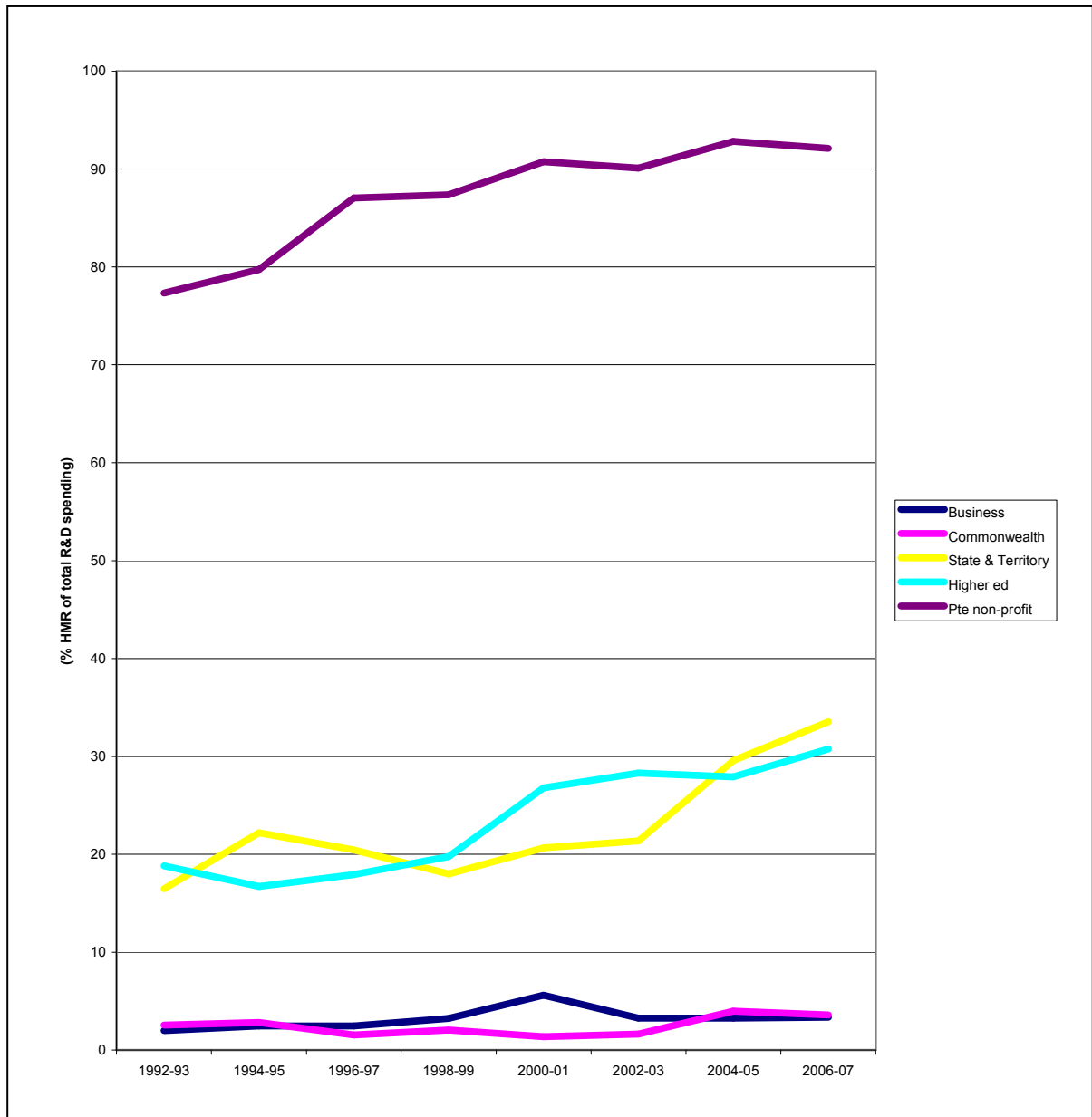
Table B5 reports relative health and medical research effort, by setting out estimates of the proportion of each sector's overall R&D spending which is devoted to the *Health*, while Chart B6 displays this information in graphical form. This information highlights the changing priority accorded health and medical research spending compared with other targets for R&D spending at the sectoral level.

Table B5: Health and medical research performance (SOE basis), by sector, 1992-93 to 2006-07: % on Health

<i>Year</i>	<i>Business</i>	<i>Commonwealth</i>	<i>State & Territory</i>	<i>Total govt</i>	<i>Higher education</i>	<i>Private non-profit</i>	<i>Total</i>
1992-93	2.00	2.54	16.46	7.64	18.82	77.33	9.17
1994-95	2.46	2.83	22.19	10.50	16.71	79.73	9.66
1996-97	2.46	1.55	20.45	8.85	17.92	87.02	9.80
1998-99	3.22	2.04	17.99	8.78	19.75	87.37	11.36
2000-01	5.60	1.37	20.65	9.16	26.79	90.74	14.44
2002-03	3.26	1.63	21.35	9.19	28.29	90.10	13.24
2004-05	3.25	3.97	29.58	13.67	27.92	92.81	14.24
2006-07	3.34	3.60	33.52	14.34	30.77	92.12	14.51

Source: ABS Cat. No. 8112.0

Chart B6: Relative health and medical research effort (SOE basis), by sector, 1992-93 to 2006-07



Looking at the figures reported in Table B5 (and graphed in Chart B6), the following trends are apparent:

- Health and medical research spending has become an increasing focus of attention over time for the Business sector (with the per cent of overall R&D spending devoted to health increasing from 2.00% in 1992-93 to 3.34% in 2006-07) — again with the 5.60 per cent figure for 2000-01 representing an outlier possibly explained by governments cutting back on health-related R&D during a downturn in economic activity;
- Health and medical research as a Commonwealth Government focus of its overall R&D spending presents a mixed picture (with the apparent upward trend from 2.54% in 1992-93 to 3.60% in 2006-07 being interrupted by falls in relative health and medical research efforts to levels of between 1.37% and 2.04% in the 6-year period from 1996-97 to 2002-03);
- Like the Commonwealth, health and medical research as a State and Territory Government focus of their overall R&D spending also presents a mixed picture (with the apparent upward trend from 16.46% in 1992-93 to 33.52% in 2006-07 being interrupted by falls in relative health and medical research efforts to levels of between 17.99% and 21.35% in the 6-year period from 1996-97 to 2002-03);
- Nevertheless, health and medical research spending as an overall government focus of R&D spending manages an upward trend (from 7.64% in 1992-93 to 14.34% in 2006-07, apart from spike to 10.5% in 1994-95) — suggesting that health and medical research spending is 'compensatory' between levels of government (in the sense that when one level of government takes its focus off health-related R&D that other tends to compensate so that an upward trend is maintained over time);
- As with the business sector, health and medical research spending has become an increasing focus of attention over time for the Higher education sector (with the per cent of overall R&D spending devoted to health increasing from 18.82% in 1992-93 to 30.77% in 2006-07); while
- The same is true of the PNP sector (with the per cent of overall R&D spending devoted to health by the Private non-profit sector increasing from 77.33% in 1992-93 to 92.12% in 2006-07).

Health and medical research by field of research

Estimates of spending on *Medical and health sciences* as a field of research are presented in Table B6 for the 11-year period 1996-97 through 2006-07, by sector. The figures are graphed in Chart B7.

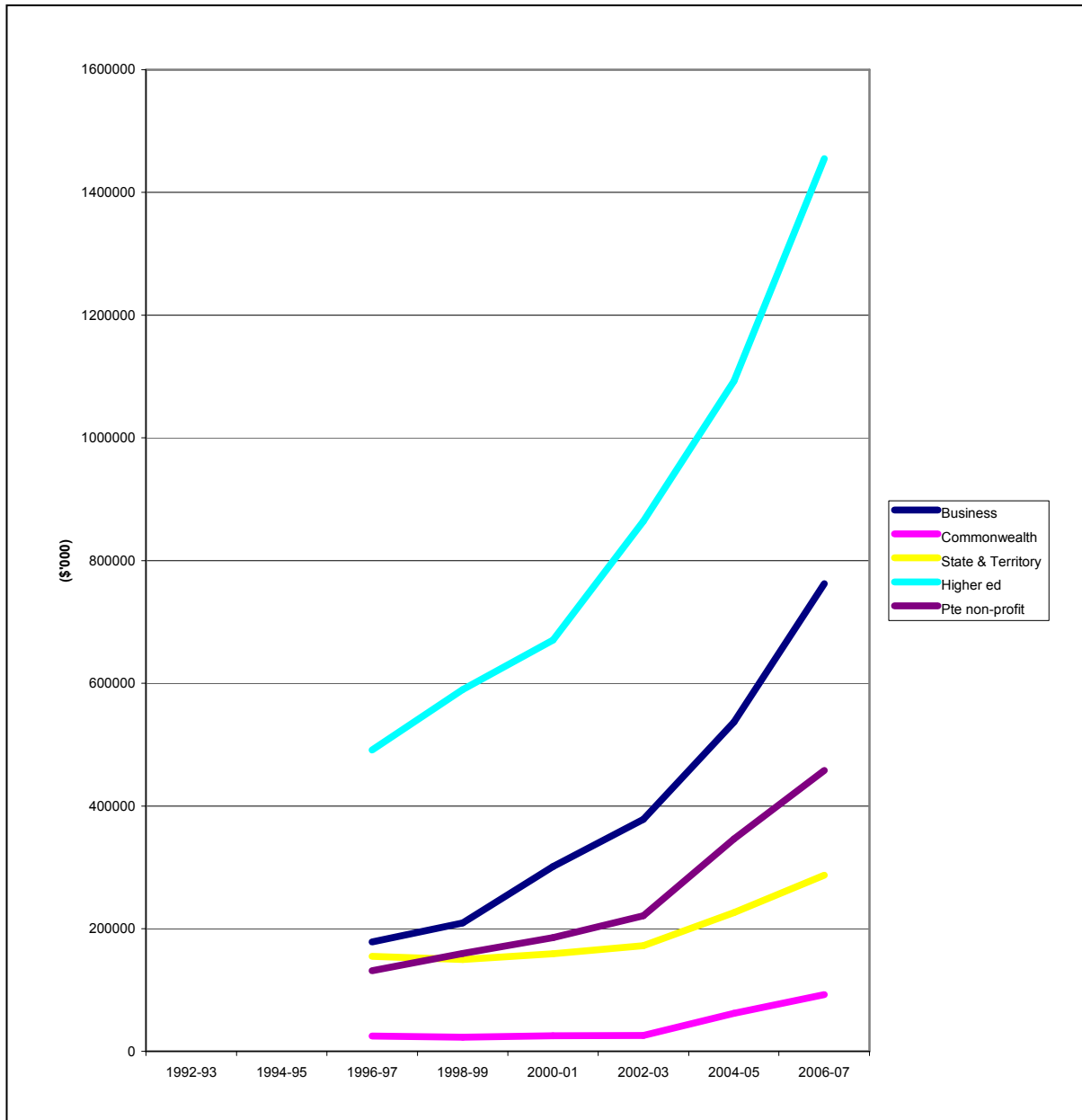
Table B6: Health and medical research performed, by sector and research field: Health and medical sciences, 1996-97 to 2006-07

(\$'000)

Year	Business	Commonwealth	State & Territory	Total govt	Higher education	Private non-profit	Total
1996-97	178313	24970	154973	179942	491378	131371	981004
1998-99	209600	23055	149790	172845	589721	159760	1131926
2000-01	301016	25542	159220	184762	670418	185393	1341589
2002-03	378267	25964	172448	198411	863816	220796	1661290
2004-05	536604	62004	225734	287738	1092512	346063	2262917
2006-07	762215	92659	286956	379614	1454670	457888	3054387

Source: ABS Cat. No. 8112.0

Chart B7: Trends in health and medical research performed, by sector and research field: Health and medical sciences, 1996-97 to 2006-07



Analogous to Table B3 above, Table B7 subtracts the AIHW average annual increase of 8.7 per cent from the year-on-year growth rates implicit in the estimates reported in Table B6 above to indicate which years spending on *Health and medical sciences* grew by more than this average growth rate for overall health spending. Specifically, it reports to what extent *Health and medical sciences* spending by *Business, Government* (at both the Commonwealth and State/territory levels), *Higher education* and *Private non-profit* organisations exceeded (or in some cases fell short of) this average annual increase in health spending — what have been previously labelled (Table B3) as 'Excess' growth rates.

Table B7: Nominal growth in health and medical research performed, by sector and research field: *Health and medical sciences*, 1997-98 to 2006-07, compared with average growth in health spending

('Excess' growth rates %)

Year	Business	Commonwealth	State & Territory	Total govt	Higher education	Private non-profit	Total
1997-98	0.1	-12.5	-10.4	-10.7	1.3	2.1	-1.0
1998-99	-0.6	-12.7	-10.4	-10.7	0.4	1.0	-1.6
1999-00	13.1	-3.3	-5.6	-5.3	-1.9	-0.7	0.6
2000-01	9.2	-3.6	-5.7	-5.4	-2.3	-1.3	-0.2
2001-02	4.1	-7.9	-4.6	-5.0	5.7	0.8	3.2
2002-03	2.7	-7.9	-4.7	-5.1	3.9	0.0	1.9
2003-04	12.2	60.7	6.7	13.8	4.5	19.7	9.4
2004-05	8.6	32.3	4.7	9.7	3.0	13.4	6.6
2005-06	12.3	16.0	4.9	7.3	7.9	7.4	8.8
2006-07	8.7	11.1	3.2	5.1	5.5	5.2	6.2
Average	7.0	7.2	-2.2	-0.6	2.8	4.8	3.4

Notes: Table entries obtained by subtracting 8.71 (the average annual growth in health spending in nominal terms over the 1997-98 to 2006-07 as estimated by the AIHW) from the year-on-year increases calculated from the entries in the preceding table.

Source: ABS Cat. No. 8112.0

Of the sectors represented in Table B7, only State and Territory governments have consistently failed to increase their spending on *Health and medical sciences* research in line with the growth in overall health spending — with such spending growing, on average, by 6.5 per cent per annum in nominal terms over the 1997-98 to 2006-07 period (based on figures reported in Table B6) compared with the 8.7 per cent per annum average annual increase reported by the AIHW (over the same period). Indeed, this relatively poor performance on the part of State and Territory

governments is enough to depress the total for the whole of government — with the figures for *Total government* growing, on average, by 8.07 per cent per annum (compared with the 8.71 per cent for health spending overall). Further, all levels of government underperformed relative to this yardstick for most of the period — with boosts to funding only occurring from 2003-04 onwards following the release and consideration by the Commonwealth Government of the Wills Review.

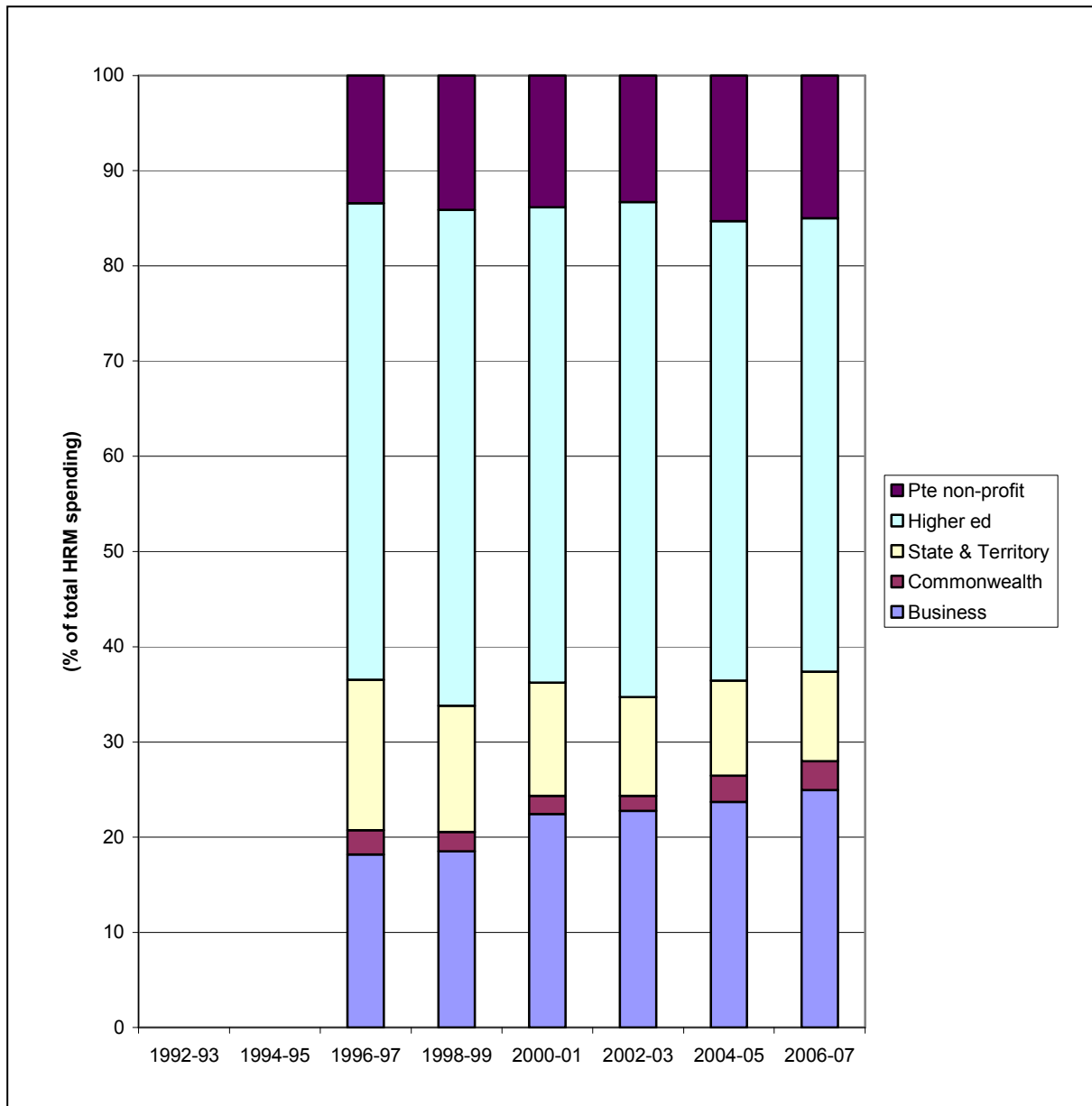
Analogous to Table B4, Table B8 shows the composition of *Health and medical sciences* research effort, by sector, in terms of sectoral contributions towards total spending on this field of research, while Chart B8 displays the information in graphical form.

Table B8: Health and medical research performance, by sector and research field, 1996-97 to 2006-07: % of total Health and medical sciences

<i>Year</i>	<i>Business</i>	<i>Commonwealth</i>	<i>State & Territory</i>	<i>Total govt</i>	<i>Higher education</i>	<i>Private non-profit</i>	<i>Total</i>
1996-97	18.2	2.5	15.8	18.3	50.1	13.4	100.00
1998-99	18.5	2.0	13.2	15.3	52.1	14.1	100.00
2000-01	22.4	1.9	11.9	13.8	50.0	13.8	100.00
2002-03	22.8	1.6	10.4	11.9	52.0	13.3	100.00
2004-05	23.7	2.7	10.0	12.7	48.3	15.3	100.00
2006-07	25.0	3.0	9.4	12.4	47.6	15.0	100.00

Source: ABS Cat. No. 8112.0

Chart B8: Composition of Health and medical sciences R&D spending, 1996-97 to 2006-07



Looking at the figures reported in Table B8 (and graphed in Chart B8), the following trends are apparent:

- Business spending on *Health and medical sciences* as a field of research has been trending upwards over time (from accounting for 18.2% of total R&D spending on this field of research in 1996-97 to 25.0% by 2006-07);
- Commonwealth Government spending on *Health and medical sciences* as a field of research was trending down over time (from 2.5% of the total in 1996-97 to 1.6% by 2002-03) before recovering to around 1996-97 levels in 2004-05 and then establishing what looks to be an upward trend in 2006-07 (by which time Commonwealth spending on *Health and medical sciences* research had grown to account for 3.0 per cent of aggregate spending on this field of research);
- State and Territory government spending on *Health and medical sciences* as a field of research has been trending down over time (from accounting for 15.8% of total R&D spending on this field of research in 1996-97 to 9.4% by 2006-07); so that
- Total government spending on *Health and medical sciences* as a field of research was trending down over time (from 18.3% of the total in 1996-97 to 11.9% by 2002-03) before staging something of a recovery in 2004-05 (to 12.7%) before apparently resuming its downward trend in 2006-07 (to 12.4%);
- Higher education spending on *Health and medical sciences* as a field of research has been trending downwards gradually over time (from accounting for 50.1% of total R&D spending on this field of research in 1996-97 to 47.6% by 2006-07); while
- PNP spending on *Health and medical sciences* as a field of research has been trending upwards over time (from accounting for 13.4% of total R&D spending on this field of research in 1996-97 to 15.0% by 2006-07).

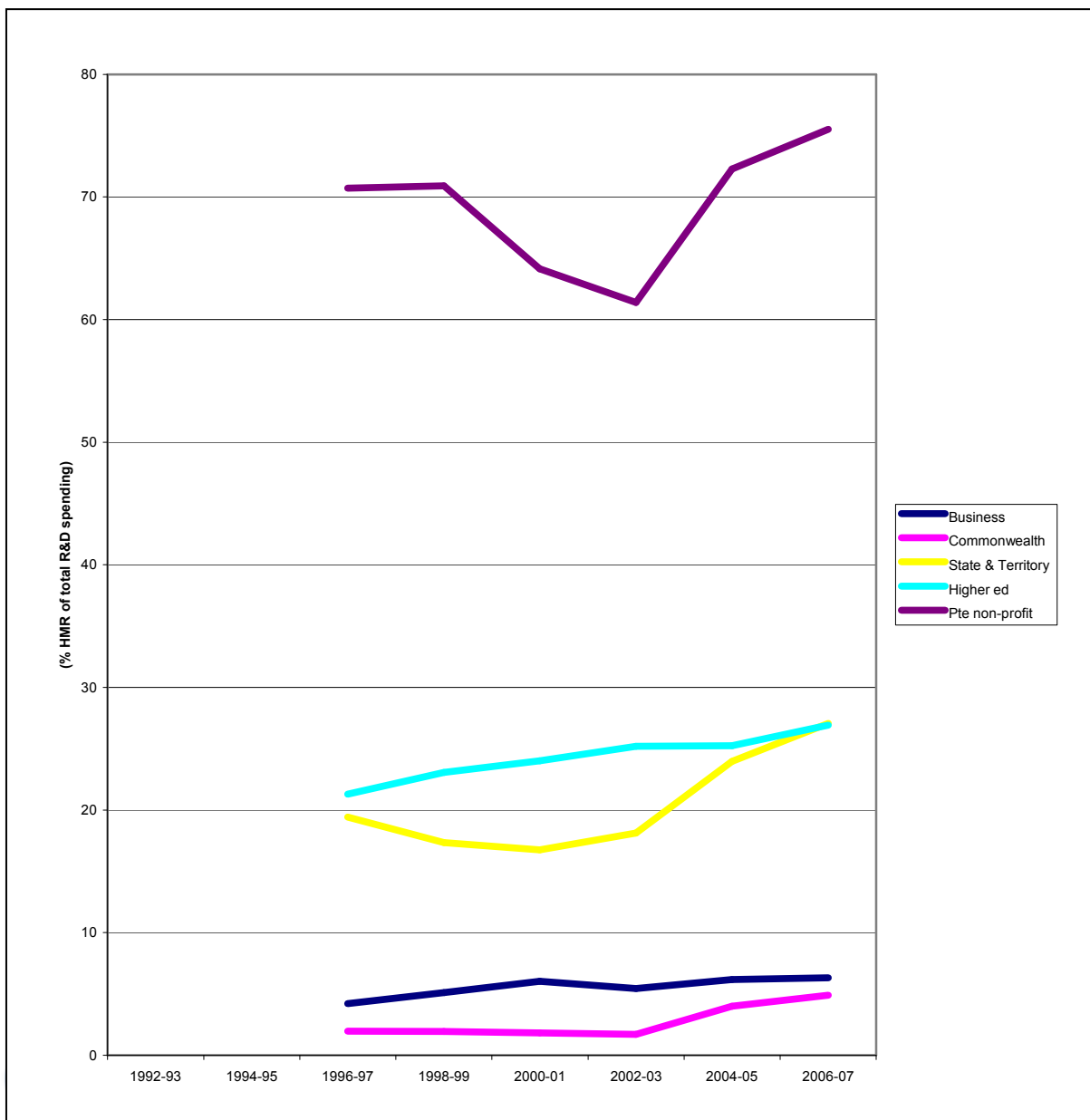
Finally, analogous to Table B5, Table B9 reports relative *Health and medical sciences* research effort, by reporting estimates of the proportion of each sector's overall R&D spending is devoted to *Health and medical sciences* as a field of research, while Chart B9 displays this information in graphical form.

Table B9: Trends in health and medical research performed, by sector and research field: Health and medical sciences, 1996-97 to 2006-07: % on Health and medical sciences

Year	Business	Commonwealth	State & Territory	Total govt	Higher education	Private non-profit	Total
1996-97	4.21	1.97	19.43	8.72	21.29	70.71	11.16
1998-99	5.12	1.95	17.34	8.46	23.08	70.91	12.69
2000-01	6.04	1.82	16.74	7.84	24.03	64.14	12.88
2002-03	5.45	1.70	18.14	7.99	25.19	61.41	12.57
2004-05	6.18	4.02	23.97	11.57	25.25	72.27	14.17
2006-07	6.33	4.89	27.05	12.85	26.92	75.52	14.54

Source: ABS Cat. No. 8112.0

Chart B9: Relative Health and medical sciences research effort, 1996-97 to 2006-07



Looking at the figures reported in Table B9 (and graphed in Chart B9), the following trends are apparent:

- *Health and medical sciences* spending has become an increasing focus of attention over time for the business sector (with the per cent of overall R&D spending devoted to this field of research increasing from 4.21% in 1996-97 to 6.33% in 2006-07);
- In the case of the Commonwealth Government, this field of research was a decreasing focus (with the per cent of overall R&D spending devoted to this field of research falling from 1.97% in 1996-97 to 1.70% in 2002-03) before the trend was reversed in 2004-05 (when the proportion of overall R&D spending devoted to this field rose to 4.02%) and an apparent upward trend subsequently established (with this figure increasing to 4.89 in 2006-07); while
- A similar pattern to the Commonwealth Government is evident in the equivalent figures for the State and Territory governments (with the per cent of overall R&D spending devoted to this field of research falling from 19.43% in 1996-97 to 18.14% in 2002-03) before the trend was reversed in 2004-05 (when the proportion of overall R&D spending devoted to this field rose to 23.97%) and an apparent upward trend subsequently established (with this figure increasing to 27.05 in 2006-07); so that
- In the case of total government this field of research was a decreasing focus (with the per cent of overall R&D spending devoted to this field of research falling from 8.72% in 1996-97 to 7.99% in 2002-03) before the trend was reversed in 2004-05 (when the proportion of overall R&D spending devoted to this field rose to 11.57%) and an apparent upward trend subsequently established (with this figure increasing to 12.85 in 2006-07);
- Like the business sector, health and medical sciences spending has become an increasing focus of attention over time for the Higher education sector (with the per cent of overall R&D spending devoted to this field of research increasing from 21.29% in 1996-97 to 26.92% in 2006-07); while
- In the case of PNPs, health and medical sciences spending has become an increasing focus of attention over time (with the per cent of overall R&D spending devoted to this field of research increasing from 70.71% in 1996-97 to 75.52% in 2006-07 — with the upward trend interrupted during the 2000-03 period of reduced economic activity (suggesting that, when times are tough, donations to health-related charities seem to suffer disproportionately).

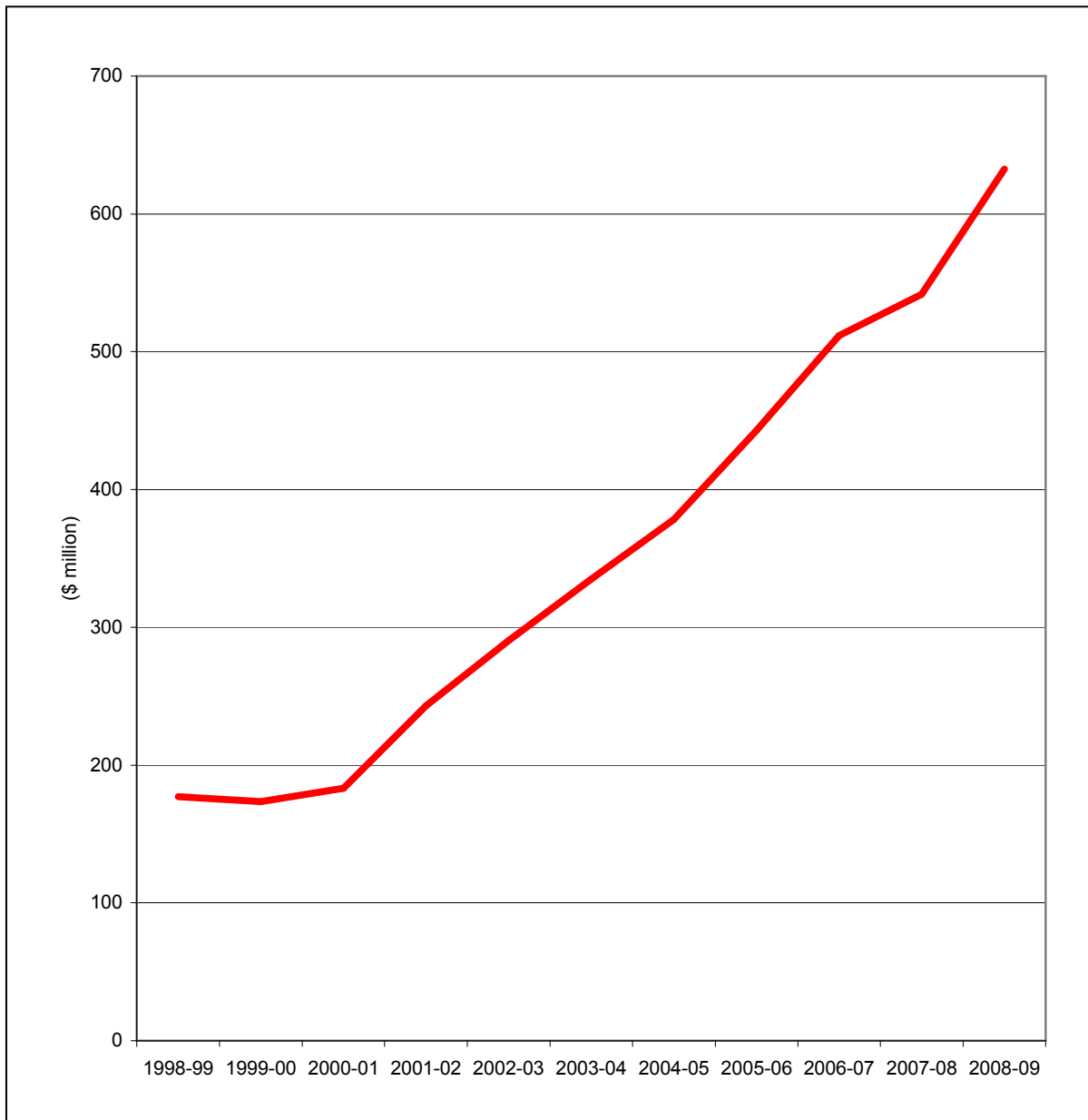
B4 NHMRC funding

The National Health and Medical Research Council (NHMRC) is Australia's peak funding body for medical research. NHMRC funding has increased nearly five-fold since 1995 (RA 2009). NHMRC funding for the period 1998-99 to 2008-09 is shown in Chart B10. Average growth rate over the decade was 13.9 per cent per annum, compared with average annual (nominal) growth in health spending of 8.7 per cent annually (see above).

Even so, with NHMRC's funding for 2006-07 at \$511.7 million out of an estimated of \$3.05 billion in total spent on health and medical research in that year (Table B1), Australia's peak body in the field accounted for some 16.8 per cent of overall spending in that year. This serves to underscore the importance of the contribution other organisations make to Australia's overall effort in the field of health and medical research in any given year.

Nevertheless with the NHMRC in charge of around one-sixth of the budget for health and medical research efforts in Australia, it is incumbent on the NHMRC to attempt to identify (on a regular basis) the benefits its funding produces in both the health and wellbeing and economic dimensions. This could take the form, for example, of an annual 'economic and health impacts' statement of the various effects of its annual funding decisions. Such regular reporting would serve the valuable function of keeping all Australians informed of the value for money they are getting from taxpayer-funded investments in health and medical research.

Chart B10: NHMRC funding/spending, 1998-99 to 2008-09



Similar to information presented in Tables B3 and B7, Table B10 presents estimates of 'excess' growth in NHMRC funding/spending whereby nominal growth in the NHMRC's annual budget is compared to annual average growth in overall spending on health (as estimated by the AIHW — see Table B2 above). As explained above, the rationale for making this correction to underlying growth rates is that — in line with the thrust of this report (that investing in health and medical research leads to higher-than-average returns for the community) — health and medical research spending should at least keep pace with health spending more generally.

Table B10: Nominal growth in NHMRC funding/spending , 1998-99 to 2008-09, compared with average growth in health spending

('Excess' growth rates %)	
Year	NHMRC funding/expenditure
1999-00	-10.69
2000-01	-3.12
2001-02	23.86
2002-03	10.80
2003-04	6.72
2004-05	4.12
2005-06	8.45
2006-07	6.77
2007-08	-2.87
2008-09	8.06
Average	5.21

Notes: Table entries obtained by subtracting 8.71 (the average annual growth in health spending in nominal terms over the 1997-98 to 2006-07 as estimated by the AIHW) from the year-on-year increases calculated from the data graphed in Chart B10.

Source: ABS Cat. No. 8112.0

Unlike the overall relatively poor performance on the part of the Commonwealth Government portrayed in Table B3 (where it is depicted as consistently failing to increase its spending on health and medical research in line with growth in overall health spending), and to an extent in Table B7 (where a poor record on the part of the Commonwealth in the field of Health and medical sciences was turned around from 2003-04 onwards), when it comes to funding the NHMRC the Commonwealth exhibits a much better track record — with growth in NHMRC funding/spending only failing to keep pace with average overall growth in health spending in the years 2000-01 (a period of reduced economic activity) and 2007-08.

However, NHMRC funding again risks falling behind to the extent that it does not share disproportionately in attracting an 'excess' share of recently announced \$7.4 billion increases in health funding announced by the Commonwealth in the context of its response to the report by the National Health and Hospitals Reform Commission. To (at least) maintain its approximately 1.7 per cent share of the health budget (Chart B13), the boost to health and medical research would have to be some \$125.8 million of this additional funding for health. (There is, of course, also the issue of Commonwealth spending on health and medical research more generally similarly more than keeping pace with increased health spending.)

It is important then, that when decisions to increase public spending on health are made, the share health and medical research wins of increased resources devoted to health be at least maintained. Otherwise, the risk is that this vital field of activity loses out in both cyclical downturns and at times when decisions are made to significantly expand health spending.

International comparisons

As noted by Research Australia (RA 2009), government spending on health and medical research in Australia as a share of GDP (Chart B11), on a per capita basis (Chart B12), and as a share of health spending (Chart B13) is currently relatively high by OECD standards, although it trails significantly behind US health R&D efforts.

Because there are exceptional returns attributable to health and medical research (as this reports documents), it would make sound economic and social sense for Australian government to commit to doubling expenditure on health and medical research (in real terms) over, say, a decade. To achieve this, spending on health and medical research would have to grow in real (inflation-adjusted) terms by 8 per cent per annum. Such a growth rate would, for example, double the estimated \$3 billion spend on health and medical research reported in Table B1 for 2006-07 to \$6 billion by 2016-17 (in constant 2006-07 prices).

Chart B11: OECD government spending on health R&D as a share of GDP, 2006

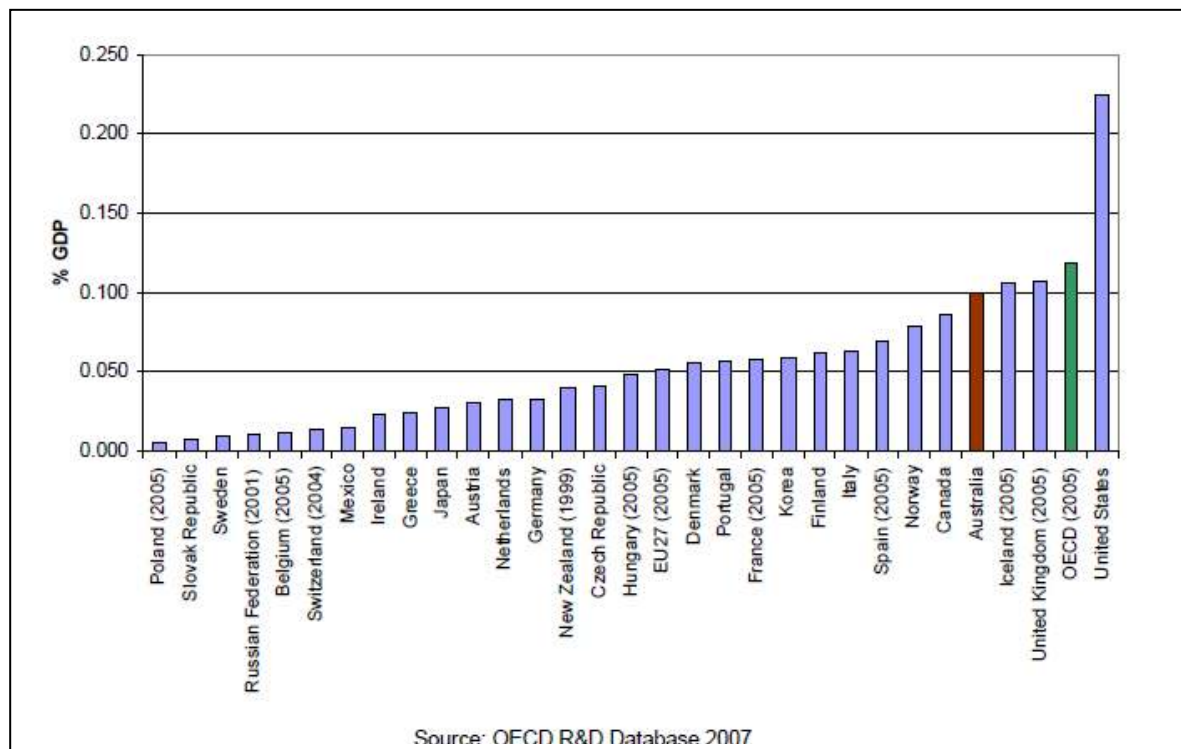


Chart B12: OECD government per capita spending on health R&D, 2006

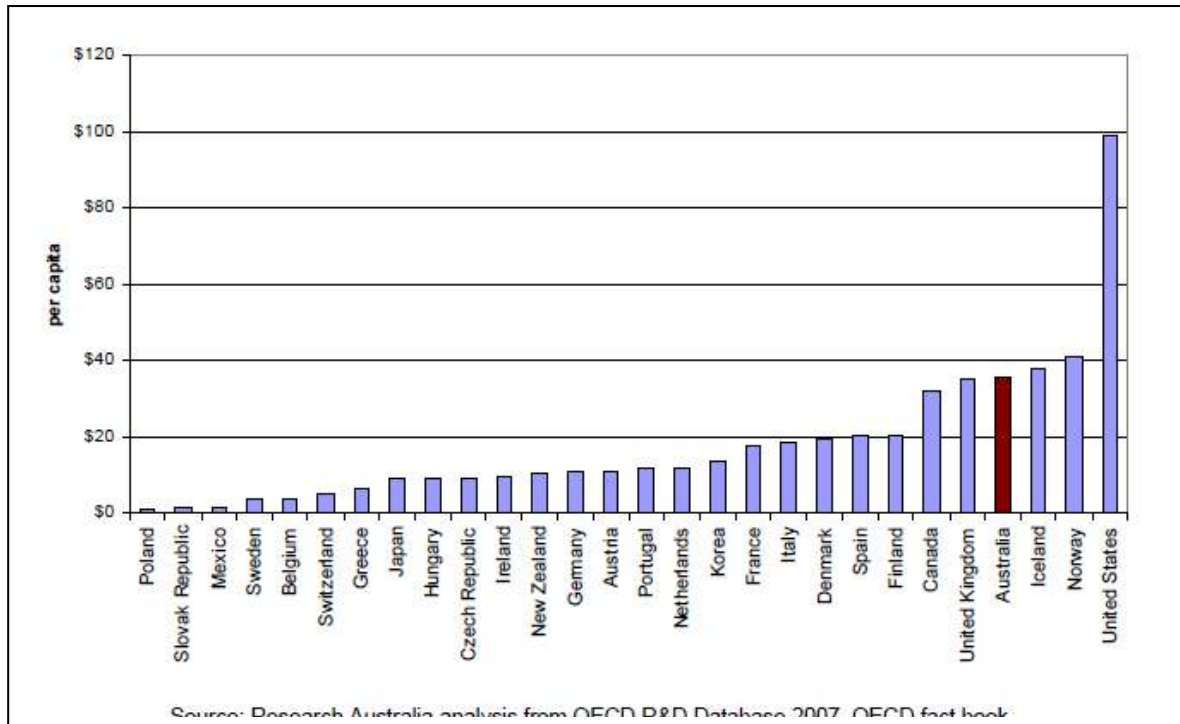
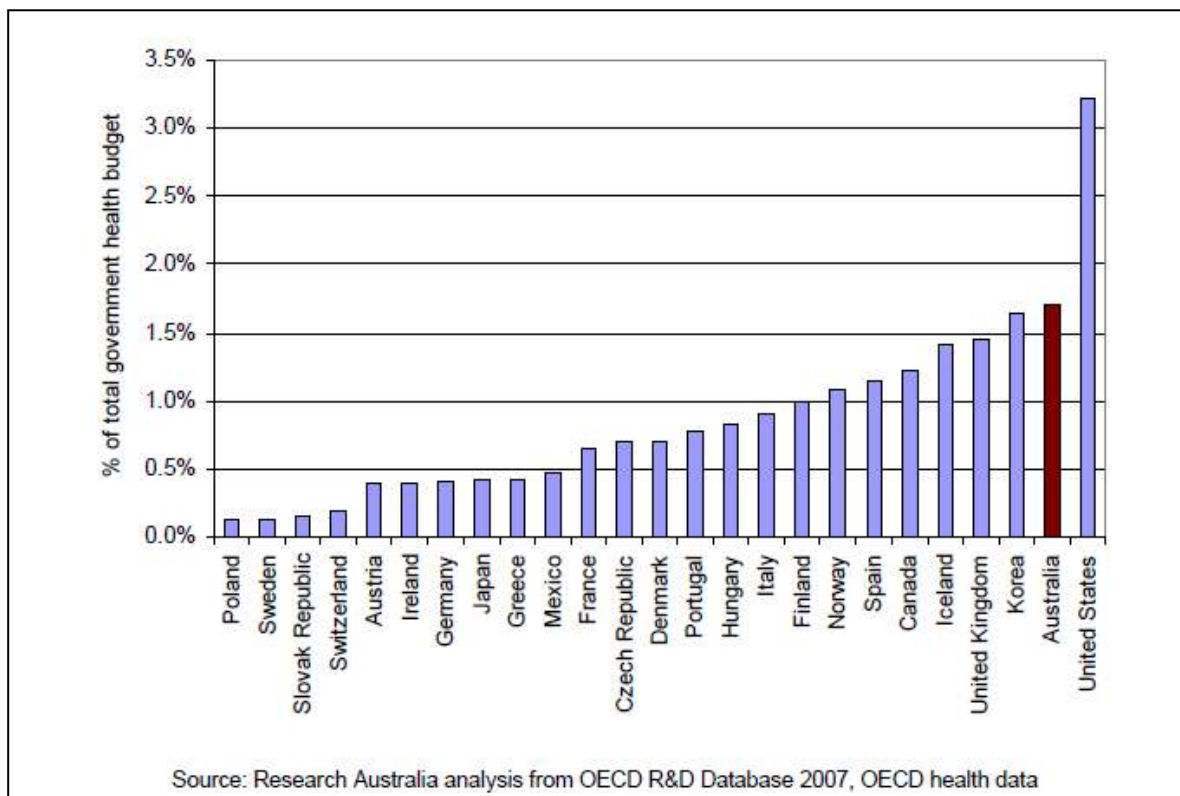


Chart B13: OECD government spending on health R&D as a share of health budgets, 2006



Focus of NHMRC research

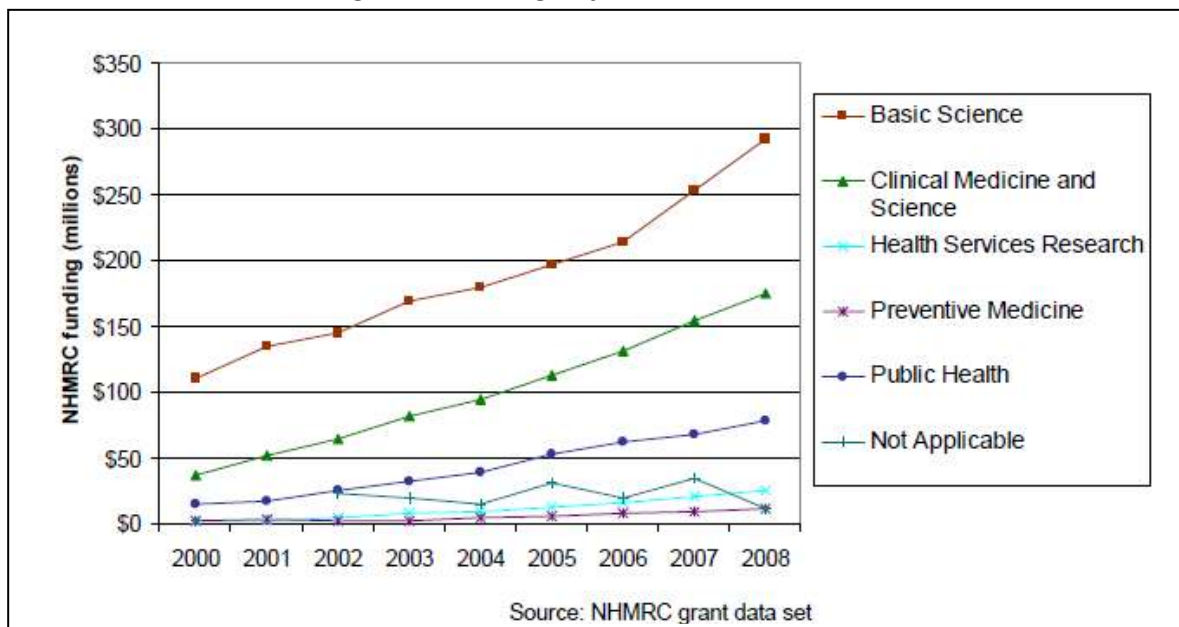
NHMRC-funded research grants have consistently supported a large body of basic scientific research. Increasingly, funding is also being allocated to support applied health and medical research, including clinical research, public health and health services (Chart B14).

As NHMRC research funding has diversified into a range of areas, the share of funding allocated to basic science has declined as a proportion of total funding (Chart B15).

R&D funding (including grant funding under the auspices of the NHMRC) also takes into account government research priorities. Australia's National Research Priorities (NRPs), as announced by the Prime Minister in 2002, seek to classify the research needs of the nation into specific areas judged to be of critical importance to securing the future prosperity of the Australian community. The four priority areas nominated by the Government are:

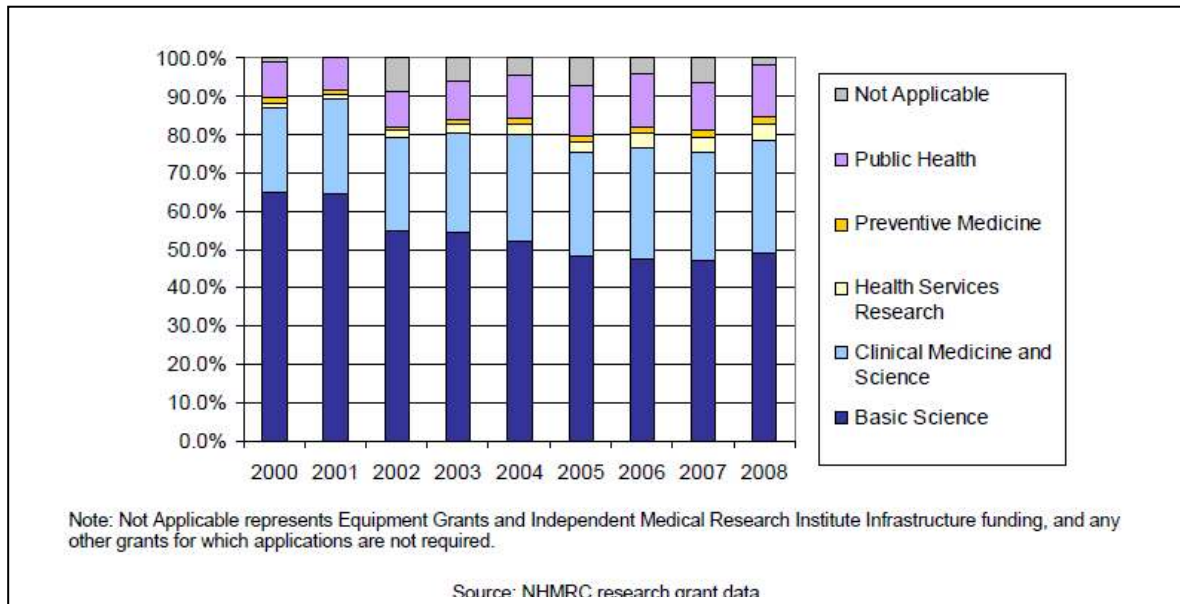
1. An environmentally sustainable Australia;
2. Promoting and maintaining good health;
3. Frontier technologies for building and transforming Australian industries; and
4. Safeguarding Australia.

Chart B14: NHMRC grant funding, by broad area of research, 2000-08



NHMRC funding is principally health-related and therefore mostly falls under NRP 2 (or is outside the scope of the National Research Priorities).

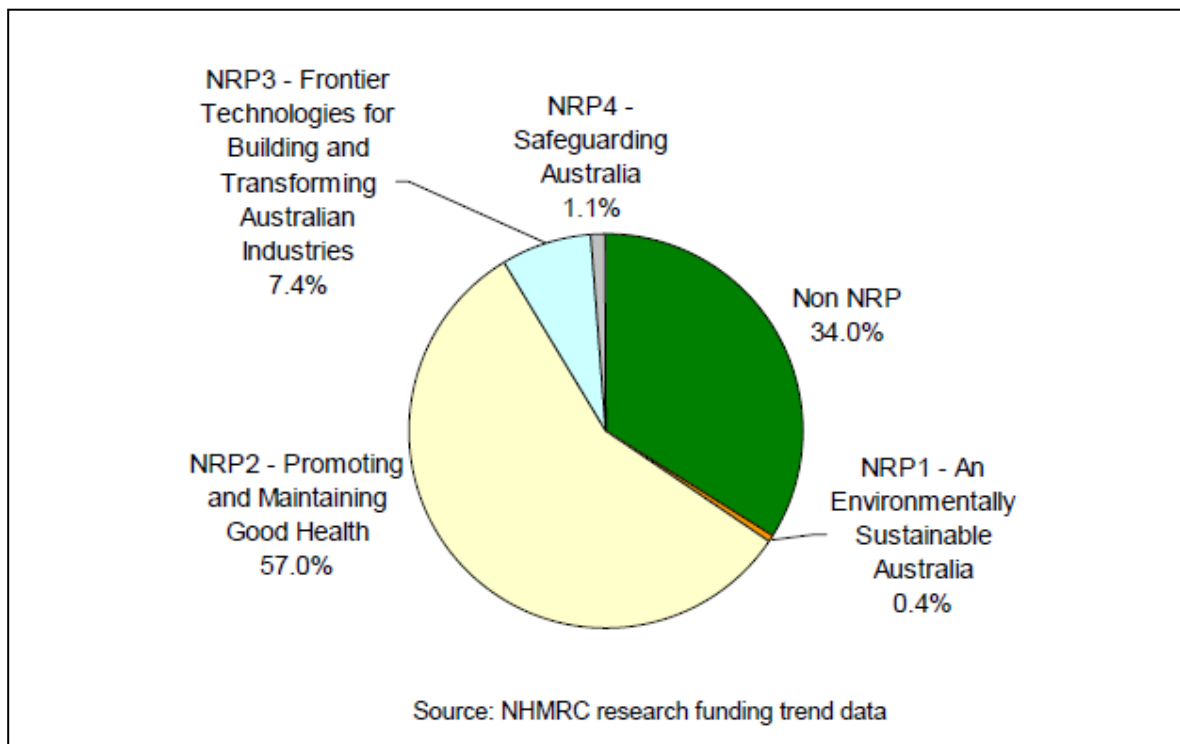
Chart B15: NHMRC grant funding shares, by broad area of research, 2000-08



The Australian Research Council also reports research funding against NRPs. For grants commencing in 2008, 19 per cent of funding was for health research under NRP 2. The leading priority was NRP 3, accounting for around 40 per cent of the total.

Funding classified to NRPs 1 and 4, focusing on environmental sustainability and ensuring Australia’s safety, continues to play a modest role in overall NHMRC expenditure. Understandably, promoting and maintaining good health continues to be the dominant focus of NHMRC funding (Chart B16).

Chart B16: NHMRC grant funding, by National Research Priority, 2006-07



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