

WORKING PAPERS IN ECONOMICS

**The Cooperative Research Program:
Is it Time for a Review?**

by

John McFarlane

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ABSTRACT

Traditional growth theories have been unable to satisfactorily explain various economic events. New growth theories appear to provide a more satisfactory basis for explaining the relationship between various factors and economic growth. However, there is not sound empirical evidence to support the claims of the new growth theorists. Although the empirical evidence to support new growth theories is not strong, there is a school of thought that insufficient emphasis on business expenditure on research and development (BERD) will restrict growth prospects.

A significant feature of R&D activity in Australia is that the major part of effort is directed towards the early stages of R&D, rather than the later stages, which are more closely linked with commercialisation. Government agencies and universities perform around 60 per cent of Australia's R&D and about 85 per cent of this is concentrated in the research stage, rather than the development stage. As a result of this situation basic research dominates research effort by a ratio of 2:1. A government initiative that has been put in place to address this issue is the Cooperative Research Centres (CRC) Program.

The paper provides an overview of the program to date and discusses some empirical evidence from CRCs, which have headquarters in NSW, or substantial research activity in the State. There is evidence presented to support the case for a review of the program, especially where there is good commercialisation prospects for the R&D but no significant evidence of spillovers occurring to other agents.

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CONTENTS	PAGE
1. Introduction	2
2. Investment in Research and Development	3
3. Cooperative Research Centres	4
4. Conclusions	8
References	9
Addendum	11

1. Introduction

OECD countries have historically subscribed to the view that science and technology development are motivating forces towards economic growth, that is, a sustained expansion of the productive potential of the economy which in the long run leads to growth of aggregate output.

The traditional growth models explained long term growth as the weighted average of the growth of aggregate inputs. The models assumed constant returns to scale. However, growth in factor inputs accounts for only about half of the growth in output in the long term. The unexplained half of the growth in output is described as the Solow residual and represents disembodied technical progress. This means that using traditional growth models leaves a very significant amount of growth unexplained(OECD, 1992, pp.168-169).

As the neo-classical growth models do not address some of the most significant factors influencing economic growth this has led to the development of new growth theories. Many of these factors are beyond the influence of market forces and are in the form of externalities and are hard to quantify (BIE, 1992, p.54).

In particular, the traditional growth models have been unable to satisfactorily explain various economic events, especially in the post World War II era. In particular, they do not explain the very high growth rates experienced in the 1950-1974 period and the world slowdown post 1974. There is also the issue of the wide variance of growth rates between countries which is not explained by traditional growth models. The traditional Solow-Swan model predicts the convergence of incomes in advanced economies, but fails to explain the divergence of incomes experienced by the developing countries, despite an increase in trade and capital mobility (Dowrick, 1992a, p.5).

The new theories point to some likely general outcomes. These include, the possibility that intervention by governments may be able to influence growth by addressing market failures, a suggestion that the diffusion of technology and knowledge internationally is critical to the determination of which countries will grow and that investment in both physical as well as human capital and innovation may be a good mechanism for generating the appropriate externalities that lead to growth (BIE, 1992, p.56).

The new growth theories vary in their emphasis on the returns to different factors. This has led to the development of various models. For example, returns to physical investment was the basis of models put forward by Jones and Manuelli, 1990, Rebelo, 1991, and Scott, 1992. An alternative model was put forward by Lucas in 1988, which focused on investment in education, acquisition of skills and learning by doing. Another alternative approach was adopted by Romer, 1990, and Segerstrom, 1991, who focused on the return from investments in research and development (Dowrick 1992a, p.7).

There is currently very little empirical evidence to support the new growth theories and in particular it is difficult to determine which of the main schools of thought are the most promising in explaining economic growth. However, Pol (1995) points out that to conclude that these new growth theories do not provide a platform for policy guidance because of the lack of empirical evidence is an inference that does not follow from the premises (Pol, 1995, p.164). Of the limited number of empirical studies undertaken to test the new growth theories work by Romer (1989) and Dowrick (1992a) indicate that convergence of incomes does occur in developed countries but there is little evidence of convergence occurring in less developed countries (Romer, 1989 and Dowrick, 1992b; cited in Dowrick, 1992a, p.11).

There are also other factors which can contribute to growth. Factors such as a society's attitudes to change and acceptance of new technology can be just as important as levels of investment. These sociological issues do not appear to be addressed in the current range of new growth theories being promoted in the literature (Industry Commission, 1993, p.64).

Although the empirical evidence to support new growth theories is not strong, there is a school of thought that insufficient emphasis on business expenditure on research and development (BERD) will restrict growth prospects. This paper evaluates Australia's investment performance in R&D, and in particular, business expenditure on R&D; (BERD). Australia's R&D performance, until recently, has been dominated by investment in public sector research. Linkages between private sector and public sector research has been poor, leading to a lack of commercialisation of research effort. One initiative that has been established during the 1990s to address this issue is the Cooperative Research Centres Program. This paper provides an overview of the program to date, and discusses some empirical evidence from CRCs, which have headquarters in NSW, or substantial research activity in the State. There is evidence presented to support the case for a review of the program, especially where there is good commercialisation prospects for the R&D undertaken, but no significant evidence of spillovers occurring to other agents.

2. Investment in research and development

During the last two decades Australian BERD more than doubled in real terms. As a percentage of GDP it has increased to 0.71 per cent in 1993-94 and now represents almost half of the Gross Expenditure on R&D (GERD), which is currently at an all time high at 1.58 per cent of GDP (DIST, 1995, p.2). In terms of international ranking's by growth of BERD, Australia held fifth place, with an average annual percentage increase in real terms of 13.1 per cent, during the period 1981 to 1991. However, there was also high BERD growth in most countries. Having started from a low base Australia only achieved a marginal improvement in its international ranking. Australia's commitment to R&D reaches the OECD average in only four of twenty one manufacturing industries (DIST, 1994, pp.13 & 21).

The increase in the level of BERD since the mid 1980s appears to coincide with the introduction of the 150% tax concession on 1 July 1985 and improved business profitability from about that time. There is some evidence to suggest that the increase in BERD was mainly from Australian controlled firms, which tend to be smaller than foreign controlled enterprises. However, this cannot be confirmed, as the ABS has

discontinued its series of data comparing BERD performance between foreign and Australian controlled firms. Data was obtained for the periods 1976/77, 1984/85 and 1986/87. There were also methodological differences between the 1976/77 data and that collected for the other periods (DIST, 1994, p.14)

A notable feature of the Australian R&D experience is the relatively small number of enterprises that account for the majority of R&D expenditure - the largest 5 per cent of all R&D performers accounted for 63 per cent of total BERD in 1988/89. Of these firms undertaking R&D that was eligible for a tax concession, the largest 5 per cent represented only 107 enterprises. These firms undertook about \$63 million of eligible R&D each. At the other extreme, the 1250 firms which each spent less than \$20,000 of eligible expenditure made up 62 per cent of registered firms but accounted for less than 10 per cent of eligible R&D expenditure (BIE, 1993, p.28).

Another significant feature of R&D activity in Australia is that the major part of effort is directed towards the early stages of R&D rather than the later stages which are more closely linked with commercialisation. Government agencies and universities perform around 60 per cent of Australia's R&D and about 85 per cent of this is concentrated in the research stage, rather than the development stage. By contrast two thirds of business expenditure on R&D (BERD) is directed at product development. However, this represents only one quarter of overall R&D expenditure. As a result of this situation basic research dominates research effort by a ratio of 2:1. This confirms the recent observations that Australia is relatively strong in basic research, but weak in commercialising the results of that research (Pappas, Carter, Evans and Koop, 1991; Block Report, 1991; and ASTEC, 1991; cited in BIE, 1993, p.9).

The Cooperative Research Centre (CRC) program was established to address this issue and improve the linkages between public and private sector R&D

3. Cooperative Research Centres:

The CRC Program was introduced by the Commonwealth Government in 1990 as a mechanism for assisting the undertaking of collaborative research between universities, government agencies, such as the CSIRO, and industry. There are similar research programs in Japan, Germany, the UK, Canada and the USA, which have objectives of improving the linkages between private and public researchers. Some of these programs have been in existence for up to 15 years. The Australian CRC model is considered to be unique as it requires a legally binding commitment from industry participants at the outset of a CRCs formation. It is claimed this approach increases industry involvement compared to similar overseas programs.

The four objectives of the CRC Program are:

- to contribute to national objectives, including economic and social development, and the establishment of internationally competitive industry sectors through supporting long-term, high quality scientific and technological research;
- to capture the benefits of research, and to strengthen the links between research and its commercial and other applications, by the active involvement of the users of research in the work and management of the centres;

- to promote cooperation in research, and through it, a more efficient use of resources in the national research effort, by building centres of research concentration, strengthening research networks; and
- to promote the active involvement of researchers from outside the higher education system in educational activities, thus stimulating a broader experience in education and training, particularly in graduate programs, and to offer graduate students opportunities to be involved in major cooperative, user oriented, research programs.

These objectives are very broad in context, and interestingly do not mention commercialisation of research. However, the agreement entered into between CRC participants and the Commonwealth Government does require CRCs to use all reasonable efforts to exploit commercially, or otherwise, any intellectual property and to do so in a manner that ensures that the maximum benefits accrue to Australia, including Australian industry, the Australian environment and the Australian economy generally. The use and exploitation of any intellectual property developed by a CRC is required to be consistent with the objectives of the program.

It is difficult to clearly see where the CRC program fits in reference to basic research programs supported by the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) on the one hand, and the Generic Technology Grants Program administered by the Industry Research and Development Board (IRDB), which are focused on high risk projects with long gestation periods, requiring partnerships between institutional researchers and commercial interests.

Since the program was launched there have been 64 CRCs approved. In 1996/97 when Government program funding will reach \$145 million per annum and the total of all funding, from all sources, will probably exceed \$400 million per annum.

Centres have been funded in the following main industry and research sectors: Mining and Energy, Information and Communications Technology, Agriculture and Rural Based Manufacturing, Environment, Medical Science and Technology and Manufacturing Technology. There are many CRCs that are not included in the Manufacturing Technology category which have a strong manufacturing focus.

The various participating organisations have committed to contribute resources in the following proportions during the initial contract period of between 5 to 7 years: as follows: CRC Program funds provided by the Commonwealth Government 30.75 per cent; Universities 22.56 per cent; Industry 15.72 per cent; CSIRO 12.65 per cent; Commonwealth Government agencies excluding the CSIRO; State Governments 8.59 per cent and other organisations, mostly medical 2.39 per cent.

The industry contribution is significant at 16 per cent (20 per cent for industrial oriented CRCs) when compared with the USA with its sophisticated R&D infrastructure. However, the level of industry funding to university R&D projects seldom exceeds 10 per cent, including those with long established industry associations. Considering the low level of participation in environment and public

health focused CRCs, this suggests a high level of endorsement by industry for the program (Slayter, 1993, p. 12).

Government's commitment to CRCs in 1996/97 represents about 12 per cent of total government expenditure on R&D (excluding Medical and Agriculture) of around \$1,174 million. This indicates that the CRC Program represents a significant element in the overall R&D effort in Australia (Commonwealth, 1996, pp. 3-62 and 4-72).

In view of the substantial commitment from the Commonwealth Government it appears timely to re-assess the programs objectives, to see whether or not they are going to contribute to maximising economic growth from investment in R&D through this type of collaborative program. In view of the program having the potential to increase in size from the 64 centres currently approved, the issue of duplication of effort and the contribution to economic growth that can be achieved from pursuing particular lines of research should be rigorously assessed.

The CRC program was evaluated by the CRC Program Evaluation Steering Committee (PESC) in 1995. The committee tabled their report (the Meyers report) in July of that year. The (PESC) claims that the major success of the program is in producing a cultural change in Australian research and education activity; and especially interaction with industry and other research users (CRC, 1995, 3.3, p.6).

To obtain a sample of the performance of CRCs, either with headquarters in NSW, or with substantial research activity in the State I have evaluated the performance of those CRCs which have been established from the commencement of the program. The following four NSW based CRCs meeting this criteria were evaluated by analysing their annual reports for the first four years of their operation. These CRCs were:

- The Cooperative Research Centre for Eye Research and Technology (ERT);
- The Cooperative Research Centre for Aerospace Structures (AS);
- The Cooperative Research Centre for Waste Management and Pollution Control (WMPC); and
- The Australian Petroleum Cooperative Research Centre (AP).

The key points arising from this exercise were as follows:

- In all cases there was approximately 80% of resources assigned to R&D with most of the balance devoted to administration. There was minimal resources expended on commercialisation or contract work.

The allocation of resources during the period was mainly to salaries (40-70%) and other non-specified expenditure (30-55%). These resources were allocated to the following activities:

Research 79-84%

Administration 10-20%

Education 0.2-5.4%

Contract work 0-4.3%

Commercialisation/Technology Transfer 0-3.5%

To put these resource allocations to various activities in context, commercialisation activity was only recorded by WMPC (3.5%) and AP (0.4%).

Although this is a very small sample to make judgements on CRC policy these results tend to reinforce the anecdotal evidence that there is some doubt about the ability of some CRCs to survive after the initial five to seven years of the Commonwealth Government's funding program.

This position was also reinforced by the PESC, who concluded that only a few centres are likely to become self funding on the basis of their research during the life time of the program (maximum of seven years). In their opinion some centres may be able to continue operations without CRC grants, but will require continuing resources from the participants in the centre. The PESC suggests that there may be a case for government funding in very selected areas on a competitive basis (CRC, 1995, 3.17-3.19, pp. 10-11).

There is a reasonable case for government funding if externalities prevent the appropriation of the R&D being undertaken in a CRC. Many centres actively publish articles on their research program, and hence the technology developed, that is diffused in this manner, has the characteristics of a public good. However, some CRCs are holding back publication of research for commercial reasons. An example of this practice is the NSW based CRC for Molecular Engineering and Technology (CRCMET), which has an objective of commercialising biochemical sensing technology for applications in a diverse range of industries. The work is based on a patent held by the CSIRO, with original collaborative research being funded by a GIRD grant in 1987. This work was subsequently absorbed into the CRCMET. When annual reports are evaluated it becomes clear that the majority of the industry contribution in this CRC, and many others, is mainly "in kind". This suggests that the government is acting as a provider of risk capital with no likelihood of accruing direct benefits, as would be the case if a venture capital provider was involved.

In the case of the CRCMET every effort is being made to meet the maximisation of benefits to Australia, including local production. Achieving this objective depends significantly on the leverage that can be brought to bear on large Multi-National Enterprise (MNE) partners. One of the benefits of the program that has been cited in this regard, is the access to a relatively long period of funding from government sources. This places the CRCs in a much better bargaining position than if funding

was sourced from a venture capitalist, who in Australia, typically have relatively short term time frames for achieving their target financial returns.

The evidence to date suggests that it is time to re-evaluate the program. Where there are few spillovers to other economic agents there is not a strong case for publicly funding these projects. In particular, the industry participants, who are typically large companies by Australian standards, should reimburse the Commonwealth Government on successful commercialisation. If this is not undertaken the taxpayers of Australia are subsidising these companies, without necessarily receiving any flow on effects such as, local production and employment generation.

4. Conclusion:

Traditional growth theories have been unable to satisfactorily explain various economic events. New growth theories appear to provide a more satisfactory basis for explaining the relationship between various factors and economic growth. However, there is not sound empirical evidence to support the claims of the new growth theorists. Although the empirical evidence to support new growth theories is not strong, there is a school of thought that insufficient emphasis on BERD will restrict growth prospects.

A significant feature of R&D activity in Australia is that the major part of effort is directed towards the early stages of R&D, rather than the later stages, which are more closely linked with commercialisation. Government agencies and universities perform around 60 per cent of Australia's R&D and about 85 per cent of this is concentrated in the research stage, rather than the development stage. By contrast two thirds of business expenditure on R&D (BERD) is directed at product development. However, this represents only one quarter of overall R&D expenditure. As a result of this situation basic research dominates research effort by a ratio of 2:1.

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One recent Australian initiative that addresses this issue is the Cooperative Research Centres (CRC) Program. To date, 64 CRCs have been approved by the Commonwealth Government, and some have been established for four years. However, there is persuasive evidence that the longest established CRCs are not putting sufficient effort into commercialisation of R&D projects. Where there are few spillovers to other economic agents there is not a strong case for publicly funding these projects, unless the Commonwealth Government can receive an income stream when projects are commercialised. In the circumstances, these agreements should be renegotiated to include the provision of an income stream from royalties for the Commonwealth Government on the successful commercialisation of projects.

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