Commonwealth Support for Science and Innovation: Options for Developing an Analytical Perspective

Input to the study aimed at Mapping Australia's Science and Innovation System

Dr Mark Matthews
Director
Policy Intelligence[1]

Discussion Paper

November 2003

[1] E-mail: mark.matthews@policyintelligence.com

Introduction

Governments world-wide support science and innovation through a mixture of budget measures and mechanisms that lie outside of the Budget per se. This overall support 'package' has a distinctive structure in the sense that it consists of a mix of measures and funding programs. A proportion of total support is delivered by subsidies (e.g. subsidies for private sector investment in R&D), a proportion by grants of different types and a proportion by contracts and by loans. Formulae are sometimes used to determine the size of some types of grants and there are different types of competitive selection process used to allocate other types of grant. Some of these competitive selection processes use peer-review methods (commonly used to award academic research grants), others use panels of public servants and selected stakeholders in varying mixes.

The structures of support for science and innovation are likely to differ markedly between countries according to their stage of economic development, mix of industries and institutional arrangements for supporting science and innovation. These factors are inter-dependent and are likely to be affected by such things as the relative importance of defence R&D expenditure and the level of private sector R&D compared with public sector R&D.

Australia is one of the countries in which the public sector plays an unusually large part in the overall national science and innovation effort. This is largely due to persistent structural weaknesses in business commitment to R&D investment. There are complex reasons for this low commitment to R&D investment (Standing Committee on Science and Innovation, 2003).

There are potentially important policy implications arising from the existence of this structure of support for science and innovation. This is because, in principle, each mode of delivery affects the 'risk-reward' relationship faced both by recipients of support and by the provider of the support. When governments deliver support they face the risk that the intended outcomes may not be achieved and that they might have been better off using the resources for other purposes or for supporting other teams. When recipients commit resources to seeking to win this support they face the risk that they may not be successful in obtaining this support. If they are successful in obtaining the support sought then they then face the risk that they may fail to deliver what they intended to. This may effect the likelihood and/or level of support obtained in the future.

Although the proposition that the structure of science and innovation support 'matters' is compelling, there is little historical and comparative international information on how these structures differ and what the policy implications of these patterns are. Consequently, we risk deploying a structure of support that may damage government's capacity to achieve its policy objectives without knowing what the nature and extent of the damage is. In effect, the risk-reward relationship may leave room for improvement – but we do not know that nature and extent of this room for improvement.

The current manner in which official data on science and innovation support is presented does not make the mode of delivery of this support clear. This, in turn, means that it is difficult for policy-makers to grasp the overall structure of this support when considering possible changes to the nature of this support. A more analytical perspective towards science and innovation support would provide this sort of picture.

The purpose of this discission paper is to examine the attractiveness and the feasibility of constructing a more analytical perspective towards government science and innovation support. The paper reports on exploratory work aimed at determining whether or not future work in this area

should proceed. This issue is best assessed by demonstrating what the results look like, and in so doing highlighting the problems faced in producing these results.

The resources devoted to this exploratory study have been relatively small (7.5 days in total) and it has therefore been necessary to make some trade-offs in how these limited resources have been applied. This has involved placing a greater priority on constructing a time-series of broadly indicative estimates than producing higher 'resolution' estimates for a more recent and limited time period. It was necessary to make the trade-off in this way because constructing a longer-term time series is more likely to generate an indication of structural change in how science and innovation support is delivered.

As a result, significant work remains to be done in increasing the detail of the time-series estimates – should this be required in the future. As this will involve going beyond readily available information in the series of science and innovation budget statements this would represent a more detailed follow-up study or activity. The more detailed follow-up work is likely only to be required in order to produce a breakdown of science and innovation support by functional objectives. It likely that the current exploratory estimates of the breakdown of support by the mode of delivery will be sufficient for policy purposes.

Background

Any steps taken to examine the public policy issues surrounding how support is delivered face two inter-related challenges. Firstly, there is no commonly accepted international framework for defining how this structure of science and innovation support can be mapped. Secondly, there is little empirical information on how these structures of support differ between countries and on how these structures are changing over time. When approached over this issue, the OECD expressed the opinion that these challenges were sufficiently severe that they had no plans to carry out any analytical work on this issue.[2]

Given the potential importance of the structure of support for science and innovation, the Taskforce carrying out the science and innovation mapping study decided to commission an exploratory analysis of this issue. This analysis has sought to produce some experimental estimates of the modes via which science and innovation support is delivered and how this structure has changed over time. In so doing, this small project has sought to determine just how difficult it really is to produce a more analytical perspective towards Australia's science and innovation budget. The project has set out to make a significant step forward in developing some experimental estimates in this area. These experimental estimates provide policy-makers with a basis for determining whether or not it is worth pursuing this line of work and should this area look promising.

This project also provides a basis for seeking to encourage state and territory governments to assist in producing a more comprehensive assessment of the structure of Australian support for science and innovation. The option has also been generated to use these experimental estimates in international fora such as the OECD in order to attempt to stimulate the production of estimates for other countries.

[2] Personal communication. The OECD's Directorate for Science, Technology and Industry has however done some work in this area in relation to government support for industrial technology, (Young, 2003).

Note on competition and contestability

When considering data on the mode of delivery of support it should be born in mind that competition and contestability are pervasive features of support. The mission-driven block grants to government research organisations are contested in the overall budget-setting negotiations and again in the internal resource allocation processes within these agencies based upon past and anticipated future performance. It would be misleading to suggest that peer-reviewed project and program grants are the only form of 'merit-based' resource allocation.

Most of these means of delivering Commonwealth support involve some form of assessment of merit, perhaps the only exceptions are tax concessions and other subsidies dependent upon external investments being made. Even in these cases however, the companies involved will characteristically carry out some form of formal or informal investment appraisal aimed at estimating the relationship between benefits and costs. The main distinction between these modes of delivery relates to the definition of merit used.

It is also worth noting that in order to be logically coherent any consideration of the mode of delivery should recognise that management capabilities in resource allocation can be of equal, if not greater, importance in determining effectiveness as how the support is delivered to that organisation. The implication for the mapping study (and other current initiatives) is that any analysis of this type should ideally be balanced by a discussion of the importance of *management*, ideally defining the key parameters against which good management can be judged.

For example, four top-level criteria could be:

1. *Excellence* (peer-judged merit).
2. *Relevance* (user-judged merit).
3. *Response time* (the capacity to achieve excellence and/or relevance quickly compared to the competition).
4. *Transaction costs* (the capacity to achieve excellence and/or relevance cost-effectively compared to benchmarks – particularly when it comes to re-configuring and integrating teams in order to address emerging opportunities and threats).

These performance criteria also apply to the modes via which Commonwealth support is delivered. Trade-offs often exist between these four performance criteria. For example, peer-judged merit in awarding grants helps to achieve excellence but this will tend to increase response time and transaction costs. The benefits (from excellence) are generally assumed to outweigh these costs.

When considering these performance trade-offs it is important to bear in mind the fact the science and innovation system is also used to provide rapid responses to threats and challenges (such as the recent SARS episode). This tactical use of science and innovation capabilities places a premium upon response time and upon managing the transaction costs associated with these rapid responses in order that the desired response can actually be achieved. The contractual red tape associated with inter-organisation cooperation may not only dramatically inflate the cost of achieving these tactical responses, it may even constrain this tactical cooperation. These 'crisis' driven transaction costs may be expensive compared to day-to-day research but they should not be prohibitively expensive. Particularly severe transaction cost and time impediments can exist when a number of cooperating commercial entities are involved.

Critical mass and the capacity to assemble teams of experts from different organisations and from different fields of expertise provide the nation with this crisis response capability. In general, the response times and transaction costs are lower when teams are assembled from within a specific organisation. Consequently, the 'asset value' of government research organisations rests partly upon their capacity for providing this tactical response capability. The capacity to achieve these tactical responses faster and cost-more effectively compared to attempting this response from more fragmented organisational structures should therefore be considered when suggesting any major changes to the modes of delivery of Commonwealth support for science and innovation.

Consequently, the over-arching design criteria are not exclusively based upon achieving excellence and relevance with competitive lead times and costs in a strategic context, Australia's capacity for tactical responses over shorter time frames must also be considered. Again, management capacity is critical in being able to actually achieve these tactical responses. The funding arrangements alone are not sufficient.

The major implication for policy is that any consideration of the modes via which Commonwealth science and innovation support is delivered should be articulated against a balanced treatment of the key performance criteria and the trade-offs that exist between these criteria. Balanced modes of delivery will tend to generate a balanced portfolio of science and innovation assets that allows both tactical responses and strategic research to be carried out quickly and cost-effectively. However, the capacity to actually deliver against these tactical and strategic objectives rests upon the effectiveness of the management of resource allocations *within* each organisation or consortium.

Methodology

The approach adopted in this project has been to conduct a series of iterations aimed at producing analytical estimates of the federal government's science and innovation budget and other support for science and innovation. These iterations have involved attempts to define workable categories for defining the different modes of support and attempts to fit readily available data to these categories.

An iterative, exploratory, approach is preferable because it is difficult to generate a coherent framework for mapping science and innovation support in a more analytical manner without the major benefit for testing these categories against real data as the work proceeds. The errors and ambiguities uncovered in this testing process provide the main means of developing an analytical framework. This approach has the advantage that it is constrained by the practicalities of using readily available data – thus generating the option for the Department of Education, Science and Training to adopt this approach in their annual statements. The more mechanical the allocation process the greater the likelihood of it being rolled-out. Consequently, it is preferable to make a trade-off between resolution/detail and the ease of producing and updating these estimates in favour of ease of production. The more complex and time consuming the process of generating the estimates the greater the scope for ambiguity interpreting detailed figures and the less likely the roll-out of such an approach. In such a context it is preferable to have access to estimates that are vaguely correct and can be interpreted with this caveat in mind rather than 'precisely wrong'.

Two aspects of a possible analytical perspective have been explored: an analysis of the mode of delivery and an analysis of the functional objectives of support. Work focused initially upon data for 2003-04 and a time-series was then constructed back to 1989-90.

Mode of delivery

Developing a breakdown of the mode of delivery of support is not a trivial task. This is mainly because the real mechanisms via which support is delivered tend to comprise a mix of various selection criteria, but it is only feasible to use a simpler 1:1 allocation (ie. allocating all funding for a given program to a particular category).

The iterative process followed in this project has generated the following six-part taxonomy. Table 1 provides the short title of each category and also provides a longer description of this category. The option does exist, in any future project, to adapt these six categories in order to be able to allocate one program to more than one category – however this would be highly time-consuming and likely to make the derivation of the results more opaque. Such an approach is not therefore recommended. In the approach adopted here ambiguity inevitably exists – but it is more transparent. A subsequent validation process would allow program-by-program allocations to be agreed with each department and agency – maintaining this transparency because it is easy to identify programs what do not sit easily within a particular category. The option also exists to modify these categories should the validation process suggest that this would be worthwhile.

It is also worth noting that care must be taken with the 'input-output' structure of the science and innovation support system. A grant-funding body may receive a block grant (characteristically a mission-driven grant) and then distribute this funding on the basis of (for example) peer-reviewed competitive grants. It is necessary to adopt a pragmatic approach to this issue and carry at the classification at the point in the process that best mirrors the rationale for the government allocating this support. In most circumstances this means that the classification is applied at the point at which the bulk of the 'value-added' is generated. A research council may receive a block grant but the bulk of the value-added takes place in the recipients of the funding (who compete on a peer-review basis). A government research agency will tend to generate the bulk of its 'value-added' by using its internal tangible and tangible assets, even though collaboration with external entities may help to create this value-added. The Rural Research and Development Corporations pose a particular challenge in this respect.

Table 1: Taxonomy of the modes of delivery of science and innovation support

Short title	Description
Peer-reviewed competitive grants	This category captures 'classic' academic grants awarded largely on the basis of peer-review procedures. The main demarcation criteria are that selection is made largely or exclusively on the basis of excellence and that the proponent defines the problem - not the donor. The criterion of excellence over-rides any specific socio-economic or field of research based criteria. It is not intended to cover peer-reviewed selections based upon calls for proposals against specific stated objectives – this funding should be classed as part of '*competitive tenders against pre-defined objectives'*.
Other competitive grants and loans	This category captures all other competitive grants and loans for which there is no over-arching statement of specific objectives as regards the precise objective of the project. This category *is* intended to cover industry and sector-specific programs for which bids for support are selected partly on the basis of problem definitions put forward by the proponent(s). However, it is not designed to cover programs in which industry or sector specific funding also defines the *specific* problem addressed by the proposal. Such funding should be classed as part of '*competitive tenders against pre-defined objectives'*.
Competitive tenders against pre-defined objectives	This category captures funding via competitive tenders against tightly specified objectives. The main demarcation criterion is that the 'problem definition' is not defined by the proponent – it is defined by the donor.
Mission-driven block grants	This category captures funding delivered via block grants associated with a defined missions and in which the recipient organisation is then responsible for internal allocations of this funding and the use of existing assets. These internal allocation processes may in principle include peer-review based competitive selection and other merit-based resource allocations.
Formula-related block grants	This category captures block grants for which the distribution of funding between competing recipients is determined fully or to a large part (i.e more than 50 percent) by a formula or formulae. As with mission-driven block grants, the internal allocation processes within recipient organisations may in principle include peer-review based competitive selection and other merit-based resource allocations.
Tax concessions and other subsidies	This category captures all tax concessions and other subsidies that characteristically offset the risk faced by an organisation able and willing to commit its own resources to the project.

Functional objectives

The initial stage of this project involved a detailed examination of portfolio budget statements in order to attempt to produce a functional breakdown of Commonwealth science and innovation support. This involves painstaking work and still leaves room for considerable ambiguity due to the nature and extent of the information on intended outputs and outcomes contained in the portfolio budget statements.

Another difficulty is constructing a functional breakdown is that the mission-driven block grants to research agencies account for a large proportion of Commonwealth science and innovation support. There is little detailed information on the outputs and outcomes in a sufficiently detailed form to allow expenditure against function objectives to be determined. Thus, whilst the development of a structure of support based around targeted programs (such as the Cooperative

Research Centres Programme) provides a basis for a functional breakdown this cannot be carried out comprehensively. As a result, the time-series results tend to reflect changes in program design (which is a useful thing) but it is not possible to generate an accurate comprehensive historical picture of overall Commonwealth support in functional terms.

Consequently, the approach adopted in this exploratory exercise is to highlight the basic distinction between support for 'research' and support for 'innovation and adoption'. The data can be broken down by each of the six modes of delivery of support. Whilst more detailed functional breakdowns can be provided (such as targeted support for large research facilities) these figures are not reported here on a time series basis. Experimental estimates are however provided for 2003-04 later on in this paper.

At present, the large role played by block grants means that there is much managerial discretion over how this funding is allocated against different functional objectives. This limits the usefulness of a functional breakdown because the results can easily be misinterpreted. A preference has been given to presenting estimates of a comprehensive nature in order to minimise the risk of misinterpretation. It was also felt that the likelihood of being able to use these experimental estimates to stimulate state/territory government involvement in producing whole-of-government estimates would be reduced if too complex a set of data requirements were involved.

Constructing a long-term time series of data on science and innovation support

Constructing a consistent time series of data on federal science and innovation support using the series of official statements is itself a useful exercise because no such long-term data-set is currently published. The work carried out in this project on constructing this long-term time series (though not yet definitive) is likely to be useful in in allowing others to construct even longer-time frame analyses of Commonwealth support.

Problems faced are that there are changes over time in the programs listed in the budget statement, inactive programs are excluded, new programs appear. Some existing programs may exit the list even though they are still funded. These difficulties are only uncovered in the process of constructing such a longer-term time series. These detailed aspects of the estimates still require further examination.

The task of producing these experimental estimates was made much easier by last year's decision to discontinue the Capital Use Charge (CUC) to federal departments and agencies. This is because the impact of the shift to accrual budgeting introduced less of a break in the time series data. Thus, the most recent S&I Budget Statement produced retrospective figures that excluded the CUC element. Previous to the publication of the 2003-04 figures, the CUC element had to be eliminated manually and the necessary figures were not always easy to track down using public domain sources.

Some of the most severe difficulties were encountered when dealing with block funding for universities. This is because the amounts involved represent a large proportion of overall Commonwealth support for science and innovation, yet there is an inherently problematic effort to draw a distinction between funding for R&D and funding for teaching and to divide up university operating grants on this basis. In this sense the budget figures are somewhat at odds with reality of highly synergistic relationship between teaching and research (particularly at the post-graduate level). The attempt to comply with the OECD's international guidelines over this issue results in both conceptual and statistical impediments.

These estimates also attempt to maintain the continuity of the ANU's block grant to the Institute of Advanced Study. Although it is not straight forward to categorise this grant, it has been treated as a mission-driven block grant not the formula-related block grant that the S&I Budget information now lumps it together with. The actual phased-in implementation of the Knowledge and Innovation reforms for funding the IAS took place over 2002 and 2003 rather than the four years originally canvassed. In return for access to ARC and NHMRC competitive grant funding, the IAS made payments from its block grant to the ARC and the NHMRC. Additional payments were made to the RIBG and the IGS in 2002 in return for access to these schemes. The S&I budget estimates have been adjusted to reflect this transition. The adjustments used are summarised in the following table. These estimates do require further validation as these arrangements are not particularly transparent. No attempt has been made at this stage to adjust for the calender year to financial year difference as the consequences are unlikely to affect the overall results.

Table 2: Details of adjustments made for handling the ANU Institute of Advanced Study (current prices)

Year	Block grant to the IAS	Total payments made in return for access to competitive grant funding	Net IAS grant used in this analysis
2000-01	$151m	-	-
2001-02	$151m	$16.5m	$134.4m
2002-03	$145m	$32.122m	$112.878m
2003-04	$140.32m	$33.85m	$106.47m

Use of price deflators

The Australian Bureau of Statistics (ABS) produce special price indices for adjusting R&D expenditure for inflation. These are based upon the sector in which the R&D is performed. The currently available deflators for the government research organisation sector and the higher education sector are provided in the table 2. These deflators were provided by the ABS following a special request. Table 2 also contains the deflator obtained by taking the average of the two sector-based deflators and shows the coefficient of variation in percentage terms (the coefficient of variation is the standard deviation divided by the mean). As the official deflators are only available until 2001-02 the previous years' increase has been used to estimate the following two years' values (indicated by figures in italics).

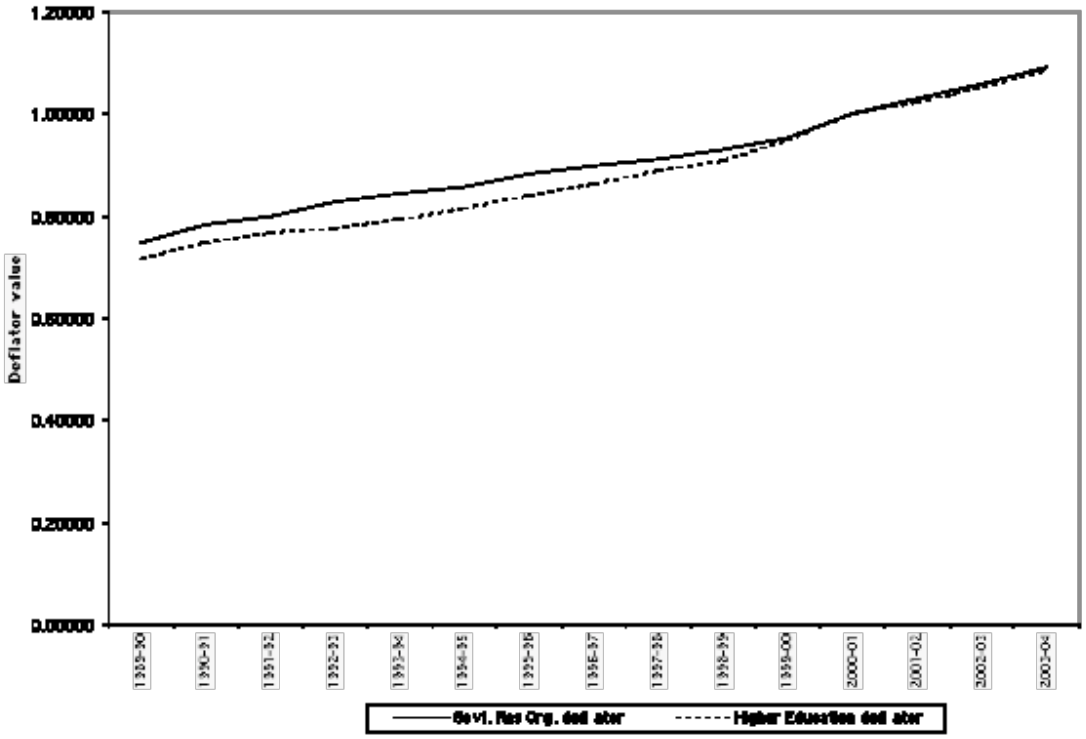
Table 2: R&D Deflators

Year	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04
Govt. Res Org. deflator	0.74810	0.78130	0.80000	0.82760	0.84280	0.85630	0.88230	0.89720	0.91060	0.93080	0.95450	1.00000	1.03020	*1.06040*	*1.09060*
Higher Education deflator	0.71680	0.74730	0.76700	0.77580	0.79350	0.81340	0.84010	0.86360	0.88800	0.90670	0.94860	1.00000	1.02310	*1.05330*	*1.08350*
Averaged deflator	**0.7325**	**0.7643**	**0.7835**	**0.8017**	**0.8182**	**0.8349**	**0.8612**	**0.8804**	**0.8993**	**0.9188**	**0.9516**	**1.0000**	**1.0267**	***1.0569***	***1.0871***
Coefficient of variation (%)	3.02%	3.15%	2.98%	4.57%	4.26%	3.63%	3.46%	2.70%	1.78%	1.85%	0.44%	0.00%	0.49%	0.48%	0.46%

Source: deflators specially provided by the ABS.

These figures indicate the two deflators are reasonably close to each other and that it would therefore by acceptable to use the average of the two to produce constant price estimates of Commonwealth support for science and innovation. The relationship between the two deflators is graphed in figure 1.

Figure 1: R&D Price Deflators for Government Research Organisations and Higher Education



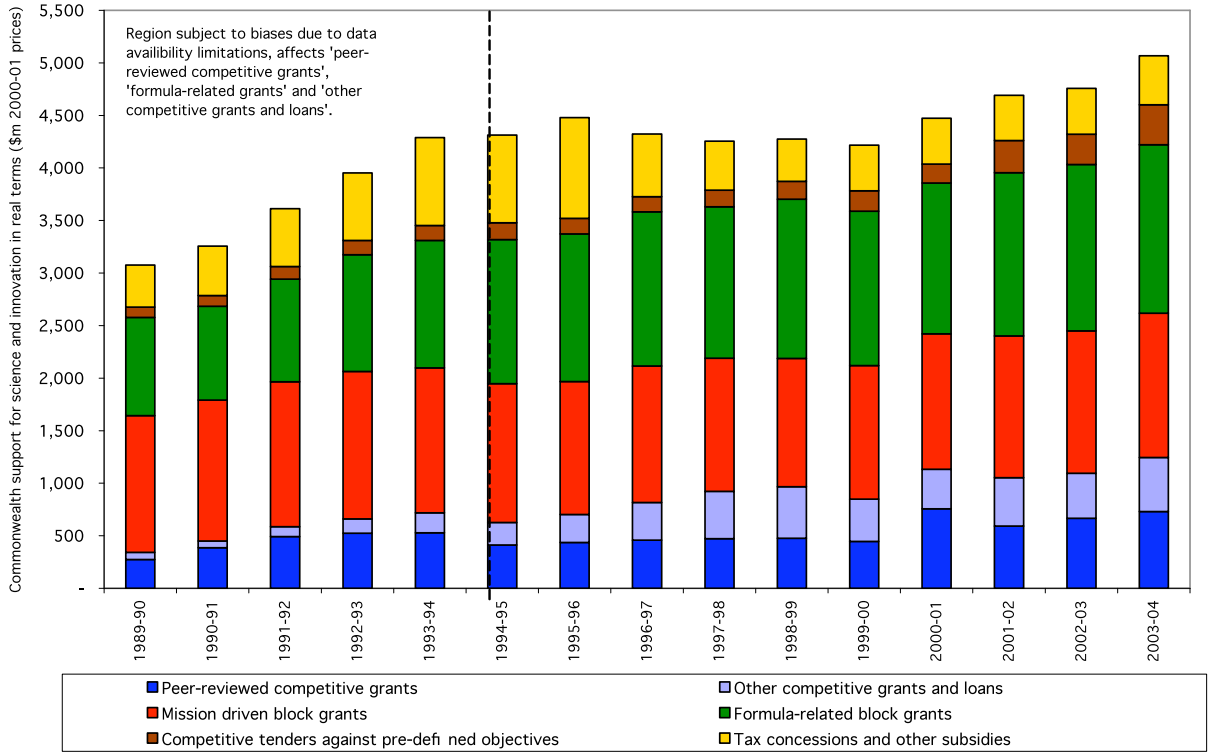
The deflators indicate that the price (ie cost) of performing R&D in the higher education sector has converged on that of the government research organisation sector over this period. Since the turn of the new century there is little to distinguish between the two (although it must be born in mind that the last two years are only estimates). This implies that there is now a 'level playing' field between the two sectors. It should also be born in mind that the use, for convenience, of an average deflator in the experimental estimates that follow means that government research organisation activities are slightly over-stated and higher education activities slightly under-stated for the period up to 1999-00. These biases are likely to be small compared to other potential errors. For instance, in 1989-90 the government research organisation deflator was only 4.3 percent higher that the higher education deflator.

Experimental Results

The following account integrates the consideration of mode of delivery and the 'top level' functional objectives as reflected in the distinction between support for *research* and targeted support for *innovation and adoption.*

Figure 2 provides an overview of the overall level of this support. This indicates that the total level of support in real terms dipped between 1995-96 and 2000-01. This had a lot to do with the reduction in the value of the R&D tax concession from 150 percent to 125 percent which has consequently comprised a smaller proportion of overall science and innovation support (the yellow part of the bars).

Figure 2: Overall levels of Commonwealth support for science and innovation by mode of delivery



Source: author's analysis of published science and innovation budget information

The other marked trend is the increasing role played by 'other competitive grants and loans' in overall science and innovation support. This is discussed in greater detail below.

Figure 3 provides a different perspective on these trends by allowing the relative levels of real support for each mode of delivery to be compared.

Figure 3: Real levels of Commonwealth support for science and innovation by mode of delivery compared

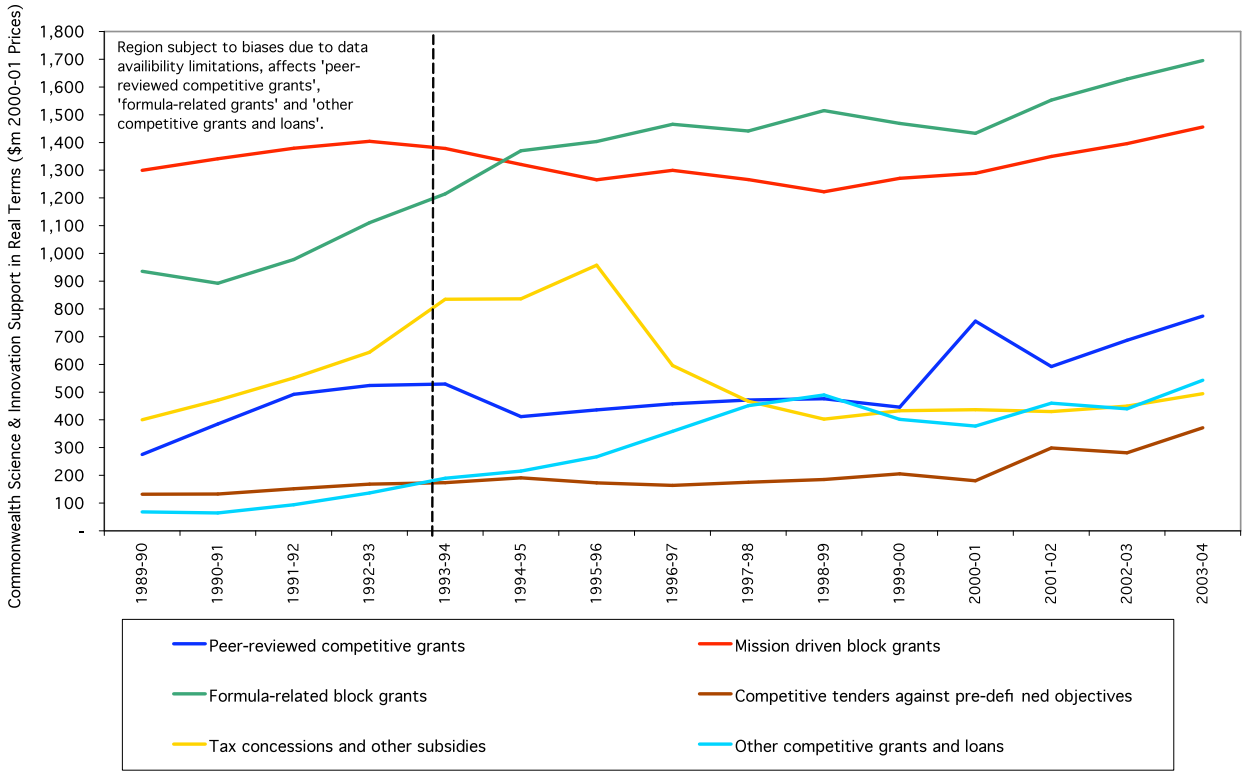


Table 3: data used in figure 3

Real terms (2000-01 prices) $m	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Peer-reviewed competitive grants	274.97	385.29	492.06	523.92	529.09	411.38	436.12	458.09	471.90	476.15	446.05	755.94	592.22	667.08	731.06
Other competitive grants and loans	68.26	64.57	93.90	136.45	189.76	215.64	267.13	358.83	450.96	489.80	401.83	377.58	459.94	426.83	512.86
Mission driven block grants	1,299.61	1,341.23	1,378.94	1,403.89	1,378.11	1,320.72	1,265.10	1,299.30	1,266.43	1,222.42	1,270.87	1,289.00	1,349.24	1,355.80	1,374.98
Formula-related block grants	935.63	892.24	978.20	1,110.49	1,214.30	1,370.33	1,403.19	1,465.98	1,441.29	1,514.60	1,469.03	1,433.40	1,552.62	1,582.46	1,601.52
Competitive tenders against pre-defined objectives	96.90	101.70	119.10	134.80	142.10	159.80	149.10	144.20	157.60	170.20	195.80	180.70	307.00	289.10	381.50
Tax concessions and other subsidies	400.03	471.02	551.37	643.63	834.81	836.08	957.97	596.32	467.03	402.72	433.19	437.10	429.94	436.77	466.58
TOTAL	3,075.40	3,256.05	3,613.57	3,953.18	4,288.17	4,313.96	4,478.60	4,322.72	4,255.21	4,275.89	4,216.78	4,473.72	4,690.97	4,758.04	5,068.50

Source: author's analysis of published science and innovation budget information

It should be noted that there is a small but significant discrepancy between the longer-time frame series assembled from historical reports and the latest published estimates of total support for these years. This suggests that some work remains to be done in the future to improve the accuracy of these estimates. This discrepancy is not due to retrospective adjustments to the tax revenue foregone via the R&D Tax Concession.

On a more policy-relevant level:

- formula-related block grants have increased their prominence in the funding system, and have now overtook mission-driven block grants in 1994-95;
- The reduction in the value of the R&D Tax Concession, possibly coupled with business cycle effects (expected profits are a major determinant of corporate R&D investment) is clear;
- Peer-reviewed competitive grants exhibit a steadily but slowly increasing prominence, the 'blip' in funding in 2000-01 relates to the period of transition in the arrangements for university research funding and may be due to the combined impact of a statistical artefact and a lag before funding under the new arrangement ramped up;

Structural change in the mode of delivery is more easily grasped in figure 4, which shows the changes in the percentage composition of Commonwealth support for science and innovation. This graph has been produced using constant price data, however the picture differs little when current price data are used.

Figure 4: Changes in the percentage composition of Commonwealth support for science and innovation by mode of delivery

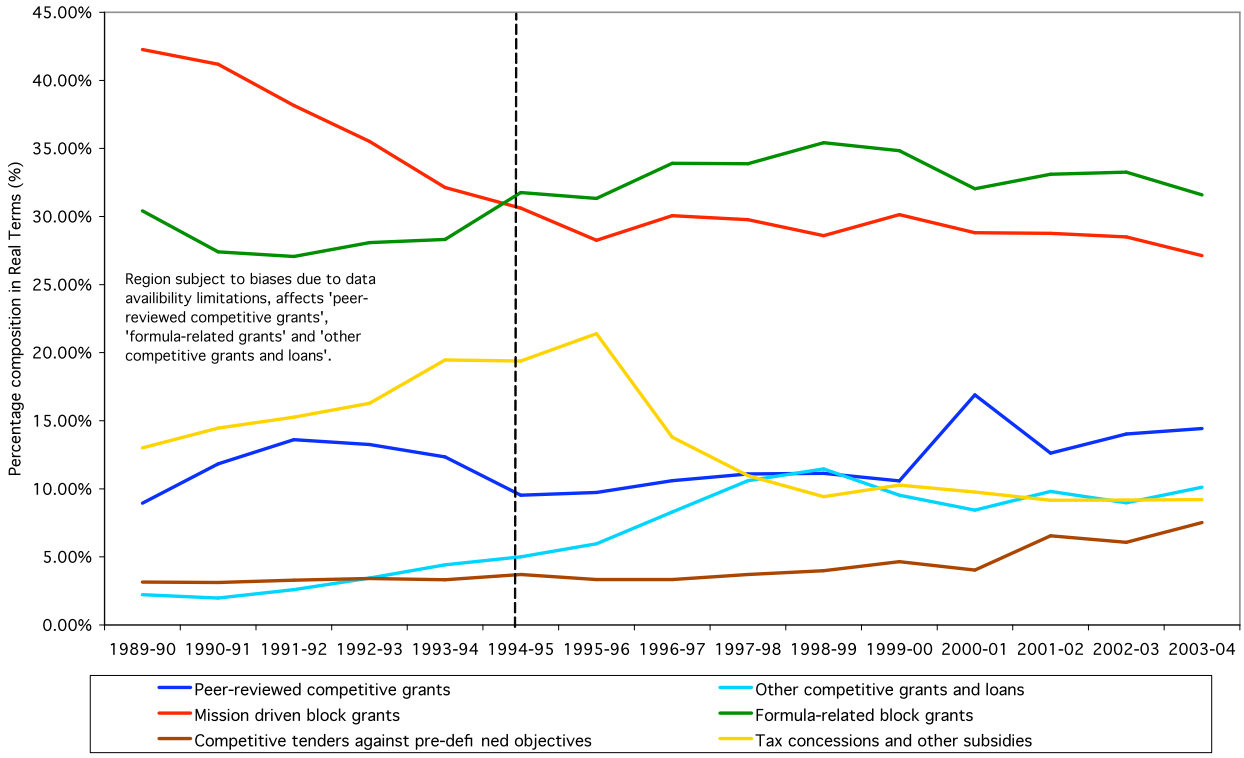


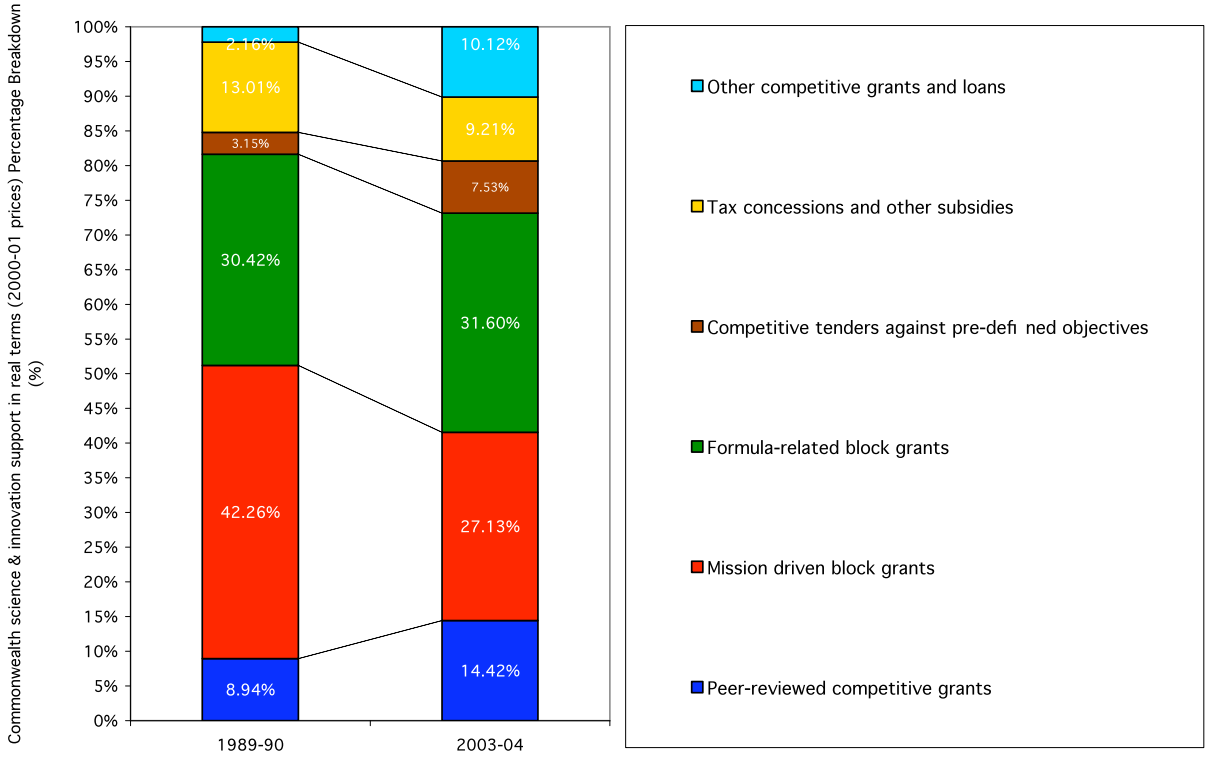
Table 4: data used in figure 4

Real terms (2000-01 prices) Percentage Breakdown (%)	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Peer-reviewed competitive grants	8.94%	11.83%	13.62%	13.25%	12.34%	9.54%	9.74%	10.60%	11.09%	11.14%	10.58%	16.90%	12.62%	14.02%	14.42%
Other competitive grants and loans	2.22%	1.98%	2.60%	3.45%	4.43%	5.00%	5.96%	8.30%	10.60%	11.45%	9.53%	8.44%	9.80%	8.97%	10.12%
Mission driven block grants	42.26%	41.19%	38.16%	35.51%	32.14%	30.61%	28.25%	30.06%	29.76%	28.59%	30.14%	28.81%	28.76%	28.49%	27.13%
Formula-related block grants	30.42%	27.40%	27.07%	28.09%	28.32%	31.77%	31.33%	33.91%	33.87%	35.42%	34.84%	32.04%	33.10%	33.26%	31.60%
Competitive tenders against pre-defined objectives	3.15%	3.12%	3.30%	3.41%	3.31%	3.70%	3.33%	3.34%	3.70%	3.98%	4.64%	4.04%	6.54%	6.08%	7.53%
Tax concessions and other subsidies	13.01%	14.47%	15.26%	16.28%	19.47%	19.38%	21.39%	13.80%	10.98%	9.42%	10.27%	9.77%	9.17%	9.18%	9.21%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: author's analysis of published science and innovation budget information

The declining role of mission-driven block grants is clear, as is the declining role of tax concessions and other subsidies. The increased prominence of other competitive grants and loans also stands out. Figure 5 summarises the structural changes that have taken place in the mode of delivery over this period. It highlights the reduced emphasis on mission-driven grants and the increased emphasis on peer-reviewed competitive grants and other competitive grants and loans.

Figure 5: Summary of structural change in Commonwealth support for science and innovation by mode of delivery, 1989-90 to 2003-04



Source: author's analysis of published science and innovation budget information

These 'headline' results indicate that mapping Commonwealth support for science and innovation by mode of delivery is worthwhile because there is evidence of structural changes in how support is delivered. The system is more heavily focused upon competitively won project level funding (peer-reviewed and other selection processes and competitive tenders against pre-defined objectives) than it used to be. Mission-driven grants exhibit the most marked decline in the share of overall support.

Having established this overall context it is worth examining trends in support for *research* and in support *for innovation and adoption*. Figure 6 shows the pattern for research support and figure 7 that for innovation and adoption support. These estimates were produced by classifying each program or other support mechanism as focused either on research or on innovation and adoption. This is not intended to mean that research support is not also used to support innovation and adoption, but this split in the figures is intended to reflect the dominant focus of support. Details of these allocations can be found in the tables that conclude this section of the report.

Figure 6: Support for research by mode of delivery

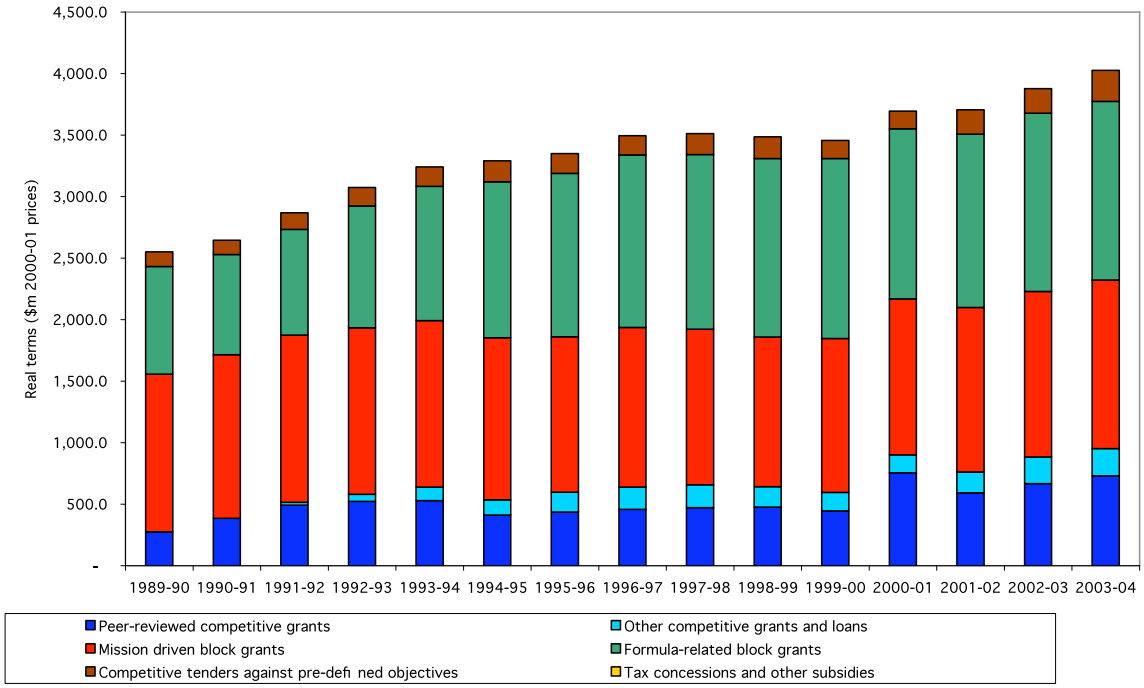


Table 5: data used in figure 6

Research focused support

Real terms (2000-01 prices) $m	Alloc	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Peer-reviewed competitive grants	R	275.0	385.3	492.1	523.9	529.1	411.4	436.1	458.1	471.9	476.1	446.1	755.9	592.2	667.1	731.1
Other competitive grants and loans	R	-	-	23.2	56.5	110.7	124.2	161.5	181.8	186.6	166.5	149.5	144.7	170.1	217.4	221.2
Mission driven block grants	R	1,282.3	1,329.6	1,360.1	1,352.8	1,352.7	1,318.1	1,262.4	1,296.9	1,264.0	1,216.8	1,250.7	1,268.6	1,337.2	1,344.6	1,369.7
Formula-related block grants	R	874.2	813.8	859.0	990.4	1,091.0	1,266.6	1,328.8	1,401.8	1,419.6	1,450.8	1,463.3	1,382.5	1,407.9	1,448.7	1,452.4
Competitive tenders against pre-defined objectives	R	119.1	116.8	134.4	151.1	157.2	171.0	160.9	156.4	169.6	176.5	147.2	142.7	198.0	199.6	251.5
Tax concessions and other subsidies	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	R	2,550.5	2,645.5	2,868.7	3,074.6	3,240.7	3,291.3	3,349.8	3,495.1	3,511.7	3,486.8	3,456.8	3,694.4	3,705.4	3,877.4	4,025.9

Source: author's analysis of published science and innovation budget information

The pattern for research support is reasonably consistent. The gradual increase in funding via 'other competitive grants and loans' is the main change in this picture over this time period. This is partly the result of the growth of the CRC Programme over this period.

Figure 7: Support for innovation and adoption by mode of delivery

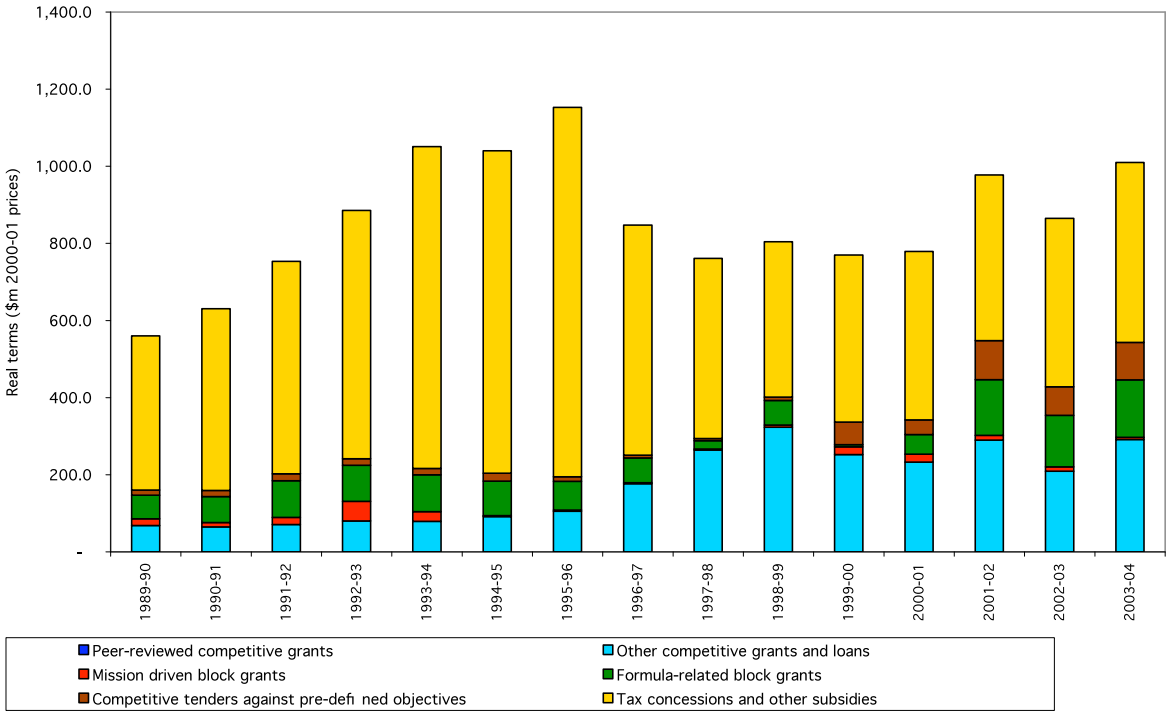


Table 6: data used in figure 7

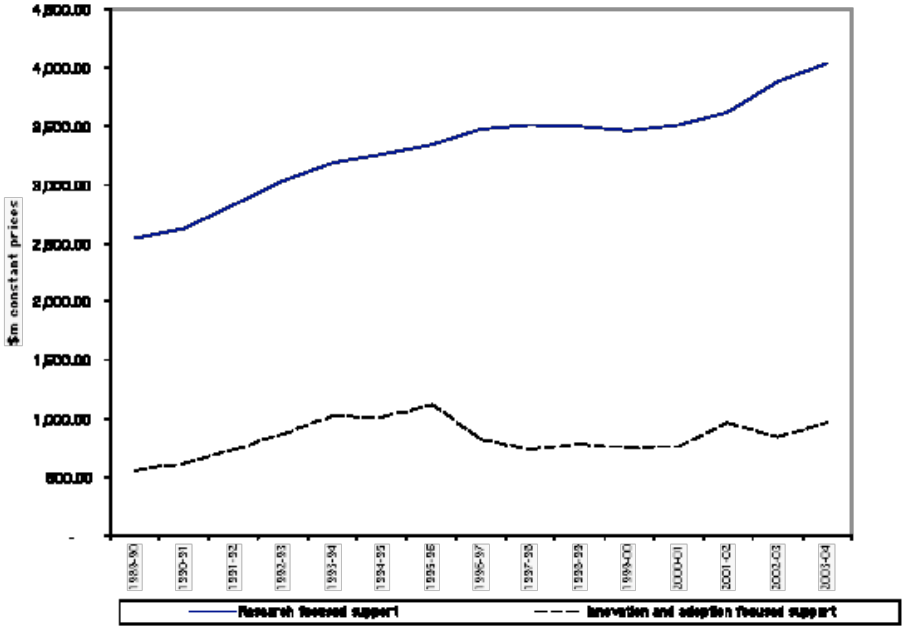
Innovation and adoption focused support

Real terms (2000-01 prices) $m	Alloc	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Peer-reviewed competitive grants	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other competitive grants and loans	I	68.3	64.6	70.7	79.9	79.0	91.4	105.6	177.0	264.4	323.3	252.3	232.9	289.9	209.4	291.6
Mission driven block grants	I	17.3	11.6	18.9	51.1	25.4	2.6	2.7	2.4	2.4	5.7	20.2	20.4	12.1	11.2	5.2
Formula-related block grants	I	61.4	67.1	95.1	93.6	95.3	89.6	74.4	64.2	21.7	63.8	5.8	50.9	144.7	133.8	149.1
Competitive tenders against pre-defined objectives	I	13.2	16.2	17.6	17.1	16.5	20.4	12.2	7.4	5.7	8.7	58.5	38.0	101.0	74.0	97.1
Tax concessions and other subsidies	I	400.0	471.0	551.4	643.6	834.8	836.1	958.0	596.3	467.0	402.7	433.2	437.1	429.9	436.8	466.6
TOTAL	I	560.3	630.6	753.6	885.4	1,051.1	1,040.1	1,152.9	847.2	761.2	804.1	770.0	779.3	977.6	865.1	1,009.7

Source: author's analysis of published science and innovation budget information

Support for innovation and adoption is both more volatile and highlights the major role placed by tax concessions and other subsidies. Competitive tenders against objectives play a larger role now than they did over the bulk of this time period, and competitive grants and loans have increased in importance since the mid 1990s. The two totals can be compared in figure 8. This indicates a sustained increase in real support for research compared with more volatile support for 'innovation and adoption'.

Figure 8: Total support for *research* and for *innovation and adoption* compared



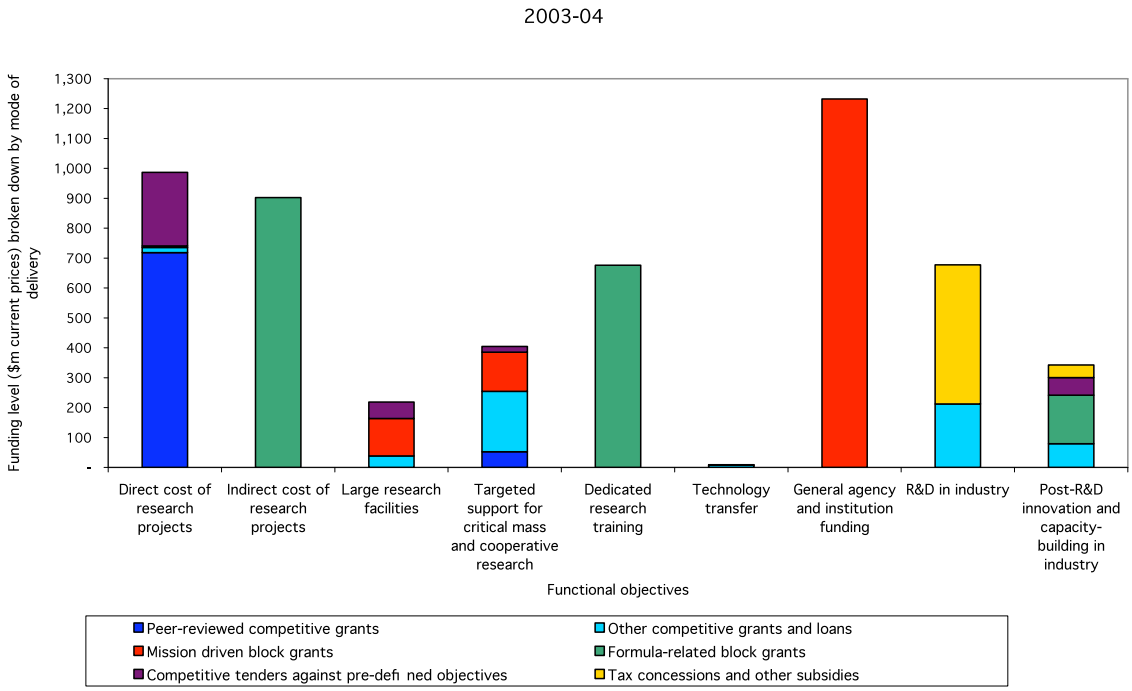
Source: author's analysis of published science and innovation budget information

Figures 9 and 10 show the relationship that currently exists between mode of delivery and functional objectives. The classification scheme for functional objectives was developed by a process of trial and error and represents and compromise between detail and the practical realities of carrying out this sort of analysis. It attempts to highlight the key aims and objectives of support. These are:

- Funding the direct cost of research projects;
- Funding the indirect cost of research projects;
- Funding large research facilities;
- Targeted support for critical mass and cooperative research;
- Dedicated research training;
- Technology transfer within the public sector;
- General agency and institution funding;
- R&D in industry;
- Post-R&D innovation and capacity-building in industry.

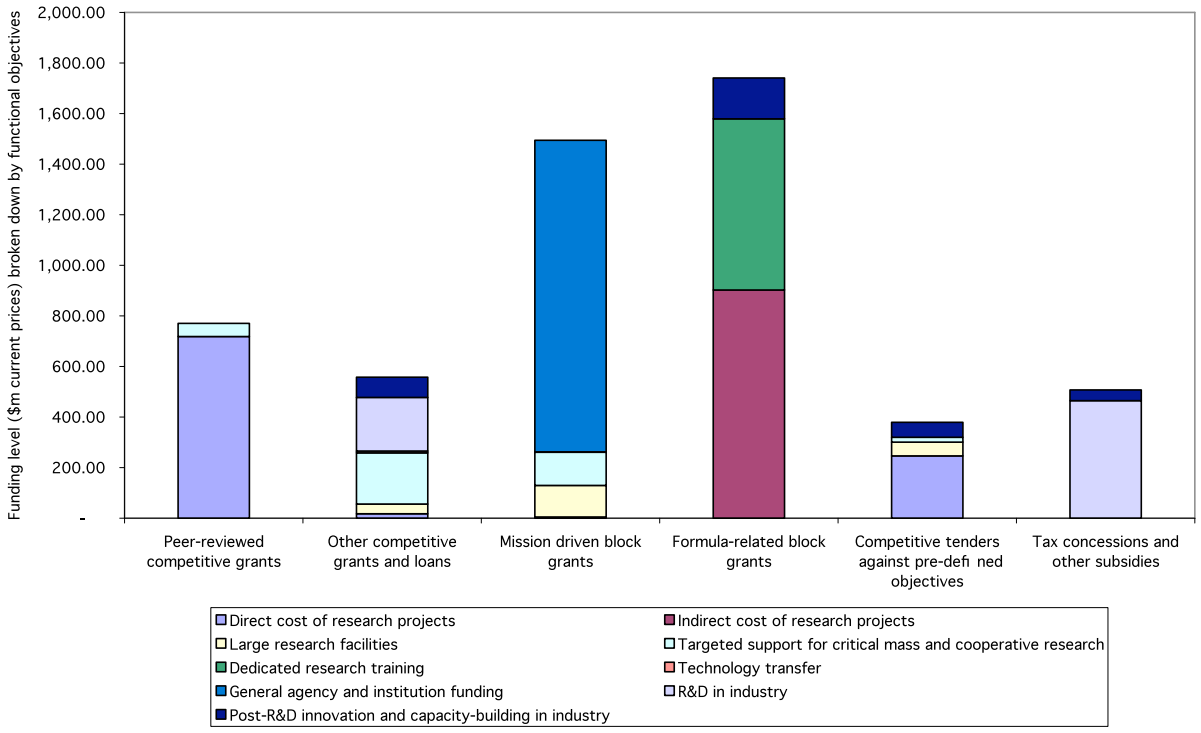
It should be born in mind that this functional breakdown of support is harder to implement than the mode of delivery classification. These experimental estimates should consequently be treated as a 'demonstration of principle'.

Figure 9: Commonwealth support for science and innovation by mode of delivery and functional objectives – functional view



Source: author's analysis of published science and innovation budget information

Figure 9: Commonwealth support for science and innovation by mode of delivery and functional objectives – mode of delivery view



Source: author's analysis of published science and innovation budget information

The remainder of the discussion of these experimental estimates is devoted to considering the details of these trends. In each of the detailed tables that follow the real (constant price) level of support on a program-by-program basis is laid out together, at the bottom of each table, with the year-to-year changes in total support and details of the level of research support vis-à-vis support for innovation and adoption. The 'alloc' column in each table indicates how each program has been classified in these overall functional terms. An 'R' indicates a *research* focus and an 'I' indicates an *innovation and adoption* focus.