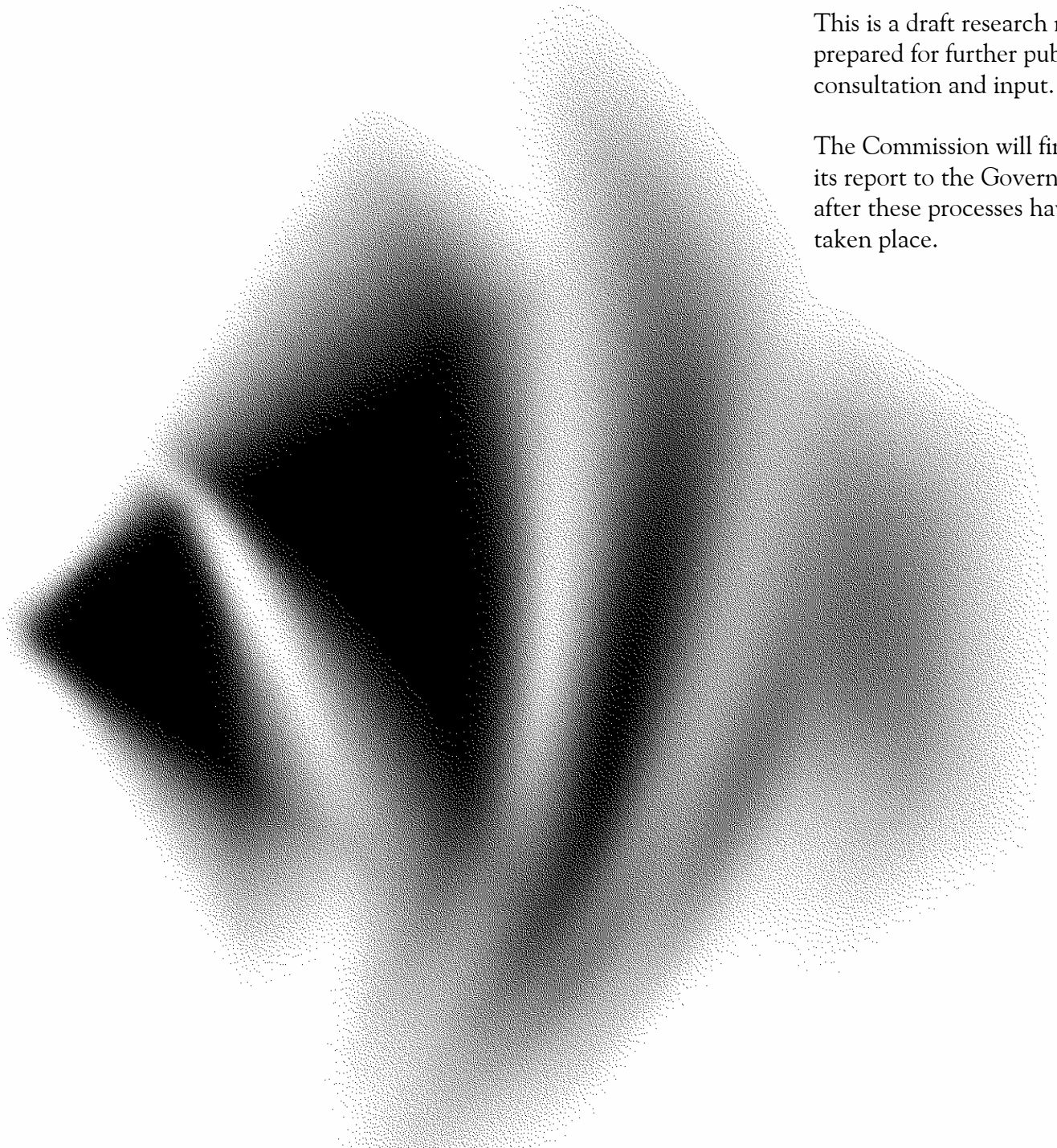
Australian Government
Productivity Commission

Public Support for Science and Innovation

Productivity Commission Draft Research Report *Overview*

This is a draft research report prepared for further public consultation and input.

The Commission will finalise its report to the Government after these processes have taken place.



Key points

- Australia is well served by its public funding support — some $6 billion in 2002-03 — for science and innovation.
  - It is not possible, given a host of measurement and methodological issues, to provide accurate estimates of the contributions of such R&D to the economy, but indications are that they are significant.
  - There are also important social and environmental dividends for Australians.
- There are no grounds for a radical overhaul in total public funding or in the allocation of that funding. However, incremental improvement is needed in some areas.
- The adequacy of existing evaluation arrangements is mixed, with some notable shortcomings in business programs.
- The net payoff from the R&D Tax Concession could be improved by orienting the program towards its 175 per cent incremental component. This offers the prospect of increasing the amount of new R&D encouraged per dollar of revenue allocated to the program. The design of the incremental component could also be improved to make it more attractive and efficient.
- Strong public support of Rural R&D Corporations with a public good orientation is justified, but the level of government subsidies for *some* more narrow industry-focused arrangements may crowd out private activity and produce only weak external benefits outside the supported rural industry. However, no changes should be made while persistent drought conditions remain.
- Although, collaboration can generate significant benefits, the CRC program is only suited to longer-term arrangements. The Commission has outlined some complementary options for business collaboration with public sector research agencies and universities that could provide more nimble, less management-intensive, arrangements than the present CRC program.
- There is a wide range of perceived obstacles to commercialisation by universities, but only some of these warrant policy action.
  - There may be a case for providing universities with some additional funding to demonstrate promising technologies so they can be more easily transferred to businesses. However, there are several options for supporting such transfer that do not involve a new dedicated funding stream.
- The structure of funding for higher education research has increasingly eroded the share of block grants. Further erosion would risk undermining their important role in enabling meaningful strategic choices at the institutional level.
- While the proposed Research Quality Framework has some benefits, it also has considerable costs. The Commission suggests that a final decision about its implementation should be delayed pending the exploration of some other options.

Overview

Innovation is critical to Australia's growth and its preparedness for emerging economic, social and environmental challenges. Governments play a major role in shaping the innovation system through the design and governance of institutions, in partly funding the education and training of scientists and engineers, and in encouraging high-value research that would not otherwise be undertaken by businesses. Australian governments play a direct role in the innovation system by financing R&D in public sector research agencies, universities and businesses, with overall funding of around $6 billion in 2002-03.

This draft report examines the impacts of such funding support for science and innovation, and considers the prospects for improving outcomes by eliminating impediments to innovation or changing the way government support is channelled to its various competing uses. The overall conclusion, at this stage, is that Australia's innovation system does not warrant radical overhaul in either its total funding or in the allocation of that funding. The existing system, by and large, provides good returns for Australians and has, over time, adapted to meet new challenges.

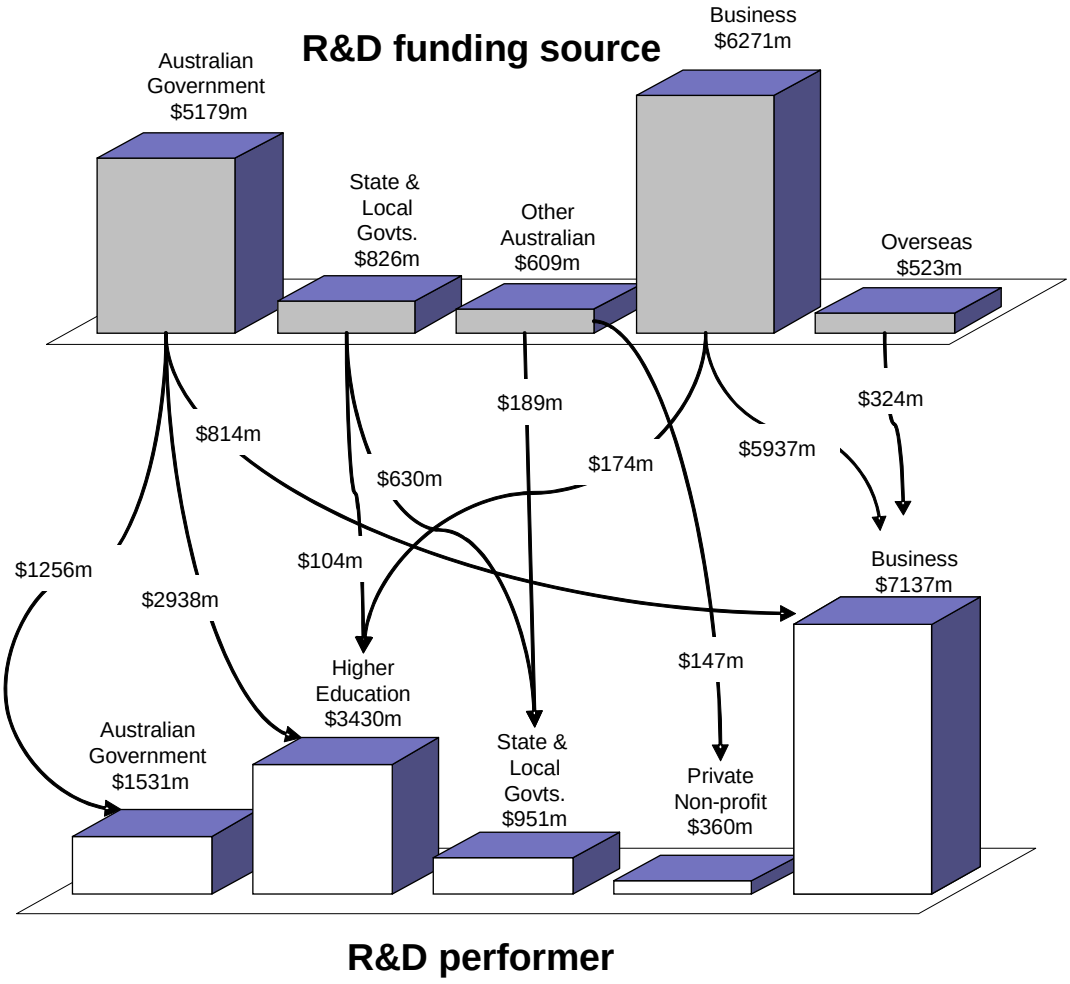
Nevertheless, there are grounds for incremental improvements in several areas. The effectiveness of business programs could be enhanced. The growing emphasis on the public support of the commercialisation stages of innovation in both business and non-business sectors should be re-considered. There is a requirement for better methods of evaluating the impacts of programs, but a need for caution in adopting new, potentially costly, appraisal methods for the assessment and funding of university research.

Rationales for evaluating public funding support

Public funding support for research and development, an important input into innovation, is substantial (figure 1). Accordingly, its provision should be based on clear and credible rationales, which should then underpin the evaluation criteria used to assess the net benefits of each program.

Figure 1 **Where does the money come from and where does it go?**

Major flows, Australian R&D funding and spending 2002-03



The study has found that the strongest reasons for public support of R&D are the returns that cannot be captured by the innovator (*spillovers)* — whether in the public, private or not-for-profit sectors.

The mere presence of spillovers does not, in itself, justify public support. Many investments that produce spillovers have sufficient private returns for firms to invest without that support. The challenge for public policy is to elicit private investments that would not otherwise have been made ('additionality'), but for which the collective private and spillover returns are still positive. Moreover, some spillovers accrue to foreigners, which are not relevant to the appraisal of net benefits for Australia.

R&D is also often an *input* into activities that are public goods, such as defence and how best to deal with environmental problems. Such R&D should be financed even if it does not, itself, generate spillovers — though this will often also be the case.

This provides strong arguments for financing research into areas like the environment. However, it does not necessarily follow that such publicly-funded research must be undertaken within the public sector.

There are various other rationales for public support. Those found during the study to have some validity include:

- intangible factors — the values that science elicits and entail (national prestige, identity, curiosity, wonder);
- the asymmetric tax treatment of risky investments — profits are taxed now whereas the tax value of losses fall through discounting as they are carried forward; and
- possible limitations of capital markets — however, the Commission is cautious in advocating policy changes in this area, since apparent imperfections may merely reflect high, but unavoidable, transactions costs of dealing with some firms.

Other rationales often given for support — the indivisibility of very large research projects; business myopia; and the goal of transforming Australia's industry structure — have little merit.

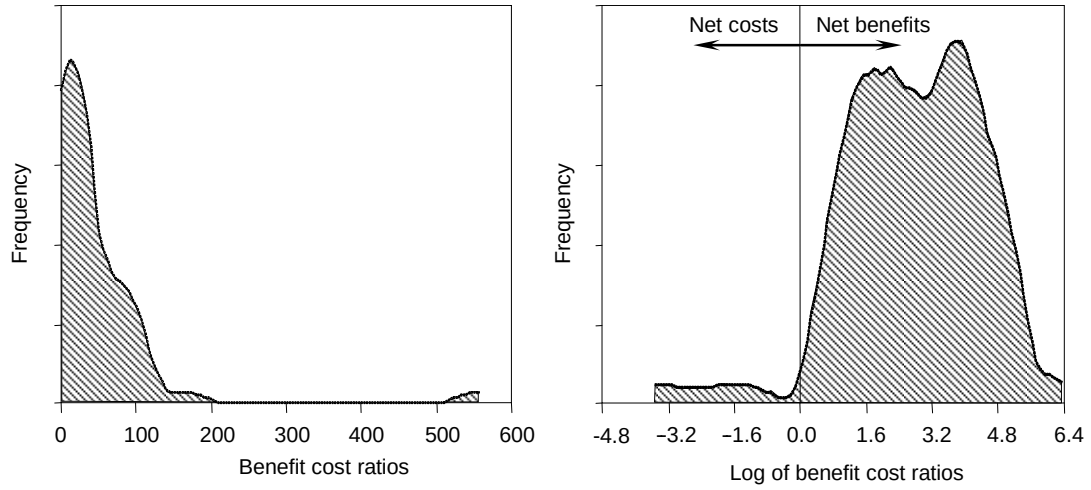
Before providing public support, other factors also needs to be assessed. These include the ability of firms to appear to be undertaking additional research where none has occurred, the inefficiency costs of the taxation required to finance the programs, the utilisation of resources on administration and compliance, and the risks of poor choices when selecting projects to be funded.

Impacts of public funding support

The conclusion that R&D contributes to the growth of national productivity is supported by case studies, aggregate time series analysis, panel data analysis across Australian States and a variety of cross-country studies.

Case studies reveal high rates of return to R&D (figure 2). In the Commission's analysis of existing studies, average benefits exceeded costs by a median 8.5 to 1. But case studies have sometimes been selected because they have been successful, thus biasing the results. The report provides a critique of current methods, but nevertheless finds useful evidence on the ways in which R&D can generate gains. Analyses of portfolios of projects, where selection biases are less germane, still suggest high returns — with benefits exceeding costs by around two to one.

Figure 2 **Australian case studies suggest good average returns**



The aggregate time series approaches — often the basis for estimates of the productivity effects of R&D — cannot realistically measure rates of return accurately (box 1). Nevertheless, these approaches point to positive rates of return to R&D.

This is also buttressed by the Commission's preliminary analysis of the sources of economic growth over time between Australian States and Territories, which suggested high rates of return to R&D. Similar studies undertaken across countries and time also tend to find significant returns. A different approach, based on allocating productivity growth to its likely sources, found that rates of return to R&D relevant to the Australia market sector could readily lie in the band from 35 to 100 per cent.

In sum, there is empirical evidence of benefits from R&D. However, the public policy issue is the magnitude of benefits from *publicly supported* science and innovation, not from R&D in total. The bulk of such public funding — around five in every six dollars — is provided to universities or public sector agencies with the remaining flowing to business. The Commission judges that there are positive net impacts from publicly supported R&D undertaken in universities and public sector research agencies, with those impacts being sufficient to justify current levels of support.

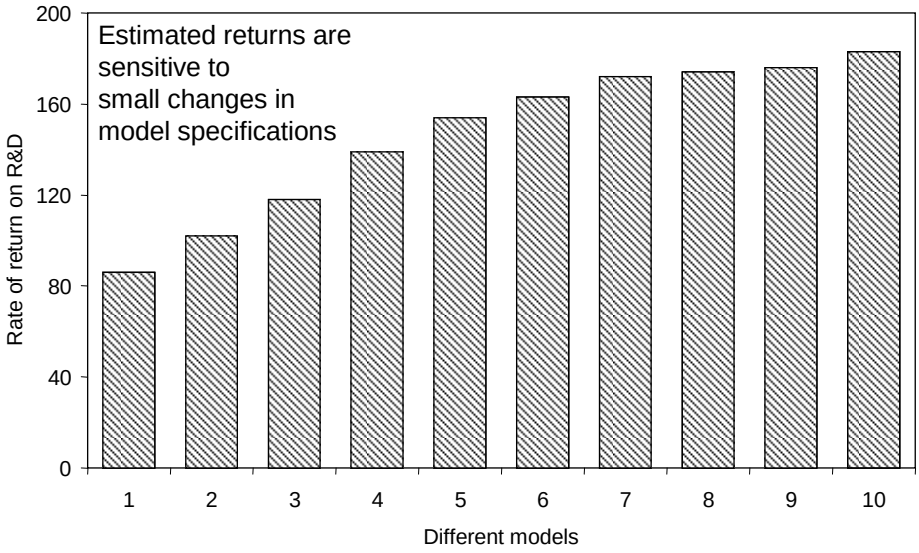
Box 1 **The problems with numbers**

Aggregate time series studies — often the basis for estimates of the productivity effects of R&D — cannot realistically measure rates of return accurately. This reflects the complex causal pathways through which R&D affects productivity growth, an excessively short span of data, errors in data, the potentially long lags from the conduct of R&D to ultimate benefits, and difficulties in controlling for the other factors that also influence productivity. Accordingly, the econometric modelling of the kind used by Commission staff in a recently released econometric study (Shanks and Zheng 2006) can find it difficult to measure the effects of domestic R&D with any precision.

However, a detailed consideration of statistically adequate models of productivity presented by that study finds that more often than not there *are* returns to domestic R&D in their models — with an average return of around 50 per cent.

The preliminary analysis of this report is also able to find some statistically and theoretically adequate models that are associated with positive returns to domestic R&D. These new results, which vary significantly by model specification (see below) are usually very high — between around 85 and 180 per cent — but have wide confidence intervals. On the basis of other evidence on the sources of economic growth, these point estimates are likely to be implausibly large, with more credible numbers lying in the range from 35 to 100 per cent.

Overall, the results from such modelling cannot realistically aspire to produce accurate estimates of the rates of return from R&D. However, the empirical evidence adds weight to the hypothesis that R&D produces significant returns to the market sector through productivity increases that are not captured as rents by the firms undertaking R&D.



In the absence of public support, R&D in these institutions would contract significantly ('additionality' is high). In some cases, such as R&D for many environmental purposes, the net gains are mostly not measured in GDP (at least in the short-run), but are nonetheless worthwhile. R&D has:

- increased preparedness and reduced risks in some areas;
- been widely adopted in a range of settings (public health, risk abatement in the environment and social and educational policy);
- developed advanced problem-solving skills among Australian graduates; and
- provided spillovers to business, for example in the mining industry.

Other indirect indicators of impacts, such as academic quality, suggest that Australian scientists are performing well by comparison with those in other advanced economies.

There are also likely to have been positive net effects on the economy from existing public support for R&D in the business sector. However, the benefits are constrained due to several factors:

- a large share of the R&D eligible for concessional treatment would have taken place in any event;
- a considerable amount of public support is directed at incremental, catch-up R&D, where the spillover benefits may be relatively small;
- individual businesses have incentives to minimise spillovers; and
- support has been concentrated in a few relatively declining sectors — such as the auto industry.

Innovation system impediments

Participants in this study identified a range of possible impediments to the operation of the innovation system. Many of these related to perceived deficiencies in the level of funding, structure, multiplicity and administration of the public support programs. These issues are discussed later. The remaining R&D impediments focused on apparently poor commercialisation, human capital, some unexpected consequences of regulation and factors that may weaken the capacity for knowledge diffusion in basic research.

Commercialisation

There is a wide range of perceived impediments to commercialisation, which includes the size of the domestic market; the distance from foreign markets; financing; incentives and cultural barriers within universities; a lack of effective linkages between research organisations and firms; intellectual property management; and skill shortages.

Some of these impediments do not, however, constitute a compelling basis for government action. For example, Australia's location and size are unalterable features of the business environment. And apparent cultural barriers in universities may reflect the preferences of researchers who are driven by curiosity, research excellence and public sharing of ideas. Addressing any cultural 'barrier' requires prudence because it poses risks for the core research functions of universities and the motivation for science career choices.

Other impediments are mainly the subject of existing, often recent, government policy measures and actions by the research organisations themselves. These should be given the time to determine if they work effectively.

However, there is possible scope for measures to deal with some residual impediments.

- Public sector research agencies and universities should ensure consistency in the management of intellectual property within their organisations to reduce transactions costs for businesses dealing with them.
- Only the largest research universities are likely to be able to develop dedicated commercialisation arms of sufficient scale and expertise to operate effectively. More flexible arrangements — including the use of private sector intermediaries — may allow universities to draw on the commercial expertise they need in a more efficient and cost-effective way.
- Universities can sometimes find it difficult to transfer commercialisable ideas to business because the concepts have not been adequately demonstrated. Funding to universities for this purpose may be warranted. One option is for new dedicated 'third stream' funding of universities. Another option that does not require a hypothecated grant is to supplement block funding and allow universities to determine themselves how much, when and what types of research should be taken along these initial commercial paths.
  - These (and other) options have both pluses and minuses. At this stage, the Commission considers it best to await the outcomes of the present examination of these matters by the Business, Industry, and Higher Education Collaboration

Council and to analyse any resulting proposals against the program design guidelines set out in this report.

The increasing policy imperative for commercialisation is built on an overly pessimistic view of Australia's capabilities. In fact, despite the existence of some impediments, there is evidence of much successful commercialisation in Australia in areas close to Australia's traditional comparative advantages in the mining and agricultural sectors, the wine industry being a current example. Australia has also successfully commercialised R&D within certain manufacturing niches, such as medical technology.

Placing undue emphasis on commercialisation may have unintended effects. The overall place of commercialisation in government innovation policy needs to be balanced.

- Universities' core role remains the provision of teaching and the generation of high quality, openly disseminated, basic research. Even where universities undertake research that has practical applications, it is the transfer, diffusion and utilisation of such knowledge and technology that matters in terms of community wellbeing. Commercialisation is just one way of achieving this. The selection of the transfer pathway should be based on maximisation of the overall community benefits, which will only sometimes favour commercialisation.
- While public spending to support business commercialisation is smaller than the support given at the earlier stages of the innovation process, business programs are increasingly oriented at commercialisation objectives. However, there are fewer clear-cut spillovers at the later stage, which weakens the rationale for public support for commercialisation in businesses. There are also large potential private returns to commercialisation — failure to commercialise gives rivals the time to poach the pre-existing R&D knowledge. So public support risks supporting investments that would occur anyway.
- Calls for governments to assume the risks for highly risky commercial ventures also have a poor basis, since such an approach would merely transfer commercial risks from firms to taxpayers.

Barriers to future growth of human capital

There is a recognised shortage of engineers and secondary school teachers in science and mathematics. The shortage of engineers has been reflected in the rapid growth in salaries for both graduate and experienced engineers, encouraging entry into the profession. In the case of science and mathematics teachers, such price signals have not been able to respond to shortages due to the inflexible pay levels

and structures. Rather, shortages have sometimes been accommodated by using teachers without adequate skills in these subjects. This may adversely affect student engagement and decrease future university enrolments in the sciences.

Research infrastructure

There is some evidence of deficiencies in public support for research infrastructure, and some States are directing funding to provide supporting infrastructure as a supplement to (and a way of leveraging) Australian Government program funding. There is also a diverse range of pricing and sharing arrangements for infrastructure between public institutions that may sometimes result in inadequate utilisation. The Commission broadly supports the recommended pricing approach of the National Research Infrastructure Taskforce. Fixed and standing operating costs should be met through public funding. Prices of major infrastructure should then be set at marginal costs for research users — with congestion charging for infrastructure that is over-utilised. A stocktake of existing research infrastructure would also help to deal with poor utilisation.

Impediments to diffusion in the basic research community

There are several possible barriers to knowledge dissemination in basic research.

Legal uncertainty about the use of patents for research has the potential to impede knowledge dissemination. One option proposed by the Australian Law Reform Commission and the Advisory Council on Intellectual Property is to introduce a provision in the Patents Act for exempting researchers from infringement when they make experimental use of patented intellectual property. This model has been applied in the United Kingdom, several European countries and Japan, and is proposed in New Zealand. The intention is to reduce legal uncertainty about the use of patents for research, without affecting commercial incentives to invest in innovation. However, the extent to which such legal uncertainty actually acts as a barrier to innovation is unclear, as are the costs and risks of any unintended consequences of implementing the proposed model.

The growth of the Internet has made it possible to lower the marginal costs of disseminating much basic scientific knowledge to zero. Current models of scientific publication, while changing, have nevertheless been perceived as limiting the possibilities of diffusion of publicly supported research. Major funding bodies in the United Kingdom and the United States have already instituted reforms.

There is scope for the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) to play a more active role than they currently do in promoting access to the results of research they fund. They could require as a condition of funding that research papers, data and other information produced as a result of their funding are made publicly available such as in an 'open access' repository.

Privacy and ethics regulation

Complexities associated with privacy regulation across jurisdictions and multi-site ethical review processes can adverse affect the conduct of some types of research, particularly in the medical field. This report recognises the valid aims of both regulatory approaches. However, streamlining the ethical review of multi-site research and introducing national consistency in privacy regulation of health information can achieve the objectives of the regulations, while imposing fewer costs on researchers.

Performance evaluation

Performance evaluation and benchmarking can assist in achieving the most effective and efficient allocation of funding, both across programs and to projects within programs.

The adequacy of existing performance evaluation and benchmarking is mixed. Programs with significant budgetary implications should be subject to routine, transparent and independent evaluation, and use scientifically rigorous methods to determine program effects. These features are not always present. There are some notable shortcomings in relation to the evaluation of business programs.

There are also deficiencies in the assessment of the quality and impacts of higher education block funding for the purposes of funding allocation. The proposed Research Quality Framework (RQF) is intended to remedy this, but as noted later, has its own limitations.

Institutions such as the CSIRO, the ARC and the NHMRC are constantly developing their research management and evaluation approaches, appropriate to their specific research contexts. For example, in line with its mission-oriented research agenda, over the last few years CSIRO has adopted a process that involves:

- setting priorities to identify new-to-the-world research opportunities with strong potential impacts;

- management of ongoing research with staged financing that depends on constant re-assessments of future impacts; and
- an independent peer reviewed ex post scientific assessment of impacts and quality.

This approach should be considered by other mission-focused research institutions, and its wider potential applicability gauged as experience is gathered in the use of sophisticated research management methods.

Ex ante peer review plays a very significant role in the assessment of research in most programs, especially those of the ARC and the NHMRC. Ex post impact assessments often measure impacts indirectly by gauging whether potential diffusion of ideas has occurred through publication and whether such publications are of high quality (based on their citation rates). It is less easy to develop broader measures of social and economic impacts akin to that used in ARC Discovery Grants or CSIRO's science assessment process because of the more basic nature of the research and the high transaction costs of assessing many thousands of small projects.

National Research Priorities

The Australian Government has articulated the broad direction of its priorities for publicly-funded science through its National Research Priorities (NRPs), though these are neither binding nor quantitatively expressed.

The Commission supports the retention of the priorities in the present level of detail as, in the main, these provide sufficiently meaningful signals of areas for research. Any marked loosening or tightening of the priorities would be problematic. Any broader level of prioritisation would no longer usefully guide research at all, whereas greater precision faces major informational and transaction cost challenges. Central government control would lack the flexibility and information to prescribe detailed research agendas.

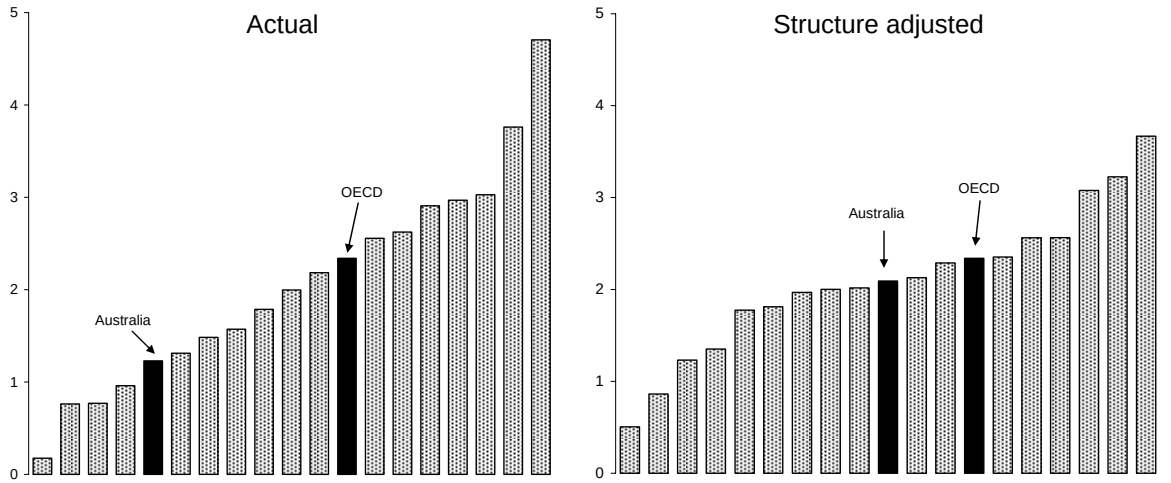
Funding issues

Although the study's terms of reference seek guidance about where and how public funding should be allocated, several participants also addressed concerns about the actual quantum — unsurprisingly the majority submitting that the level of funding should be increased.

There are several indicators and processes that help guide whether funding levels are appropriate. International comparison is a useful broad indicator of adequacy, but must be interpreted carefully. Some participants in this study claimed the apparently low Australian aggregate R&D to GDP ratios are an indicator of significant under-investment, requiring redress through increased government funding. However, international differences in aggregate R&D ratios mainly reflect differences in industry structure, not the size of government funding for R&D (figure 3).

Figure 3 **The R&D 'gap' narrows considerably once industry structure is taken into account**

BERD/value-added ratio (per cent), 2002[a]



[a] The structure-adjusted estimates use the (OECD average) industry structure.

Other macro indicators — multifactor productivity growth and business innovation propensities — suggest that Australian businesses are performing well with their current R&D investments.

Neither industry nor government research agencies suggested that under-funding was a major problem, while the area where the most concern was raised about resourcing levels — higher education — is not towards the low end of the distribution of R&D spending to GDP among OECD countries.

And while apparent measured rates of return to R&D are high, the results are too imprecise to provide a clear case for significant further funding. In any case, large increases would run into supply constraints over the shorter run. New spending measures also have transaction costs associated with compliance and unexpected incentive effects, as well as the costs of raising finance through distortionary taxes (or those associated with displacement of other public spending). A decision to spend more has to balance the marginal benefits against the marginal costs.

In regard to the spending mix, the evaluation of the effectiveness and efficiency of the current programs is important. Are there any obvious poor performers? Are the marginally funded projects in one program achieving significantly better outcomes than in another program? Do the governance structures and processes consistently specify objectives and desired outputs? Do they factor performance measurement into initial design, follow through, and also feedback? Is there independence and transparency of assessment? The Commission has suggested several improvements in these areas.

Several participants considered that the balance of public support had shifted inappropriately towards applied R&D and commercialisation at the expense of basic and strategic R&D. While there is no absolute standard against which to judge the appropriateness of this shifting balance, it is clear that, when assessed against the rationales for public support for R&D, there are dangers if the trend goes too far.

A further aspect of decision making about levels and mix of funding is the Budget process, set in a framework of incrementalism, diversity and devolution. It usually results in an incremental reallocation of the quantum of funding to science and innovation relative to other priorities, and a reallocation of the science and innovation quantum between competing programs. This process works adequately, but the Commission considers that better performance evaluation of programs would enhance the outcomes of the annual Budget deliberations.

Australia's State and Territory Governments are increasingly active in the provision of public support for R&D. At the intergovernmental level, federalism creates interesting experiments in new program design, but also risks program proliferation, poor coordination and overlaps.

Business programs

Australia's current suite of business support programs could be improved to target more effectively the twin objectives of encouraging research activity with high social benefits (spillovers), which would not take place without public support (additionality).

Reforms of general business R&D funding arrangements

The R&D tax concession — including its incremental component — is the most important single mechanism for public funding support of business R&D. It has the advantage over grant programs in that it leaves businesses with the flexibility to undertake the kinds of R&D suited to their business strategies and needs. Its total

budget costs were over $600 million in 2005, which was around 60 per cent of total direct business R&D support by the Australian Government.

One of its major limitations is that the criteria for the basic 125 per cent tax concession do not screen out R&D that would have happened anyway. This increases the costs to revenue from stimulating any additional R&D and reduces the likelihood of net benefits from the program.

The net payoff from the concession could be substantially improved by rebalancing the R&D tax concession away from the generally available 125 per cent subsidy towards the 175 per cent incremental component of the program. This could be achieved, for example, by maintaining the basic concession for smaller firms, whose R&D is more responsive to the subsidy, but otherwise using the 175 per cent incremental component as the principal vehicle for stimulating business R&D. Alternatively, the scheme ultimately could be shifted completely to the 175 per cent component, if threshold issues about firm size were considered to provide adverse incentives for the growth of smaller R&D-intensive enterprises.

The effectiveness and attractiveness of the 175 per cent incremental scheme itself could be enhanced by:

- adopting a fixed base of an R&D-to-sales ratio as the basis for payment, rather than the current rolling base;
- giving start-up firms access to the premium component from which they are currently excluded because they do not have a three year history of R&D performance to determine the base;
- considering relaxing the beneficial ownership requirements by allowing foreign subsidiaries holding their IP abroad access to the incremental concession only; and
- potentially even increasing the concession rate for the premium component or introducing a tiered system with progressively higher subsidy rates depending on the extent of the increase in a firm's R&D activity.

As noted previously, the increasing focus of some business programs — most notably the Commercial Ready program — on later-stage commercialisation rather than research runs the risk of supporting R&D that might have occurred anyway and of shifting support away from the R&D stage where spillovers are most likely. The various manufacturing industry-specific programs, while generously funded, should be evaluated, in part, against a broader objective of facilitating structural adjustment — the automotive industry program being a case in point.

Subsidy rates for some types of RRDCs should be re-calibrated — in the long run

The governance design of the Rural R&D Corporation model is inherently sound. In the absence of compulsory levies to fund rural research, individual producers may attempt to free-ride on the R&D of others, with resultant significant under-provision. Levies that are decided by, and apply to, all beneficiaries of the R&D overcome this. There are also strong grounds for significant public co-funding of RRDCs that provide spillover benefits beyond industry members and where that research would not proceed in the absence of support (for example, research into improving salinity-damaged areas). Government contributions should aim to ensure sufficient research of this type occurs.

However, the Commission considers that there is a weak rationale for the present substantial co-funding of some industry-centred RRDCs. The government contribution rates per dollar of R&D in such industry-centred RRDCs are from three to ten times that received in manufacturing and other sectors. Yet there is little compelling evidence that there are correspondingly higher additionality or spillover rates that could justify these differences.

However, in considering changes to these arrangements, the Commission is aware of the severe financial situation that many rural producers face over the short to medium term as a result of persistent drought conditions. In this context, a reduced government contribution in the short term would probably not be made up through increased levies, putting at risk R&D that is important for the future sustainability of the sector. This suggests that the present arrangements should remain in place until the effects of the current severe climatic conditions have receded.

There may be grounds for a complementary program to CRCs

The Cooperative Research Centre (CRC) program received mixed responses from participants, some arguing there are high returns while others pointing out low ultimate impacts, high start-up costs and ongoing compliance burdens. Current cost-sharing arrangements seem to direct high levels of subsidies to the business collaborators, as they are primary beneficiaries of the Centres.

Several options may improve collaborative arrangements of this kind.

The original objectives of the program — the translation of research outputs into economic, social and environmental benefits — should be reinstated. This is likely to produce better outcomes than focusing public support on the commercialisation of industrial research alone.

The low incentives for CRCs to wind up early if research targets are not met considerably lowers the potential returns from R&D through such ventures. Allowing parties to retain all, or a significant portion of, the unspent funds left over after the early termination of CRCs may address current poor incentives.

The CRC is geared toward large-scale, longer-term research programs, which are more suited to big research users, with relatively cumbersome avenues for CRC partners to enter and exit the venture and a heavy compliance burden. There is scope for complementary options for business collaboration with public sector research agencies and universities that could provide more nimble, less management-intensive arrangements than the present CRC program. There are several options in the design of such arrangements, but whatever design is selected would need to ensure that the joint goals of flexibility, additionality and spillovers were likely to be achieved. Some eligibility criteria that may achieve these goals are mooted by the Commission. Any new arrangement should be piloted.

There may be grounds for also supporting flexible collaborative R&D arrangements just between businesses, but these would need to involve a sufficient number of partners that they would be unlikely to occur in the absence of support. The development of other forms of intermediation between business and research organisations is discussed in the report.

Higher education

Funding of higher education research accounts for over 40 per cent of total Australian Government financial support for science and innovation. Universities receive block funding direct from the Australian Government (about $1100 million in 2004). They are also the primary recipient (about $700 million in 2004) of the competitive-funding programs administered by the ARC and the NHMRC.

The conceptual arguments for dual streams of funding of higher education research are sound, encouraging researchers to compete on quality and impact (competitive grants), while providing institutions with a base research-funding level intended to allow them to make their own strategic choices (block grants) with reduced transaction cost burdens of external grant applications. (Similar arrangements apply to CSIRO and appear to work well.) But funding for higher education research has increasingly eroded the share of block grants. The Commission assesses that further shifts away from block grants would risk undermining their important role.

Block grants are currently given out on a formula-basis that does not include direct peer review or direct assessment of economic, social and environmental benefits.

The proposed RQF would rely on peer review and, as well, assess impact. But such differing funding allocation methodologies have both benefits and costs.

While the current block-funding methodology does have shortcomings:

- there is no clear evidence pointing to deficiencies in the scientific quality of research currently funded through this mechanism; and
- block grants are implicitly exposed to peer review since they are used to support competitive grants, where these processes are already established.

The RQF may well allow the development of better measures of quality and impact. There is, however, evidence that the RQF will bring significant costs as well as benefits — such as through the additional burden it would place on resources for peer review. At this stage, it is not possible to assess the balance.

The Commission suggests that it is too early to make a final decision about implementation of the RQF, and suggests that its adoption should be delayed, pending the following investigation and analysis:

- continue with limited trials, based on RQF peer-review principles, but focused on providing indicators of the quality and impact of research dependent on block funding;
- examine whether current procedures within institutions are sufficiently rigorous to promote the quality and impact of block funded research;
- examine what benefits, if any, fine tuning of existing block-funding formulae could bring; and
- examine the merits of externally applied, risk-minimisation approaches to enhancing the quality and impact of block-funded research applied in conjunction with formula-based approaches to funding.

Draft findings

DRAFT FINDING 3.1

There are strong rationales for the provision of public funding support for science and innovation.

DRAFT FINDING 4.1

Taking account of multiple sources of evidence, the Commission considers that there are significant positive economic, social and environmental impacts from publicly supported science and innovation.

DRAFT FINDING 5.1

Several impediments to innovation should be addressed:

- *major publicly funded research infrastructure should be priced to maximise utilisation, while avoiding congestion;*
- *there should be national consistency in the application of privacy regulation and in ethical review of multi-centre research;*
- *published papers and data from ARC and NHMRC-funded projects should be freely and publicly available; and*
- *there should be greater flexibility in pay structures for teachers to help address science and maths teacher shortages.*

DRAFT FINDING 6.1

Decision making within universities in relation to the transfer, diffusion and utilisation of research outputs should not focus unduly on an objective of commercialisation to the detriment of maximising the social return from the public's investment.

DRAFT FINDING 7.1

Performance evaluation and reporting arrangements have developed significantly in recent years, particularly through the adoption of an outputs/outcomes focus. There are, however, examples of major deficiencies. Arrangements should be reviewed against the following criteria.

- *Outputs and intended outcomes should be defined in relation to the rationales for public support and to the community benefits expected from that support.*
- *Evaluation should be developed in a benefit–cost framework, balancing greater precision against administrative and compliance costs.*
- *Where undertaken, selective case studies of impacts should be placed in a supplementary rather than central evaluation role.*
- *Assessment should be undertaken with adequate frequency — this might vary between different types of measure.*
- *Assessment should be as independent and transparent as reasonably possible.*
- *Feedback mechanisms that promote continuous improvement in terms of funding allocation to programs and to projects should be developed and implemented.*

DRAFT FINDING 8.1

There is no evidence that the overall quantum or mix of public support for science and innovation in Australia is currently inappropriate for Australia's needs and aspirations. However, there are concerns if the trend towards publicly funding applied science and innovation, at the expense of basic and strategic science and innovation, goes too far.

DRAFT FINDING 9.1

The R&D tax concession could be improved by:

- *shifting the orientation of the concession towards its 175 per cent incremental component;*
- *relaxing the beneficial ownership requirement and the expenditure and turnover thresholds for the tax offset for the incremental scheme alone;*
- *changing the base on which the incremental subsidy is paid to a firm's ratio of R&D to sales at a given, fixed date; and*
- *allowing access to the incremental scheme to start-up firms.*

DRAFT FINDING 9.2

In principle, competitive grant programs such as Commercial Ready provide greater scope to target socially valuable R&D projects that would otherwise not proceed. However, this can be compromised by the current focus on commercialisation objectives.

DRAFT FINDING 9.3

There are strong grounds for significant public co-funding of RRDCs that provide spillover benefits beyond industry members where that research would not proceed

in the absence of support. But there is a weak rationale for the present substantial co-funding of some industry-centred RRDCs. Any changes to current support arrangements should be delayed until current economic conditions in the rural sector have improved.

DRAFT FINDING 9.4

The CRC program could be improved in several ways:

- *the original objectives of the program — the translation of research outputs into economic, social and environmental benefits — should be reinstated. This is likely to produce better outcomes than focusing public support on the commercialisation of industrial research alone; and*
- *the share of public funding should be aligned to the level of social benefits provided by each CRC, thereby reducing some of the large rates of subsidy to business collaborators.*

DRAFT FINDING 9.5

A complement to the CRC program with broader collaboration goals could be developed which supports smaller, shorter and more flexible collaborative arrangements between groups of firms either independently or in conjunction with universities and public sector research agencies.

DRAFT FINDING 10.1

The Commission considers that the current real level of public appropriation funding for CSIRO should not be reduced. Aspects of its approach to priority setting and performance management may have wider applicability to other parts of Australia's innovation system.

DRAFT FINDING 10.2

The effectiveness of DSTO research is heavily dependent on the effectiveness of the procurement practices and the research directions set by the Australian Defence Organisation.

DRAFT FINDING 11.1

Consideration should be given to delaying the adoption of the RQF further, while undertaking the following investigations and analyses:

- *continue with limited trials based on RQF peer-review principles, but focus them on providing indicators of the quality and impact of research dependent on block funding;*

- *systematically examine whether current procedures within institutions are sufficiently rigorous to promote quality and impact of block-funded research;*
- *examine what fine tuning of existing formulae, if any, might be advantageous in promoting incentives for continuing enhancement of quality and impact of research funded through block funding; and*
- *examine the merits of externally applied, risk-minimisation approaches to enhancing the quality and impact of block-funded research (applied in conjunction with formula-based funding).*