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Innovation Financing and Use of Income Contingent Loans

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Abstract

Innovation is the engine of growth in the modern knowledge economy. Yet market processes in relation to innovation have important limitations. In this paper the innovation role is defined, market flaws are dissected, the status of current innovation policy instruments is examined and a new way forward based on income contingent loans is proposed. Evidence is provided as to how such schemes can be designed, and how they are an unequivocal efficiency improvement over conventional instruments. Extension of the model to public-private partnership approaches is also considered to further enhance efficiency and effectiveness.

1. The Nature and Importance of Innovation

In its 2005 Innovation Survey, the Australian Bureau of Statistics (ABS) defines innovation as the development, introduction or implementation of new or significantly improved goods, services, or operational or organisational processes. In the recent report of the Review of the National Innovation System, *Venturous Australia*, innovation is more broadly defined as a dynamic, evolving process of knowledge production, application and diffusion that responds to real needs or opportunities.

Innovation in business is important because it enables firms to establish and maintain competitive advantage in anticipating market opportunities. A number of studies have attempted to quantify the private rate of return here by estimating, using econometric models, the impact of a firm's innovation (often proxied though by the narrower measure of R&D[1]) on the firm's output. The estimates of returns vary considerably among studies and across countries. Using US firm level data, Griliches

[1] In this paper the desired influence is upon the wider conception of innovation. But often particular studies and measures focus on the narrower notion of research and development, which is a sub-set of innovation activity.

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(1992) estimated a rate of return of around 27 per cent. In Canada, the private rate of return has been estimated to be 22 per cent (Bernstein, 1988). In Australia, Bosworth and Rogers (2001), using a Tobin's q approach, found that innovation is positively and significantly associated with the market value of firms. Dowrick (2003) reviewed the literature on the rates of return to R&D and concluded that while returns vary widely, the average private rate of return is approximately 20 per cent. More recently KPMG-Econtech (2009) found that the literature produces a rate of return range of 20-40 per cent across a wide range of studies.

Innovation is seen as a key driver of economic growth and prosperity. The prosperity of a nation depends on its productivity, and innovation assists in this. But the private rates of return that drive firm innovation may under-estimate their economic benefit. This is because as well as providing private returns, innovation spillovers generate social returns. The social return to innovation can be examined by comparing productivity growth at the national level directly with innovation effort. Studies on the social returns to innovation have generally reported very high rates of return. Coe and Helpman (1995) estimated returns at over 100 per cent for larger (G7) countries and 90 per cent for smaller (15 non-G7) countries. In Australia, the Industry Commission (1995) calculated a rate of return of approximately 50 per cent. Williams *et al*. (2003) reported higher returns but found that the aggregate return to Australian R&D fell from 173 per cent in 1990-91 to 116 per cent in 1999-00.

Harris and Kells (2007) and Jones and Williams (1998) confirm that innovation activity often gives rise to spillover effects, and Griliches (1992) and Henderson and Cockburn (2000) claim that the spillover effects for publicly funded R&D can exceed those for privately funded research.

Innovation then is shown to have a significant and positive impact on productivity at the level of the firm, industry and country. Yet Australia's business innovation intensity is low by OECD standards. Using the narrower R&D measure, at 0.89 per cent of GDP in 2003-04, Australia's business expenditure on R&D ranked 18th among OECD countries, well below the OECD average of 1.51 per cent (Department of Education, Science and Training, 2006).

A number of factors have been put forward to explain Australia's poor performance in business research and innovation compared to other countries. First, Australia's industrial structure predisposes Australia to lower levels of R&D expenditure. In all countries, manufacturing industries perform a high proportion of business R&D. In Australia, the manufacturing sector is small.[2] Second, the Australian economy is characterised by the presence of a large number of small businesses which are particularly susceptible to innovation risks and enjoy less access to resources. Third, there is a high proportion of foreign direct investment amongst larger firms, which increases reliance upon overseas innovation.

The low private R&D effort for that component of innovation has been offset somewhat by a higher than average share of GDP being allocated to public sector research in Australia, but the offset is incomplete and the total effort remains behind OECD benchmarks.

[2] For example, Australia's manufacturing sector comprised only 11 per cent of GDP in 2000-01, compared with about 23 per cent in Japan in 1997. While R&D (and innovation) intensity varies widely across sectors, within most manufacturing industries, Australian firms tend to be less R&D intensive than their OECD counterparts (Industry Commission, 1995).

The question persists therefore as to how private research and development (and wider innovation) could be improved further, if Australia is to continue to compete well from a distance in the new century's 'global knowledge economy'.

This paper takes its focus from recognition that in any country there can be a significant private finance problem - and that perhaps one new solution to that is to apply a distinctive Australian innovation, income contingent loans, to the problem. Certainly in the 2008 National Innovation Survey, 'lack of funds within the organisation' and 'lack of finance from outside sources' were perceived as being among the most important barriers to innovation (Ausinnovation, 2008). Equally the Review of the National Innovation System (Cutler, 2008) recognised both the problem and the possible solution proposed in this paper, as presented to the Review in an earlier submission to that Review by two of the present authors (Dadd[3] and Withers, 2008).

Of course, optimal innovation depends upon much more than resolving only the finance problems. The complexity that can underpin innovation is emphasised in approaches to innovation in the so-called 'National Innovation System' literature (e.g. OECD 1997), which emphasises the flows of knowledge (especially technology) across people, firms and other institutions such as government agencies and universities, and their interconnections. Such an approach can identify a wide range of gaps and deficiencies within such systems.

But this paper focuses on finance and directly related issues only. For this purpose the so-called 'market failure' approach favoured by economists is sufficient. Moreover it is the authors' view that the systems approach, while useful descriptively and potentially complementary to the market failure analysis, still lacks adequate theoretical and applied policy foundations to be operational in the well defined and incisive way desired here. For this paper's purpose, market failure analysis is well-established, fully developed and widely accepted by policy economists (Weimer and Vining, 2004).

2. The Policy Rationale for Public Support of R&D

A fundamental premise of modern welfare economics is that government should only intervene in market activity where there is a demonstrated market failure, or where the market outcome is inequitable, and there is good reason to believe that the intervention will produce a better outcome than the free market.

In relation to research and development there are a number of market failures present that do suggest at least a prima facie role for government intervention. One is the existence of externalities from research and development. Some benefits can be privately obtained from research and development for the innovator. This can include what is often now termed 'first mover' advantages, which are the additional returns above competitive levels that may be obtained before widespread emulation of a new product or process takes place and returns profits to the norm. But inability to appropriate all the benefit limits the incentive to innovate.

In this sense, much knowledge created has public good characteristics. It is not used up in the act of consumption and hence is a 'non-rival' commodity, unlike purely private goods. Other than by attempted secrecy, knowledge is also largely a

[3] Amanda Denniss (nee Dadd).

'nonexcludable' commodity. Its information content is often readily shared at low cost, especially in the modern digital era. Even costs such as 'reverse engineering' are not insuperable cost barriers to information diffusion in many cases.

The social return to R&D therefore can be multiplied by diffusion, yet the public good characteristics of knowledge that support this at the same time produce a tendency for private under-investment in such innovation, as the competitive use of the knowledge will emerge and costs of the knowledge production cannot be recovered from the wider set of beneficiaries.

In addition to possessing externality effects, which are benefits to third parties outside the market transaction, knowledge as a commodity is also distinctive in terms of the substantial risk and uncertainty that is inherent in the process of its generation. Moreover this can include elements of 'moral hazard' and of 'adverse selection' such that markets for risk and uncertainty do not operate fully efficiently for this process.

Moral hazard arises when risk transfer arrangements create an incentive to engage in more risky behaviour. And adverse selection arises when sellers of risk have more knowledge of the true risks and which they can conceal without detection from risk-buyers. These elements reduce the ability of businesses to fund or insure their research and development and innovation activities.

Funding may also be restricted in knowledge markets for ideas where asset backing for loans is unavailable. Potential borrowers of funds from backgrounds without realisable assets that can be used as loan security will not be able to borrow.

Because innovation for small enterprises often possesses this characteristic not only will the overall supply of innovation be reduced below desirable levels, but process will be skewed against the less well off – so raising equity issues.

Indeed linked to this may even be 'merit good' issues. One of the few realisable assets commonly available to small business innovators is the family home. When ventures fail the home is sold to repay debt and the provision of adequate shelter for family is compromised. And the extent of failure for start-ups is high – around 50 per cent by five years.

Thus there are reasonable prima facie reasons for collective intervention in research and development markets. This has been accepted in Australia by the watchdog over inappropriate intervention, the Productivity Commission (2002b, p.4.3), which has concluded that:

> "Certain activities such as new knowledge generated by R&D, give rise to more spillovers than others do. Governments have attempted to overcome potential under-investment in R&D through a myriad of mechanisms, such as public provision and funding of research and education, generic subsidies to industrial R&D and enhancement of firms' ability to appropriate larger fractions of the gains from innovation through intellectual property protection".

That said, there are, equally, some prima facie problems with such intervention that could arise such as so-called "rent-seeking" behaviour by businesses, interest groups and by bureaucrats. This occurs where resources are devoted to seeking government intervention that benefits recipients without enhancing efficiency correspondingly. In addition there can be 'short-termism' in policy support by politicians constrained by

electoral cycles, and there can also be high 'transaction costs in administration of interventions, 'deadweight losses' from raising revenues to support the interventions and 'information asymmetries' in determination of targeting of interventions. Each of these considerations points to the potential for 'collective failure', i.e. policy outcomes that are less than the best of intentions.

This array of considerations suggests a policy design that must focus on maximizing the benefits from redressing market failures in this area while minimising the costs of intervention. This design would include:

- Enhancing marginal rather than infra-marginal externalities, i.e. avoiding 'windfall gains';
- Balancing the incentives as between invention and dissemination;
- Reducing incentives for unduly risky behaviour by those not bearing the costs;
- Facilitating more equitable market access for those without adequate assets;
- Providing guarantees about continuity of interventions;
- Minimising administration costs.

In looking to define interventions that might match these objectives arising from both market failure and collective failure analysis, the full spectrum of government instruments should be considered, ranging from the least intrusive to the most interventionist. Essentially this spectrum is as follows:

- Inform/Exhort/Facilitate: use of the profile and status of government to exhort, condemn, encourage and facilitate as broker or intermediary;
- Induce/Discourage via incentives: operate on prices not processes and hence through pecuniary incentives not exhortation or commands e.g. taxes and subsidies;
- Provide: use revenues to provide transfers or services, including under public ownership e.g. cash or in-kind transfers for redistribution, state owned enterprises;
- Constrain/Regulate: use compulsion to alter behaviour and processes via the 'rules of the game", backed by legal penalties of fines or imprisonment.

From this spectrum a form of intervention, or a package of interventions, that optimises the outcome is sought.

3. Current Policy Approaches to Research and Development

Government intervention can take a number of forms. Governments may choose from selective or non-selective policy instruments, debt or equity involvement, subsidies or tax concessions, or policies which target particular industries. In general, two distinctions are commonly made in considering instruments of support for business innovation. The first distinction is between *direct* instruments (such as grants, loans and equity) and *indirect* instruments (e.g. fiscal incentives such as tax concessions). The second distinction is between *general* (across-the-board) instruments and *selective* (targeted) instruments.

Most indirect instruments tend to be general or nonspecific in their objectives whereas direct instruments tend to be targeted (Industry Commission, 1995).

AusIndustry is the Australian Government's business program delivery division in the Department of Innovation, Industry, Science and Research. It delivers more than 30 business products to over 10,000 small and large businesses each year in a range of sectors, including the manufacturing, resources and technology sectors. There are three main types of schemes in place: broad-based concessions, selective grants and the provision of venture capital. For illustrative purposes, one representative scheme from each category is described below. Theses are the R&D Tax Concession, the Commercial Ready program, and the Innovation Investment Fund, respectively.

R&D Tax Concession

The R&D Tax Concession was introduced in 1986 to encourage Australian businesses to undertake more research and development activities. It is the Government's principal mechanism for enhancing business expenditure on R&D. It is a broad based, market driven program that supports a tax deduction of eligible expenditure. It has three elements:

- *125 per cent Tax Concession* – allows businesses to deduct 125 per cent of eligible expenditure inccurred on R&D activities from assessable income;
- *175 per cent Premium Tax Concession* – allows businesses to deduct 175 per cent of additional R&D expenditure above the previous three-year average; and
- *Tax Offset* – allows small businesses (annual turnover of less than $5 million) to cash out their benefit from the Tax Concession.

At 30 June 2006, 6295 companies were registered for the 2005-06 financial year, with reported R&D expenditure totalling $9.2 billion (Department of Industry, Tourism and Resources, 2007).

Commercial Ready Competitive Grant

Commercial Ready was the Australian Government's flagship innovation grants product, providing $200 million a year to SMEs since its introduction in 2004. The initiative commenced on 1 October 2004 and replaced the R&D Start Program. The Government has recently decided to phase out the Commercial Ready program, and the program was closed for application as of 14 May 2008. It is however still useful to briefly describe this program as it offers a good point of comparison with a proposed scheme, described later below. Commercial Ready was a competitive, merit-based grant program with the following notable features:

- *SMEs-focused* – Commercial Ready provided grants from $50,000 up to a limit of $5 million for projects of up to three years in duration; and
- *Commercialisation-driven* – Businesses could apply for funding to meet up to 50 per cent of the eligible expenditure incurred in developing a new product, process or service involving any one or more of research and development, proof-of-concept, and early-stage commercialisation activities.

Other selective grants currently provided by the Australian Government include the Commercialising Technologies (COMET) program which offers grants to early growth businesses, the Industry Cooperative Innovation Program which supports projects benefiting industry sector development, and the Climate Ready program which encourages businesses to develop processes that save energy in innovative ways.

Innovation Investment Venture Fund

A third way in which the Australian Government supports business innovation is the provision of venture capital. The ABS defines venture capital as high risk capital directed towards new or young businesses with prospects of rapid growth and high rates of return (ABS, 2002). The venture capital industry is a source of investment finance for firms to commercialise new ideas and translate them into marketable outcomes. Australia's venture capital market is small compared to other corporate financing sources. However, it has been growing rapidly in recent years (Department of Education, Science and Training, 2003).

The Innovation Investment Fund (IIF) was established in 1997 to provide small, high-tech companies at the seed, start-up or early expansion stages of development with access to equity capital. By providing early stage capital, the IIF is intended to enhance the commercialisation of Australian business innovation. The IIF consists of nine private venture capital funds and by June 2005, there were 89 investments in 74 companies. At June 2005, the total amount invested by the funds was $221 million, with returns to investors of $261.4 million. The Australian Government invested a total of $138.5 million in the funds at June 2005 (Department of Education, Science and Training, 2006).

The current policy approaches have a number of drawbacks. Because the tax concession is broad based, it cannot discriminate against projects that would have proceeded without the support. With respect to selective grants, assistance has only been available to a small number of firms. As at 30 June 2007, 151 applicants had been offered funding. This is a small number compared to the 48,000 businesses that innovated during 2004-2005 (Australian Bureau of Statistics 2005 Innovation Survey). Selective grants also lack reciprocity in that the financial relationship between the Government and innovating businesses ceases once the grant is paid out. The grants are also very costly to Budget. The accessibility to venture capital funding is much more limited and requires high returns to cover risk. Finally, as these programs are tax funded, and there is no possibility of recoupment, there are significant opportunity costs involved.

4. A New ICL Approach to R&D Support

The present approach to industry assistance, be it incentives to undertake R&D or more specific assistance to industries or firms is failing to deliver high levels of innovation, compared to other nations. Explanations can be offered in terms of Australian industry structure and the size distribution of firms as to why the R&D share, for example, might be lower than average for these reasons (see above).

Of course there are some areas where innovation intensity is higher than the OECD average. This suggests that general finance issues are not the only explanation of performance. It also raises questions of the ambit across sectors of this and other

industry innovation schemes. A good principle is to fund increases in innovation over existing levels wherever they can be found.

Consistent with this approach, the point remains that for a country that is competing from a distance (Withers, 2007) there is every need to increase innovation above international norms. Any view that average performance is acceptable or that Australia can free-ride on the rest-of-the-world's knowledge is demonstrably mistaken.

Yet the current approach to increasing investment and international competitiveness in Australia through innovation is intellectually ad hoc, subject to the vagaries of program change (see, Commercial Ready program above) and either provides assistance only to a relatively small number of firms and industries because of caps and quotas or does not discriminate between firms which would innovate without assistance and those that would.

Equally the private venture capital alternative has major weaknesses too. For transaction cost reasons, including business case development, it often has high threshold investment requirements that lead to so-called 'financing gaps'. One anecdotal 'rule of thumb' in Australia, is that venture capital is rarely available for projects under $5million. At best, 'business angels' assist but the market is highly imperfect.

Also the loss of entrepreneurial autonomy in venture capital taking an equity and management position in a start-up can be unacceptable to some owners, and there can be suspicion that the equity may be sold 'too quickly' by the venture capital firm in order to realise profits early. Bank capital by contrast imposes up-front repayment discipline that may not match the asset position and the expected cash flow pattern associated with many small business entrepreneurial initiatives.

An alternative approach to better solving the problem of a lack of depth in the venture capital market in particular is to provide firms with gross revenue/profit contingent loans for R&D expenditure. Such a program would provide funding to firms for a proportion of expenditure on specific R&D projects that meet clearly defined criteria while recognising that firms potentially gain quite significant private gains from R&D expenditure.

Firms that successfully gain funding under this scheme would be required to begin repaying the amount of the grant once revenue/profit increases, in real terms, in excess of a benchmark or threshold e.g. five per cent above the year in which the initial funding was granted (the base year). By basing repayments on revenue the problem of firms manipulating income in order to avoid repayment is averted. But if reporting is felt to be reliable and not subject to new manipulation then profit might be a better measure, since it does allow for cost changes.

Either way here payment in tranches can also be considered, as this will allow progressive judgements to be made as to the success and performance of the projects supported. This would help with the challenge of possessing adequate gate-keepers for approval. Naturally the ICL scheme implies more of such scrutiny than most tax-deduction based approaches, but it is not different from other grant schemes.

What is more distinctive is that firms may have an incentive to avoid repayment by directing revenue or profit to related entities or by liquidating the company to which the grant was originally awarded. To avoid these problems, related companies would also be liable for repayment of the innovation grant. Similarly, firms applying for assistance under such a scheme might be required to sign a covenant over the intellectual property

associated with the grant. Such a covenant would place restrictions on the ability of a firm to sell certain assets in the event of liquidation without Government approval.

So called 'gaming of grants' is also a challenge. This refers to 'rent-seeking' behaviour whereby extra resources unrelated to the product itself are expended on manipulating activities to meet program requirements. For example, consultants and analysts who put together proposals to meet government support criteria, may add to additional costs and/or obtain subsidised equity through the scheme. Intellectual property 'tagging', as suggested, may assist with such readily codifiable knowledge, but more broadly additional costs must become part of the calculus of social benefit ahead of cost, bearing in mind the activities can still be part of entrepreneurial advice jointly with governmental process advice. Also ICL approaches are no different from other support schemes in this respect.

Where the ICL approach is fundamentally different is in that government revenue received from grant repayments can and should be recycled to increase the size of the pool of available funds for innovation support. Such an approach would help meet the government's stated objectives of increasing innovation and international competitiveness, while at the same time increasing both the accountability and equity of the current assistance arrangements.

The presence of some patient capital helps somewhat with the problem of supporting the radically new experiments that also open up possibilities for other innovators too. In this way a more conscious portfolio approach could even be adopted where a social return filter could augment the single-firm business case. This would need careful specification as an elastic definition of social criteria can emerge and grow over time, and begin to erode rather than augment true rates of return. Once again though the point must be made that these issues are no different from those that apply to present grant schemes.

In short, our proposed scheme has the following distinctive features:

- *Cost recovery* – in contrast to an outright grant, a repayable loan provides for the possibility of cost recovery for Government;
- *Default protection* – businesses are protected from default risk as no repayment is required if the business does not earn a profit;
- *Profit smoothing* – the deferred nature of repayments provides a form of profit smoothing which diminishes financial pressures on businesses; and
- *Built-in subsidy* – businesses enjoy a real subsidy in the form of interest savings.

5. Micro-Simulation Analysis

This section illustrates the possible effects of the proposed income contingent loan approach in practice at the firm level by using micro-simulation analysis drawn from the unpublished work of Yuan (2006).

The effects of the scheme over a 20 year period are modelled, drawing on data available as at 2006. The patterns of repayment, outstanding debt and government subsidy are projected forward for 20 years. The data used was based on the Business Longitudinal Survey conducted by the ABS. The methodology used involves two steps. First, a number of hypothetical scenarios representing different combinations

of firm size, levels of innovation expenditure and profit levels are projected over a 20 year period to illustrate the effects of the scheme under a range of possible scenarios. Second, a micro simulation model is built to examine the effects for a weighted sample of the entire population of SMEs in Australia.

The parameters used in the model are outlined in table 1. It is assumed that a company may borrow 50 per cent of their expenditure on innovation, for a duration of three years up to a limit of $5 million in total. These assumptions were chosen to match those applicable to the pre-existing Commercial Ready grant so that meaningful comparisons could be made between the two.

Table 1 - Summary of Model Assumptions

Min repayment threshold	$10,000
Min repayment rate	3%
Loan proportion of expenditure	50%
Loan duration	3 years
Total loan limit	$5 million
Indexation	2.8%
Discount rate	5.44%

Scenario Results

Eight extreme scenarios and one median scenario are considered. Firm size, innovation expenditure and profitability are the characteristics used in determining the hypothetical scenarios. The scenario cut-offs are derived from the data. Future profits are simulated from the data and incorporate a level of stochastic variation. Each scenario has been simulated 1000 times to derive a realistic distribution. The scenarios are summarised in table 2.

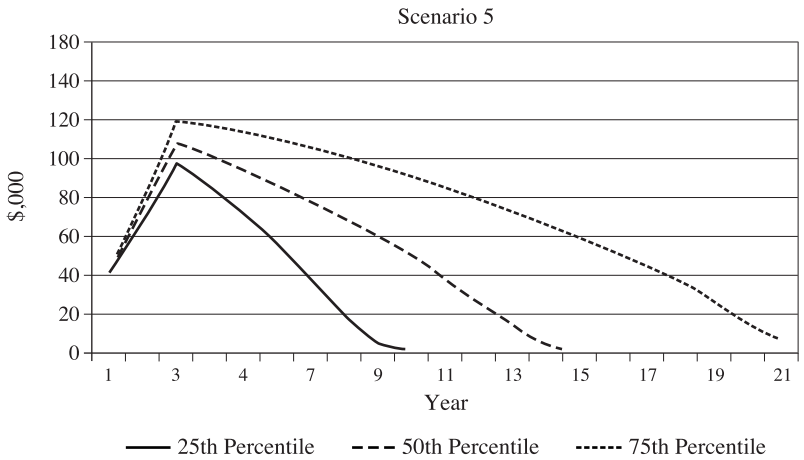
Table 2 - Summary of Hypothetical Scenarios

Scenario	*Size*	*Expenditure*	*Profit*
1	Small	Low	Low
2	Small	Low	High
3	Small	High	Low
4	Small	High	High
5	Medium	Mid	Mid
6	Big	Low	Low
7	Big	Low	High
8	Big	High	Low
9	Big	High	High

It should be made clear that the simulations give rise to a distribution of profits and that 25th percentile represents high profits. The profitability measure used is net profit before tax.

For purposes of illustration, the median case (scenario 5) is considered first. This scenario represents a typical firm participating in the scheme, a medium-sized firm with medium levels of innovation expenditure and profitability. In numerical terms, this is a company with between 19-48 employees, an innovation expenditure of $80,000 and a starting profit of $92,000. Figure 1 shows the projected pattern of outstanding balance for the medium scenario over the 20-year projection period.

Figure 1 - Stochastic Profit Projections: Outstanding Balance for Median Case



The graph can be interpreted as follows. If 1000 companies with the levels of innovation expenditure and starting profits characterised by Scenario 5 enter the scheme, about 250 of the companies can expect to repay the loan in less than 11 years, 500 can expect to repay in 16 years or less, and just under 750 companies will be able to repay the loan within the projection period of 20 years.

Figure 2 - Probability of Total Repayment in t Years for Median Case

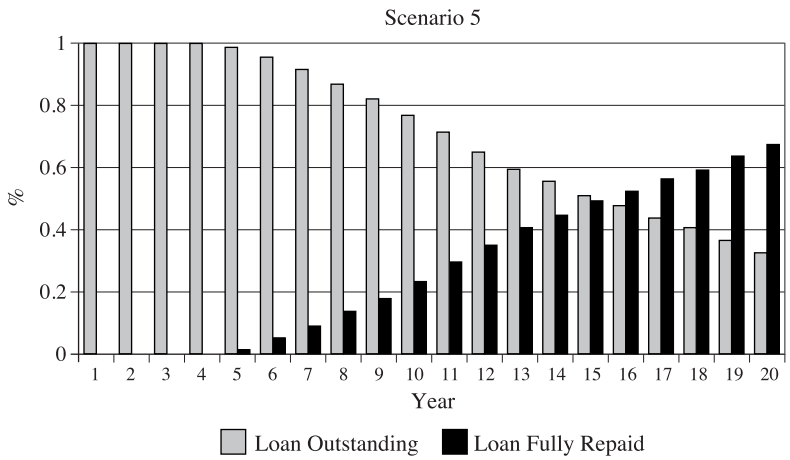


Figure 2 shows the proportion of businesses that have fully repaid the loan at each time period. It can be seen that the proportion of businesses with outstanding loans decreases over time and the proportion of firms that have fully repaid the loan increases over time. Some businesses can expect to fully repay the loan in just five

years. About 70 per cent of companies under scenario 5 can expect to repay the loan within the 20 year period.

Figure 3 - Stochastic Profit Projections: Outstanding Balance

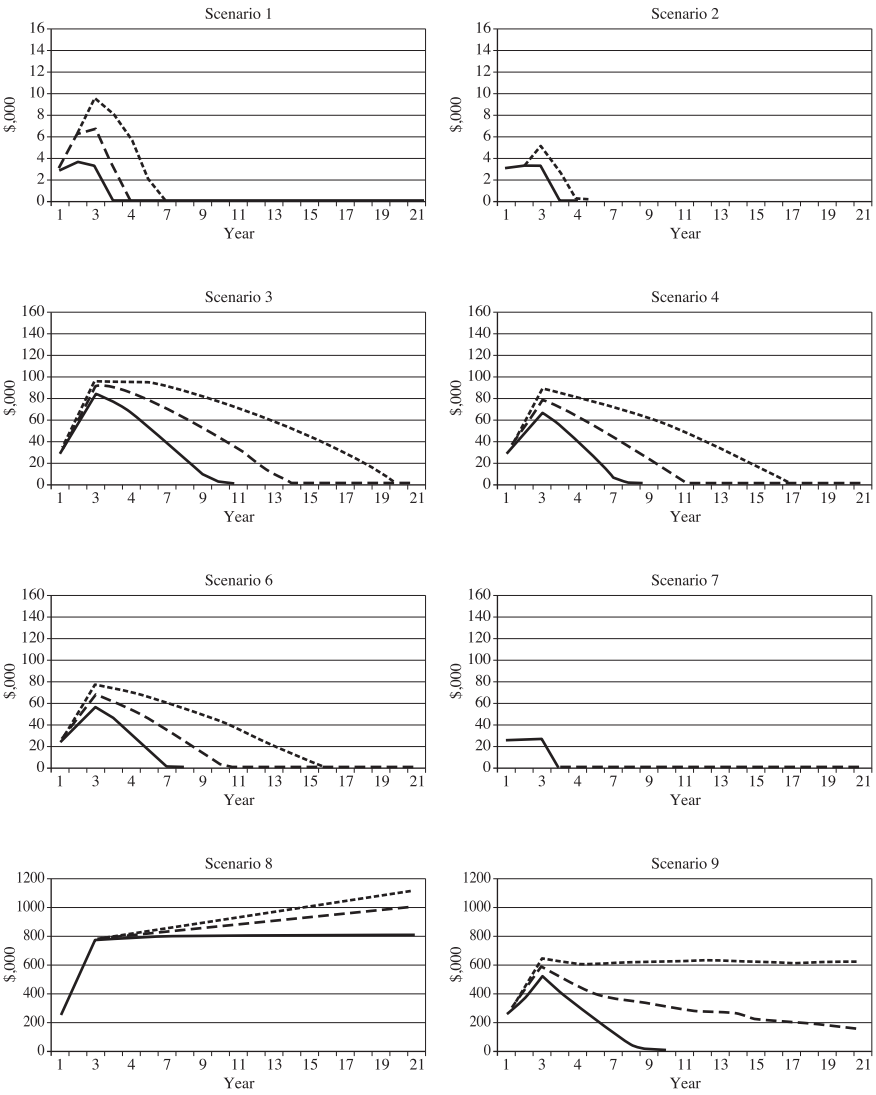


Figure 3 shows the patterns of outstanding balance for the 25th, 50th and 75th percentiles under stochastic profit projections. Notably, for small businesses (scenario 1-4), the loans can be expected to be repaid within the projection period at the 75th

percentile. Businesses with higher starting profits (scenario 2 and 4) can be expected to repay the loan sooner than businesses with lower stating profits (scenario 1 and 3). Businesses that report high levels of innovation expenditure (scenario 3 and 4) also take longer to repay the loan than their less innovative counterparts (scenario 1 and 2). For big businesses, the impacts of both profitability and innovation expenditure are more dramatic. Note that the loan cannot be expected to be repaid under scenario 8 even at the 25th percentile.

The crucial difference between this scheme and the existing Higher Education Contribution Scheme (HECS) scheme providing income-contingent loans for higher education in Australia is that while personal income can be regarded as reasonably stable, company profits vary widely from year to year and can even be negative. Arguably, both the company and the government can benefit from the added volatility. From a company's perspective, in periods of adverse volatility, no repayment obligations apply. The government effectively offers insurance against this volatility risk. To compensate for bearing this risk, the government can design the scheme in such a way as to maximise repayments in periods of positive volatility.

How does this translate into the likely cost for government? Table 3 shows the effective government subsidy for the 25th, 50th and 75th percentiles of the simulated population under each scenario.

Table 3 - Stochastic Profit Projections: Government Subsidy

	Scenario								
Subsidy	1	2	3	4	5	6	7	8	9
($)									
25th	229	226	10,067	6,340	11,314	5,296	1,881	513,699	53,685
50th	442	233	14,938	10,148	17,462	8,299	1,881	599,960	157,312
75th	748	367	21,798	15,609	28,199	12,725	1,927	649,735	392,092
(%)									
25th	0.03	0.03	0.11	0.07	0.10	0.07	0.03	0.70	0.07
50th	0.05	0.03	0.17	0.12	0.15	0.11	0.03	0.82	0.21
75th	0.09	0.04	0.25	0.18	0.24	0.17	0.03	0.89	0.53

The subsidies are low for most scenarios, ranging from three per cent to 25 per cent. Note that the subsidies increase with each level of percentile. One way of interpreting these percentiles is to view them as proxies for the future profitability of a firm, where the 25th percentile represents firms with prosperous future prospects, and the 75th percentile represents firms likely to experience future financial distress. The increasing subsidies then highlight an important principle of the profit-contingent loan: subsidies are equitably distributed among the businesses such that companies in the greatest financial distress benefit the most from the scheme.

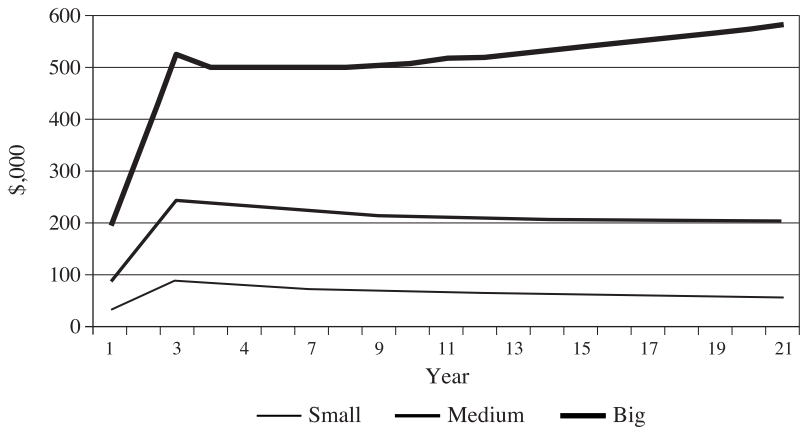
Aggregate Results

While the above discussion provides a useful illustration of the potential impact of the scheme on the different business types, it does not give an insight into how representative these scenarios are of the business population in Australia or the overall impact of introducing the scheme from a government's perspective. In order to

examine the aggregate effects of the scheme, microsimulations were conducted on the entire population of SMEs in Australia using the actual innovation expenditure and profit amounts obtained from the data and taking into account the relative weights of the unit records. The data used in the microsimulation model consists of 500 records representing a total of 12,330 SMEs that innovated.

Figure 4 compares the average outstanding balance for the three size categories over the 20-year projection period. Clearly, the average debt for small firms is much lower than for medium or big firms.

Figure 4 - Businesses by Size: Outstanding Balance



The pattern of total repayment also differs for the three size groups. As can be seen in figure 5, for small firms, over 80 per cent would be free from debt by the end of the projection period. For medium sized firms, the prospect of total repayment is less optimistic. An interesting pattern emerges for big firms. While 35 per cent of businesses are expected to fully repay the loan in just five years, only 40 per cent are expected to repay by Year 20. One explanation for this is that big firms may be characterised by distinctly 'prosperous' or 'distressed' firms with the former paying off the loans very quickly and the latter struggling to pay.

In terms of the government subsidy (table 4), clearly bigger firms would be more costly for government. This lends support for the adoption of a scheme design which is aimed to favour small businesses, considering also that small firms tend to be in most need of government support. The percentile values of the percentage subsidy are heavily skewed within each size category. This implies that the government should take steps to avoid large losses. Note that the total government subsidy appears quite large. This is because it was assumed that every innovative SME in Australia would receive a loan. In reality, the total amount of subsidy would be capped. Therefore, it is informative to compare the loan directly against the pre-existing Commercial Ready grant for a given level of subsidy.

As can be seen from table 5, almost six times the number of businesses can gain access to government support of innovation at no additional cost to government. This means that the overall pool of available funding for innovation can be increased.

Figure 5 - Businesses by Size: Probability of Total Repayment in t Years

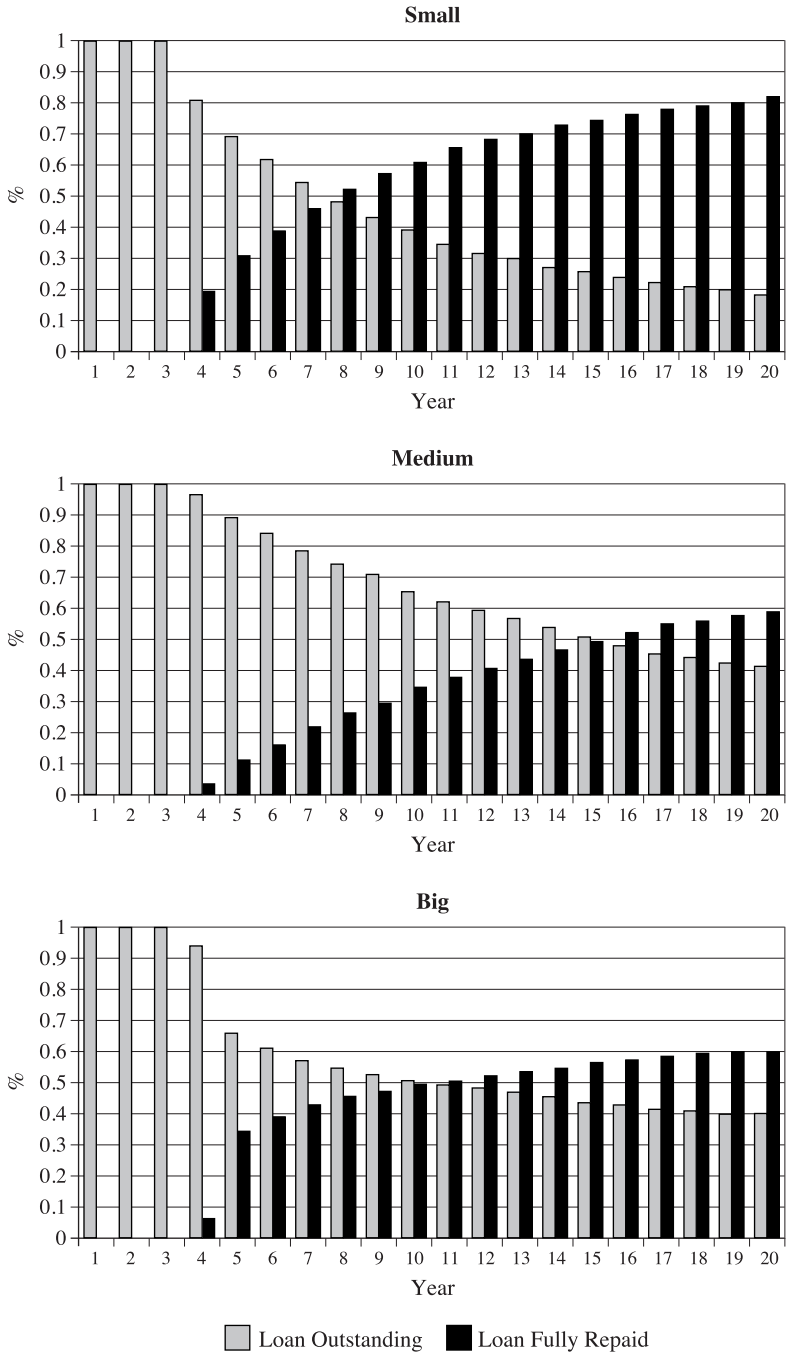


Table 4 - Businesses by Size: Government Subsidy

	Small	*Medium*	*Big*
Present Value of Loan ($ million)	438	1,063	1,737
Present Value of Repayments ($ million)	247	490	623
Total Government Subsidy ($ million)	191	573	1,114
Total Government Subsidy (% of Loan)	43.7	53.9	64.1
Distribution of Government Subsidy Mean ($)	38,938	134,273	354,271
25th Percentile (% of Loan)	3.4	7.1	2.6
50th Percentile (% of Loan)	8.0	15.8	9.9
75th Percentile (% of Loan)	17.7	51.0	64.0

Table 5 - Comparing Income-Contingent Loan with Commercial Ready Grant

	Loan	*Capped Grant*	*Loan*
Total Government Subsidy ($ million)	1,907	612	612
Average Government Subsidy ($)	154,663	154,663	904,762
Number of Businesses Supported	12330	3944	676

In summary, our results highlight the following findings:

- Firms characterised by low profitability, high expenditure and distressed future prospects receive the greatest subsidies;
- Firms enjoy protection in periods of negative volatility in profits, and make sizeable repayments in periods of positive volatility;
- The overall pool of funding can be effectively increased by six-fold compared with competitive grants;
- Distribution of the subsidy is heavily skewed and the government faces the danger of subsidising large losses, the magnitude of which increases with firm size.

6. Further Enhancement of the ICL Approach to Innovation

There are two key reasons why there may be unfulfilled innovation opportunities: cash-flow and business skills. The income contingent loan scheme proposed in the previous sections helps clearly with the former matter. But the issue of business discipline and business skills remains. These are dealt with under existing government schemes in various ways, e.g. mentoring, and there is every reason that such mechanisms should continue. But the ICL approach could be modified to also allow another set of disciplines and incentives coming from the private finance sector itself.

The basic ICL approach is well-established, as reviewed in Chapman (2008). Its possible use in areas beyond its original application to higher education is the focus of many companion papers in this volume, including Higgins and Withers (2009). But in application to innovation finance the logic suggests the need for a distinctive integrated program to support skill enhancement and financing for small business innovation based on a partnership between enterprises, government and financial institutions.

Other schemes typically do not draw on the full complementary range of

expertise and motivation and so often embed poorly aligned incentives for firms, are inflexible and distort loan priorities and do not address human resource development in getting firms ready.

Therefore following Chapman and Simes (2006) it is possible to propose an Innovation Development Fund that:

- would require firms to have had or to undergo business training and to accept assistance in developing proposals to a finance-ready stage as a condition of entry into assessing and approving financing arrangements; and
- would provide part of the finance through a profit-related loan to be repaid through taxation on future positive net earnings to complement a further proportion of the finance that would be provided on normal commercial terms.

This Fund would involve government providing a default-protected loan mechanism where commercial banks are reluctant to take on all risk. We can justify government assuming a share of risk by the pooled probability across the Fund of a high social pay-off through the opportunities generated from small business innovation activity that would not otherwise be undertaken.

In this plan taxpayer subsidies can be recovered but only where the investment supported has paid off. The scheme therefore provides a form of revenue or profit smoothing so as to diminish financial pressures precisely at the time this is most needed. In this way government expands the pool of venture capital, which represents only a small part of overall sources of finance for small innovative businesses.

A training requirement and commercial assessment under the partnership principle helps minimise risks. The phases in this process should be at arms-length so that financing decisions are made separately from project development. The drive and responsibility for the success of the projects after pre-finance assistance and suitable finance provision will then rest directly with the firms themselves.

From the government's point of view we see a two-stage approach as possible with a separate government agency involved at each stage. Firstly the proposal would be vetted under a new government scheme, the Innovation Development Fund (IDF). The IDF would be managed by a dedicated unit, say the Office of the IDF, who would assess proposals and provide feedback and support. Where additional work is necessary to develop proposals to a finance-ready stage, the IDF should be able to:

- tap into the range of programs already in existence; and
- provide grant money to partially fund the refinement of proposals e.g. for the production of a detailed business plan.

The IDF's feedback can include identifying gaps in management or other skills that the enterprise will need to satisfy a financier of its likely commercial viability. The agency will compile a register of accredited courses suitable for meeting the skill requirements for access to finance under the scheme. These can be both in formal public educational institutions and from private providers, including professional associations and community organisations.

Various forms of exemption will be available for prior studies deemed equivalent to the accredited courses in the areas that would otherwise be required. The cost of course attendance will be shared by the applicant and the Fund, consistent with the partnership approach embodied in the Fund notion.

Suitable proposals would then be referred for the second stage - consideration for financing. The IDF performs a valuable part of this process by reducing screening costs. Experience suggests that without this screening the extent of private funding would be significantly restricted.

There are three parties to the financing: the enterprise, the government and the relevant financial institution. In most projects being considered, the additional private finance being sought will take the form of debt and the financial institution will be a bank. However, private equity injections will be appropriate for some proposals and it is important that the vetting process does keep this option open. Indeed, the involvement of, say, a venture capital fund may bring more management skills to the table than would a bank.

The government's role in assisting financing would be the responsibility of the Office of Innovation Finance Assistance (IFA). This would be a quite separate agency to the Office of the IDF in order to ensure that financing decisions are made on an arms-length basis from the development of any proposal.[4]

Public financial support will take the form of profit related loans. Having support from the public sector is justified because of the social benefits of the project and/or market failure in the financial system. This support takes two forms:

- any subsidy embedded in the loan itself; and
- collection of this part of the debt is based on taxation of the future profits of the enterprise – this can only be provided by the public sector through the tax system.

The Office of the IFA will determine the appropriate level of profit-contingent loans based on the expected community benefits from the project and the extent of the buy-in from those involved in the enterprise. There could also be an option for the Office of the IFA to provide some direct grant for particularly desirable projects if this were deemed necessary to make the project a viable commercial proposition.

After determining the extent of public support, the Office of IFA would coordinate with the relevant financial institution – eg bank or venture capital fund – to bring the full package of financing together.

As an aside, we stress the need for the close involvement of a bank (or other financial institution) to ensure that the projects operate as commercially as possible. However, at the initial stages, the banks may be reluctant to be involved given the limited size of the program and the lack of a track record. Hence it might be necessary in the early stages for the program to operate a pilot scheme with banks being paid a fee for vetting/monitoring services.

As the program becomes established, the scheme could in principle be open to any bank. Instead, we recommend that banks tender to assume the role of principal

[4] That is, the two stages will assist in the governance aspects of the public sector's involvement.

debt financier for the scheme. The successful bid would be based more on the nature of the commitment the bank would bring to the task rather than any fee. The attractions of having a single bank involved in the early part of the scheme include:

- benefits for the successful bank for its corporate image and, over time, having a head start in establishing a potentially profitable new line of business; and
- for the Government, having greater confidence that there would be an ongoing commitment to the success of the scheme from a large financial player.

The scheme we propose has the following advantages:

- it could act to improve the functioning of loan markets where innovation activities are below what a government might consider to be optimal;
- because some part of taxpayers' subsidies would be recovered when the enterprise is succeeding commercially, there is an important equity dimension;
- not only is it fair that average taxpayers don't eventually foot the bill for all subsidies to successful enterprises, the fact that there are returns to the public sector should also be seen to be desirable because of the associated potential to reduce national budgetary pressures. The repayments thus allow the financing of more innovation projects than could be forthcoming if the scheme was solely grant financed (or lower taxes, or higher provision of alternative government services); and
- such schemes essentially provide a form of revenue (or profit) smoothing, and thus diminish financial pressures on enterprises at the time in which this is most needed.

Because of the originality of the scheme, it is critical that there is some experimentation at the outset, perhaps through the introduction of different pilot programs. With flexibility and the obvious potential for learning by doing, the basis for a firmer public sector commitment, and its nature, should be forthcoming. This will include closer review of whether any existing funds can be suitably adapted for these purposes, once further detail requested for the consultants is provided. The need to specify favoured industries for priority in such support, and how that should be administered can be a part of that review.

Our recommendation is to establish a new Innovation Development Fund to complement existing initiatives by being based upon pre-financing training and development conditions and a mix of commercial loans and a government profit-related loan repayment scheme.

This would give specific implementation content to the welcome recognition by the Report of the Review of the National Innovation System of such schemes when it recommended that 'Consideration should be given to extending the platform created to enforce payments and administer income contingent loans through the tax system;

for instance by extending income contingent loans for tertiary education outside universities and for sole trader entrepreneurs seeking to fund innovative projects' (Recommendation 10.2).

Similarly the Review proposed a Competitive Innovation Grants Program where 'successful firms would be required to repay grants from the royalties or earnings streams accruing from commercial success' (Recommendation 9.1).

This paper suggests that such proposals have considerable merit, and related research also shows that they would have considerable public support (ASSA/ANU, 2008).[5]

References

Academy of the Social Sciences in Australia and Australian National University (2008), 'Australians Support HECS for R&D: Survey', Media release, 8 October.

Australian Bureau of Statistics (2002), 'Venture Capital 2000-01', ABS Cat. No. 5678.0, Commonwealth of Australia.

Australian Bureau of Statistics (2006), 'Innovation in Australian Business 2005', ABS Cat. No. 8158.0, Commonwealth of Australia.

AusInnovation (2008), '2008 National Innovation Survey', Commonwealth of Australia.

Bernstein, J. (1988), 'Costs of Production, Intra- and Interindustry R&D Spillovers: Canadian Evidence', *Canadian Journal of Economics*, 21, 324-47.

Bosworth, D. and Rogers, M. (2001), 'Market Value, R&D and Intellectual Property: An Empirical Analysis of Large Australian Firms', *The Economic Record*, 77(239), 327-337.

Chapman, B. (2008), Government Manging Risk: Income Contingent Loans for Social and Economic Progress, London: Routledge.

Chapman, B. and Simes, R. (2006), 'Profit Contingent Loans for Social and Community Investment in Economically Disadvantaged Regions', *Public Policy*, 1(2), 93-102.

Coe, D. and Helpman, E. (1995), 'International R&D Spillovers', *European Economic Review*, 39(5), 859-887.

Cutler & Company Pty Ltd (2008), 'Venturous Australia: Building Strength in Innovation', Commonwealth of Australia.

Dadd, A. and G. Withers (2008), Applying Income Related Loans to Financing Innovation, Submission to the Review of the National Innovation System, April 2008, Submission 425.

Department of Education, Science and Training (2003), 'Mapping Australian Science and Innovation – Main Report', Commonwealth of Australia.

Department of Education, Science and Training (2006), 'The Australian Government's Innovation Report 2005-06', Commonwealth of Australia.

Department of Industry, Tourism and Resources (2007), 'Innovation Australia: Activities of the Industry Research & Development Board', Commonwealth of Australia.

[5] Also see the companion paper by G. Withers and T. Higgins, this volume.

Dowrick, S. (2003), 'A Review of the Evidence on Science, R&D and Productivity', paper prepared for the Commonwealth Department of Education, Science and Training, The Australian National University.

Griliches, Z. (1992), 'The Search for R&D Spillovers', *Scandinavian Journal of Economics*, 94, 29-47.

Harris, M. and Kells, S. (1997), 'Knowledge Spillovers, Location and Growth: Theory and Evidence', Melbourne Institute Working Paper, 6/97, University of Melbourne.

Henderson, R.M. and Cockburn, I.M. (2000), 'Publicly Funded Science and the Productivity of the Pharmaceutical Industry' in A. Jaffe et al. (eds.), *Innovation Policy and the Economy*, Cambridge, Mass., NBER,

Higgins, T. and G. Withers (2009), 'Community Attitudes to Income Contingent Loans', *Australian Journal of Labour Economics*, 12(1), pp here

Industry Commission (1995), 'Research and Development', IC Report No. 44, Commonwealth of Australia.

Jones, C.I. and Williams, J.C. (1998), 'Measuring the Social Returns to Research and Development', *Quarterly Journal of Economics*, November, 113(4), 1119-1135.

OECD (1997), *National Innovation Systems*, Paris, OECD.

Weimer, D. and Vining, A. (2004), *Policy Analysis: Concepts and Methods*, New York, Pearson.

Williams, C., Draca, M. and Smith, C. (eds.) (2003), 'Productivity and Regional Economic Performance in Australia', Office of Economic and Statistical Research, Queensland Treasury, Brisbane.

Withers, G. (2007), 'Can Distance Be Defeated?, in Committee for Economic Development of Australia (CEDA), *Competing From A Distance*, Melbourne, 18-27.

Yuan, M. (2006), 'Advancing Australia's Ability – Applying a Profit-Contingent Loan to Innovation and Research', Honour's Thesis, Australian National University.