CSL Limited
45 Poplar Road Parkville
Victoria 3052 Australia

T +613 9389 1911
F +613 9389 1434
www.csl.com.au

Mr Mike Woods
Commissioner
Science and Innovation Study
Productivity Commission
PO Box 80
Belconnen ACT 2616
Australia

15 December, 2006

Dear Mr Woods

I welcome the opportunity to contribute to the Productivity Commission's Study on Public Support for Science and Innovation in Australia, in response to the publication of your Draft Research Report and the recent round table discussions.

The biotechnology sector makes a valuable contribution to the Australian economy. Public support of science and innovation has been hugely important in helping to establish biotechnology in Australia, and will continue to be important in ensuring its growth. Your Draft Report is a useful reminder of this, and I broadly endorse your preliminary findings.

As Australia's largest biotechnology company, CSL has much to gain and much to contribute to this valuable sector. But working in Australia is not without its challenges. CSL's submission focuses on a few of the impediments to building a world leading biotechnology company in Australia. I believe that Australia needs to develop some biotechnology companies that have global scale, in order to maximise the returns from the overall sector. Based on our own experience, the submission highlights how public support can help this happen.

If you have any questions on the submission, or would like to discuss any of these issues further, please don't hesitate to contact me.

Yours sincerely

Dr Brian McNamee
Chief Executive Officer and Managing Director

Submission to the Productivity Commission Research Study into Public Support for Science and Innovation in Australia

CSL Limited

15 December 2006

Introduction

CSL Limited is Australia's largest biotechnology company. CSL was established in 1916 to provide the Australian community with human vaccines and sera that could not be guaranteed in the event of war. CSL continues with that proud tradition, supplying products of national interest such as influenza vaccine, pandemic vaccine in the event of a pandemic influenza outbreak, plasma products made from Australian plasma, anti-venoms and vaccines.

CSL was incorporated in 1991 and sold by the Commonwealth Government in 1994. CSL's evolution into a global speciality biopharmaceutical company was achieved through the acquisition of the Swiss Red Cross fractionator ZLB (2000), US blood collection centres from NABI (2001) and Aventis Behring (2004). That growth is continuing with our recent acquisition of Zenyth (2006). CSL Limited has a market capitalisation in excess of $11.5bn[1] employs over 7,000 people, has major operations in 25 countries and has manufacturing facilities in Europe, USA, Japan and Australia. We retain our corporate headquarters in Melbourne, collocated with our major R&D hub, a reflection of the strategic importance of R&D and of Australia to CSL.

Key conclusions

1. The Commission's Draft Report is a valuable contribution to the discussion of innovation policy.
2. CSL believes that substantial social benefits would arise from increasing government support for science and innovation.
3. CSL welcomes the Commission's note of caution against increasing the quantum of university funding from commercialisation, but sees value from increased government funding of basic science.
4. As regards business support, CSL agrees that the concepts of 'spillovers' and 'additionality' are important.
5. There are substantial spillovers from larger biotechnology firms that maintain Australia as their main centre for R&D and IP. These benefits accrue to basic research and to the broader biotechnology community.
6. There is considerable merit in increasing the level of business support through the tax concession, and biasing the concession in favour of incremental R&D. This is most likely to deliver additionality. CSL would certainly increase its own expenditure on high risk R&D if there was greater government support.
7. However, if this were to be done, the definition of what is 'incremental' would have to reflect the realities of biotechnology innovation, namely the long development cycle. This could be achieved by, for example, extending the assessment base from 3 to 10 years.

CSL's Australian operations — excluding the substantial financial contributions from its overseas subsidiary, CSL Behring — contribute more than $1bn annually to the Australian economy, and contribute in excess of 5,500 jobs (see Figure 1). CSL's R&D contribution is particularly important to the Australian biotechnology sector. In 2004 the R&D and Intellectual Property Scoreboard[2] found that CSL had the third highest R&D expenditure in

[1] As of 15 December 2006

[2] Published by IP Australia, a Government agency, in August 2004. CSL trailed only Holden and Ford.

Australia, and we have increased our R&D expenditure significantly since that time. CSL is the only significant scale biotechnology firm, by world standards, that is based in Australia.[3]

Figure 1. Contribution of CSL's Australian operations to the Australian economy[4]

	Output ($ million)	Income (labour) ($ million)	Employment (number)
Direct contribution	366	109	1,333
Contribution to other industries	664	164	4,237
Total contribution	1,030	273	5,570

Source: CRA International *CSL's contribution to the Australian Economy*, April 2006

Innovation, research and development at CSL

CSL has a very successful track record in research and development (R&D) from its Australian operations.[5] CSL pioneered the chromatographic manufacture of a liquid formulation immunoglobulin (IVIg) at its Broadmeadows facility, a technology that is only now being emulated by our overseas competitors. CSL is at the forefront of research into prions (the agents responsible for Bovine Spongiform Encephalopathy and its human counterpart, human variant CJD), with Broadmeadows an important contributor to the work. And CSL, through its collaboration with Professor Ian Frasier (Australian of the Year in 2006) at the University of Queensland, developed the intellectual property at the heart of Merck's Gardasil vaccine against cervical cancer.[6]

As a result, innovation through highly effective research and development expenditure is one of the cornerstones of our growth strategy. To this end, we are increasing our R&D expenditure from $141m in 2004/05 to a forecast level of $188m in 2006/07 and expect that growth to continue thereafter (see Figure 2). Considerably more than half of the anticipated R&D expenditure will be centred on our Parkville and Broadmeadows sites in Australia, even though CSL earns only around 16% of its revenues from the Australian market.

---

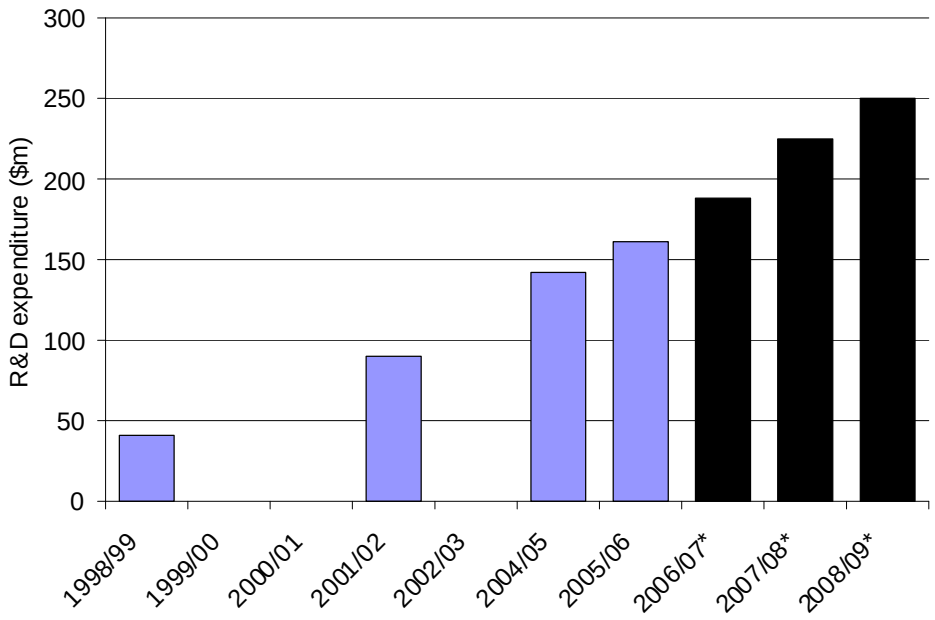
[3] When Ernst & Young presented their study on biotechnology in the Asia-Pacific region (Beyond Borders: Global Biotechnology Report 2006) they reported "*a scorching 46 percent increase in revenues*" to the sector. CSL was the only mention of Australia during their presentation. Source: Factiva.

[4] The direct contribution, CSL's Australian output and employment, amount to $366m, but CSL's activities stimulate a further $664m of output from other firms. This then generates 4,237 extra jobs, in excess of the 1,333 employed directly.

[5] CSL also has very successful R&D operations at its international sites. For example, there is a high quality R&D unit in Marburg, Germany, researching and developing coagulation products.

[6] CSL will receive a 7% royalty on Gardasil sales, which could amount to many hundreds of millions of dollars returned to CSL shareholders and the Australian economy over the life of the product.

Figure 2. CSL's global R&D expenditure (A$m)



*CSL forecasts

Our current and future R&D activities include extensive clinical trials of our influenza vaccine in the US in anticipation of entering the US influenza vaccine market, development of a vaccine against the H5N1 pandemic influenza virus, development of a manufacturing facility for our novel vaccine adjuvant, ISCOMATRIX®, which we expect to be used in a range of new generation human vaccines, developments of our portfolio of plasma derivatives such as a high concentration liquid immunoglobulin formulation designed for subcutaneous administration, and research into a number of novel therapies based on, amongst other technologies, monoclonal antibodies.

The costs, risks and returns from biotechnology innovation

Developing new biotechnology products targeted at unmet medical need is expensive and risky. When proper account is taken of the rate of failure and the long development cycle, typical costs of development range between US$800m and US$1,200m depending upon the nature of the product and the size of the market it serves.

Typical failure rates for a project might be 35% in phase 1, 29% in phase 2, 55% in phase 3, 20% at the registration phase and 10% at launch.[7] Compounded, these yield an overall success rate of between 5% and 15% depending upon the therapeutic area and the underlying pharmaceutical technology. The development costs at each stage, preclinical and then stage 1 through 3, typically increase by an order of magnitude. So a US$800m project

[7] For a description of the phases of development see the September 2006 AusBiotech submission

might cost $0.72m in preclinical, $7.2m in phase 1, $72m in phase 2 and $720m in phase 3 and beyond.

The returns from innovation are commensurate with the risks involved. Hence, the majority of the risks of development are incurred late in development, particularly in phase 3, and the bulk of the returns from successful products accrue to firms that undertake this late stage development. This is well illustrated with Merck's HPV vaccine against cervical cancer and genital warts, Gardasil: CSL developed the IP on which the vaccine is based, and licensed the IP to Merck who undertook the extensive and very costly late stage clinical trials. CSL receives a 7% royalty on all Gardasil sales, but Merck will probably realise at least 80% of the rent from the project.

Even now, it is doubtful whether CSL would choose to develop a product similar to an HPV vaccine entirely on its own. The sheer scale, duration, cost and risk of the phase 3 clinical trials dictate a development path in partnership with one of the very large pharmaceutical companies. But CSL has now reached a scale where we can invent, develop and commercialise some of our own products into world markets. Hence, CSL is planning to launch its influenza vaccine in the US in 2008 even though there are substantial clinical trial and launch costs. We are also in the process of launching the vaccine in Europe and in Asia.

Our ability to do so is a direct result of the strategy that CSL has chosen to adopt, acquiring the essential set of complementary assets:

- the financial resources to fund late stage R&D expenditure;
- global commercial operations capable of marketing a global product;
- integrated clinical and regulatory support functions, with Australia as a hub, that can support the product in international markets;
- the scientific skills to continue to develop and improve products; and
- the skills and facilities to manufacture products at both developmental and commercial scale.

Biotechnology firms seeking to commercialise their products from Australia, and to retain the bulk of the returns from doing so, will need to acquire a similar set of financial resources, skills and assets. Otherwise, their commercialisation path will have to be based on licensing or being acquired.

A Darwinian model of biotechnology

Biotechnology is a fiercely competitive market place. That competition manifests itself through competition for ideas, competition for skilled staff and competition for funding. It is also risky, so few ideas will turn into commercial products. The sector requires proliferation of ideas (which spring from basic and translational research), and a culling process that filters out the unsuccessful projects and funnels genuine prospects to the firms that can develop them.

The industry structure therefore comprises a large number of small firms, each of which is seeking to develop a few possibilities, often just one. Their business model is the single minded development of their IP, to the point at which it of value to the next firm in the chain, a firm that will be capable of the next stage of development. If the ideas they are working on fail, then the companies themselves fail. Even if their IP does prove to be of value, many will be swallowed up by larger firms. Our acquisition of Zenyth is an example of just this.

The fact that many companies will fail and that very few have a long-term future should not be seen as a sign of market failure or a signal for the government to intervene. This Darwinian model is efficient in that it gives the strongest possible incentives to develop IP, but is ruthless in cutting of funding when they are shown not to work. It allows scale economies to develop where they are important — in the costly later stages of clinical development and in commercialization — without lumbering the early stage with scale diseconomies. In our view, it would be unwise to base biotechnology innovation policy on the belief that these small firms can grow into profitable global biotechnology companies.

The successful intermediate and large pharmaceutical companies that can develop these early stage projects have to be 'intelligent receptors'. CSL is the only example in Australia at present, and is only mid-sized by international standards. Such firms clearly need the infrastructure to take products through to the market, but they also need high quality science that can make insightful judgements about the many prospects they will see. Very few small biotechnology companies will successfully grow to a global scale. The few that do will take 20 or more years to do so, and will likely make the transition on the back of one or two successful partnered projects that provide the financial resources to take on an increasing share of the development risks.

While very few such firms can be expected to develop in Australia, it is important that there are at least one or two that can operate on a global scale. There are substantial spillovers from the integration of basic research, a number of small biotechnology companies and one or more large biotech companies. The full social benefits of biotechnology innovation in Australia will not be realised if this structure does not emerge. The issue of spillovers is addressed in more detail below.

Lord Sainsbury, Minister for Science in the UK[8] identified the importance of biotechnology clusters to successful biotechnology innovation, and noted the presence of a large firm along side a strong science base (amongst other factors) as key components of a successful cluster. The evidence of biotechnology clusters in the US, such as Boston and San Diego, clearly supports this.

The larger firms, acting as 'intelligent receptors' can harness the value of biotechnology innovation.[9] Making the most of Australia's biotechnology innovation potential requires that

---

[8] See Biotechnology Clusters. 1999. Report of a team led by Lord Sainsbury, Minister for Science http://www.dti.gov.uk/files/file28706.pdf

[9] They also provide substantial benefits to the cluster. For example, large firms tend to be source of skilled staff to the broader community (including not just other firms, but also regulators and similar agencies).

these firms find Australia an attractive centre for their development activities. This is not currently the case. To understand why, it is necessary to understand the factors that influence the R&D decisions of such firms.

The inter-relationship between R&D, head office and manufacturing

The R&D portfolio is the key strategic asset for a mid to large scale biotechnology firm. Accordingly, there are compelling commercial reasons for co-locating head office and R&D. Hence, CSL has chosen to locate its headquarters at Parkville along side its main R&D centre.

For protein based biotechnology firms, it also helps to locate R&D close to manufacturing facilities. A substantial component of the late stage development effort relates to optimising yield and scaling up from research to commercial scale. Regulatory and medical support are also critical for to the development of those products. These are challenging activities which benefit from a close collaboration between manufacturing and R&D.

CSL implements this model in Australia, combining manufacturing experience across two close integrated sites (Parkville and Broadmeadow), and employing more than 1,300 staff of which 16% are dedicated to R&D.

Home market bias in R&D

CSL's commitment to R&D in Australia conforms to a well-established fact that even companies that are highly internationalised display a degree of 'home market bias' in their R&D decisions, for example by locating R&D close to corporate headquarters. This reflects several factors.

Unique knowledge of, and ability to exploit, innovation-related skills in its home market may be a source of competitive advantage, for example, because of long-standing ties to research establishments and key researchers.

Once a company has such an accumulated advantage, it tends to be self-perpetuating. This is because the company can use its local connections to be a more efficient "picker" of winners than could other firms: for example, it will have the local knowledge needed to identify promising researchers or promising lines of research.

This can create a virtuous circle, in which local scientific efforts are encouraged by the availability of a firm that can readily spot promising work and assist in taking it to late stage development. At the same time, with a richer pool of local scientific and technological opportunity, the global firm's worldwide competitiveness is enhanced, and hence its ability to sustain the costs and risks of late stage development. These are important spillover effects.

Spillovers

At its heart, the Commission presents the view that government support for research is desirable there will be too little investment[10] by the private sector as a result of market failures. One of the central market failure identified by the Commission is the existence of spillovers, whereby third parties benefit from private investment in innovation, but the innovator cannot capture these benefits in the form of a contribution to the return on investment.

We concur with the Commission that the existence of spillovers from expenditure in innovation results in socially inefficient levels of investment, and that government support is required to offset this effect.

Spillover effects in network industries

Network industries provide some of the best and easiest to understand examples of spillovers.

Take the example of credit cards. A credit card is useless if there are no retailers willing to accept it. And retailers are unwilling to support a credit card unless there are enough cards in circulation to justify the expense. Adding a new retailer to the card network makes a credit card more valuable (because it can be used in more places). Adding a new card holder increases the value to the retailer of supporting the card (because it attracts more customers).

Both effects are spillovers. Until card coverage becomes near universal (both for retailers and customers), some form of transfer payment between retailers and customers is needed to secure socially efficient network expansion.

There are substantial spillovers from R&D in the biotechnology sector. For example, CSL has between 50 and 100 active collaborations with universities and research institutes in Australia. These collaborations foster active research projects, provide excellent training grounds for scientists involved in basic research, and generally foster vibrant and effective basic research.

Few, if any, of these collaborations will lead directly to a finished commercial product — a simple reflection of the technical risks. CSL certainly cannot capture (in the form of returns to shareholders) the broad range of benefits that accrue to the universities and institutions, nor to the researchers working on the projects. The benefit to CSL comes in the form of extensive contact with the basic research which provides us with insight, but that is only a fraction of the overall gains to the community.

By way of example, CSL has decided to lease space for 50 scientists in the Bio21 Institute attached to Melbourne University. Bio21 offers excellent value to CSL, but other tenants at the Institute will benefit from working alongside CSL scientists.

The reason why biotechnology clusters are productive is that they provide an environment in which these types of relationships, and the spillovers they develop, can emerge.

We believe that maximising the social gains from Australia's investment in basic science requires a complementary set of firms capable of developing that science into commercial

[10] An inefficiently low level of investment from a societal perspective.

products (in the same way that credit card networks work best when the number of card holders and the number of retailers are complementary). When linked to Australia's basic research engine, these firms create substantial spillovers which they cannot capture. In the absence of government support they will remain absent or sub-scale, and fail to deliver the full social benefits that the innovation economy can deliver.

Additionality

The Commission states that government support for business R&D should result in more R&D, the 'additionality' criterion. It should not be directed at R&D that efficient firms would undertake anyway. *CSL concurs: government support that does not result in increased R&D is unlikely to deliver social benefits.*

CSL's own experience is that R&D expenditure falls into two broad categories, non-discretionary and discretionary. Firms in most markets have to undertake at least some level of R&D simply to compete and prosper in product markets — the non-discretionary component. In contrast, firms can and do change the level of expenditure on discretionary R&D, that which is generally directed at higher risk and new products. CSL's further divides its own R&D into three categories: life cycle management, market development and new product development:

- **life cycle management** R&D is essential to maintaining biopharmaceutical product sales. It includes activities ranging from ongoing clinical and regulatory support (e.g. maintaining product registrations, dealing with adverse event reports, labelling requirements) to changes in product formulation, storage and administration aimed at making the product more attractive to patients and clinicians;

- **market development** R&D is essential for increasing the sales of existing products. It primarily involves expanding the indications for which a product can be used where there is already clinical evidence of efficacy, and selling existing products into new geographical markets; and

- **new product development** R&D involves researching new products that target unmet medical needs. This entails very high risks of failure (technical risk) because the research and development is at the borders of existing scientific knowledge.[11]

The first two categories are both non-discretionary and relatively low risk: all companies that sell products have to undertake similar activities to ensure that they remain profitable.[12] The third category is discretionary. Our anticipated expenditure on each category is shown

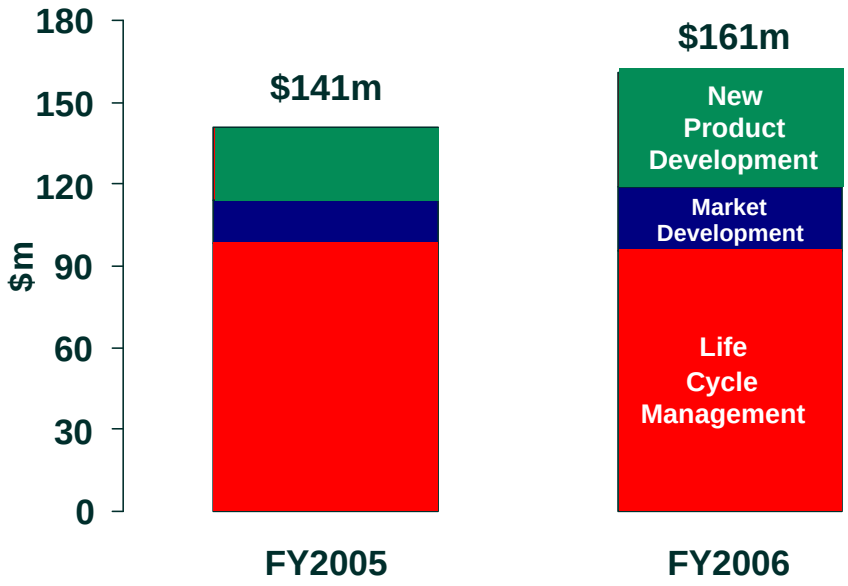
---

[11] The distinction is not hard and fast. For example, CSL is investigating whether Zemaira (its α1PI product) can be used to treat cystic fibrosis. While this could be seen as expanding indications, the project has substantial technical risk because Zemaira is not currently used in cystic fibrosis, because it will involve a new mode of administration, and because the science is challenging. As a result, we treat his project as new product development.

[12] As a broad 'rule of thumb' we believe that firms in our sector need to spend around 3% of revenues on life cycle management and market development just to sustain their business.

in Figure 3. CSL could, it if chose, divert the resources dedicated to new product development into, for example, acquisition or expansion of existing manufacturing capacity.

Figure 3. R&D expenditure by type in 2005 and 2006



For successful firms, there is a level of R&D that should not be affected by government support. The level will vary across firms and sectors. Our life cycle management and market development R&D are largely unaffected by the level of government support.[13] Public support for this type of R&D is not likely to deliver large social gains. Indeed, public support for this type of R&D could have the unintended consequence of supporting firms that are inefficient — i.e. it could result in net social losses.

In contrast, public support for science and innovation that is targeted at this discretionary expenditure on truly innovative high risk R&D is most likely to deliver the 'additionality' outcome that the Commission has put forward.

High risk product development

Larger firms exercise considerable control over the level of their high risk R&D expenditure aimed at new products. The size and extent of a firms' innovation portfolio is generally a strategic issue evaluated along side other strategic options such as mergers and acquisitions and major capital investments. The key consideration in such strategic decisions is the extent

[13] In the longer term, firms that have a choice over where to locate manufacturing may change the location of their non-discretionary R&D in response to public support. Hence, for example, Ireland is a favourable manufacturing base due to the low corporate tax rate, and is therefore a sensible base for life-cycle management R&D associated with those products.

to which a firm withholds current returns from shareholders in return for the prospect of greater but less certain future returns.

Expected future return is a key consideration. Many factors impinge on this assessment beyond the characteristics of the individual projects. For example, the franking of dividends in Australia increases the incentives to shift R&D offshore. And in the current private equity climate, the trade-off between immediate returns and long-term returns is becoming increasingly stark.

This trade-off is clearly affected by the extent and nature of government support. CSL would increase its own high risk R&D if the level of government support were to increase. So from our perspective, government support for business innovation satisfies the *additionality* criterion. Indeed, we suspect that the multiplier effect from government support — the amount of extra R&D engendered by a one dollar of government support — increases with the underlying riskiness of the R&D.

The unique challenges of biotechnology

Research and development in pharmaceutical biotechnology is uniquely risky. The likelihood of successfully developing a product from proof of concept through to the market is typically between 5% and 15%, and even then the product may not be a commercial success.

The risks are so high because of the nature of the development process. The regulatory standard are exacting, to be sure, but the real difficulty lies in the nature of the development process itself: because biological systems are so complex, developing new products generally involves exploring new science. As Gary Pisano* puts it pharmaceutical biotech is "science as a business"

**Pisano G (2006), Science business, the promise, the reality and the future of biotech. Harvard Business Press*

A recent example at CSL illustrates the case well. The rising threat of an influenza pandemic indicated that a pandemic vaccine would be an invaluable for public health. CSL is a world leader in influenza vaccine. Even so, the extreme technical and commercial risks associated with developing such a vaccine were a formidable deterrent. The Australian government stepped in with direct funding of part of the clinical development program which enabled CSL to proceed.

We concur with the Commission that the 'additionality' is an important outcome from government support of innovation and science directed at business. CSL's own experience is that government support for biotechnology does result in significant additional R&D.

That said, CSL has two concerns over the notion of additionality which the Commission may wish to address:

- it is difficult to unambiguously differentiate the two forms of R&D — discretionary and non-discretionary, and therefore to structure a system of government support that preferentially targets truly additional expenditure. We would be concerned if, in trying to design such a system, the government sought to intrude into the details of the R&D that is undertaken; and

- it is difficult to construct a system that does not result in perverse incentives, an issue we touch upon later in the submission. As a result, the precise details of the scheme are of great importance.

Other sources of market failure

R&D spillovers are a form of market failure. As such, they are likely to result in socially inefficient underinvestment in innovation. There are other market failures that are relevant to science and innovation support.

Capital market failures

The development cycle for innovation, particularly in medical biotechnology, is long and fraught with risk. This has always been the case. As a result, until the 1970s, pharmaceutical R&D was solely done by vertically integrated large firms that could manage the risks across the whole development path, and there was almost no market entry.

Since that time, a complex architecture has emerged to allow the development path to be segmented, a process that has involved the monetisation of intellectual property. Consequently, a large and sophisticated system involving basic science, patents, small, medium and large companies and the capital markets has emerged to support biotechnology development. The system is most advanced in the US. Hence for example, the development of a new idea emerging from basic science might go through a grant funded stage, patenting, transition into a small company supported by FFF[14] investors, angel investors,[15] venture capital and then through later stage development supported by either a public offering (generally on the back of partnership with a larger firm) or through acquisition.

Australia has made considerable progress in developing similar structures over the last decade, particularly with the emergence of biotechnology venture capital funds. State governments have been instrumental in kick starting this venture capital infrastructure through initiative such as the Queensland Biocapital Fund.[16] None the less, Australian capital markets, particularly at the very early FFF and angel fund levels which fund projects before they are of interest to venture capital, are noticeably less vibrant than in the US.

---

[14] The three Fs, "friends, family and fools"

[15] Wikipedia describes an angel investor thus: an angel investor (business angel in Europe, or simply angel) is an affluent individual who provides capital for a business start-up, usually in exchange for ownership equity. Unlike venture capitalists, angels typically do not manage the pooled money of others in a professionally-managed fund. However, angel investors often organize themselves into angel networks or angel groups to share research and pool their own investment capital.

Angel capital fills the gap in start-up financing between FFF and venture capital. While it is usually difficult to raise more than $100,000 - $200,000 from friends and family, most venture capital funds will not consider investments under $1 - 2 million. Thus, angel investment is a common second round of financing for high-growth start-ups, and accounts in total for more money invested annually than all venture capital funds combined ($24 billion vs. $22 billion in the US in 2004, according the University of New Hampshire's Center for Venture Research).

[16] A $100 million biotechnology-specific venture capital fund that aims to establish globally enduring bio-businesses, owned by the Queensland Government.

It is important that the few commercial prospects that arise from basic research are taken forward. That is, there must be an effective transition from public to private funding for ideas that merit further development. Venture capital usually requires a 'proof of concept' model before committing funds. There is a substantial amount of applied research involved in taking the product of basic research to proof of concept — a process sometimes referred to as 'translational' research — and making the transition from public to private funding. The research and biotechnology community identifies this as one of the problem areas in biotechnology innovation in Australia (and no doubt the lack of FFF and angel funding contributes to this).

The problem has been tackled in other markets through a variety of mechanisms. Proof of concept funds (of which there are a number of examples) explicitly target this stage of development. The funds may supply true grant funding, or may supply refundable grants which are repaid if and when the project achieves some commercial success.

Consideration should be given to these types of mezzanine funding models,[17] but we should be cautious if this results in further proliferation of small single project biotechnology start-ups lacking the rigorous science that is a prerequisite for successful further development.

Biotechnology innovation is risky and difficult. It is therefore important that potential projects are screened to weed out poor science and poor commercial prospects. The process of securing translational funding may be an important screening step.

CRCs

In 1990 Australia established Cooperative Research Centres (CRCs) which establish links between researches and potential users of that research. $11bn of funds have been committed to CRCs since that time. There are 8 CRCs in medical science and technology. CSL was a partner in the Vaccine Technology CRC, and continues as a partner in the Oral Health Science CRC. CSL believes that this is a valuable program that has helped bridge the gap between basic science and the first stages of market driven commercialisation.

We do not see lack of translational funding as a impediment to our own growth, or as an impediment to the emergence of commercial opportunities from Australian science. We accept that CSL may be unusual in this regard, a reflection of our extensive but informal links with basic research — in the nature of scientist to scientist dialogue — and our experience as a member of several CRCs.

[17] Or alternatively, perhaps, a small proportion of funds currently allocated by the ARC and NHMRC might be directed at translation research. Projects could be screened by a panel with a mix of scientific and commercial experience, and funding might be staged to reflect identifiable stages in the translational process.

The government's role in procuring health services

Australian governments are, essentially, monopsony buyers of health services in Australia. There are compelling public policy grounds for minimising the costs of health care through government procurement or provision. But there are inevitably some adverse consequences. In the case of pharmaceuticals, governments exert downward pressure on pharmaceutical pricing through the Pharmaceutical Benefits Scheme (PBS) and the Pharmaceutical Benefits Pricing Authority (PBPA).[18] CSL sells products that are subject to the PBS.

The importance of the US market

It is not possible to review biotechnology innovation in Australia without recognising the importance of the US pharmaceutical market. The US market is huge, representing 33% of the US$550bn global market in 2004, and does not regulate the prices of medicines in general and innovative medicines in particular. As a result, any biotechnology firm located in Australia must develop their products with an eye on the US. This necessitates that late-stage clinical trials — the most expensive and risky stage in development — will have to be directed at the US.

As the Commission notes, it is not sensible to use government support to seek to overcome Australia's geographical disadvantages. But it is important to consider whether other impediments, such as downward pressure on pharmaceutical pricing, exacerbate the geographical challenge that Australian biotechnology firms already face.

CSL also sells products outside the scope of the PBS, most notably plasma products, influenza vaccine and pandemic influenza coverage. The prices for these products are determined through competitive tender (in the case of influenza vaccine) and by direct negotiation. In both cases, CSL has faced downward pressure on prices. One of the notable features of our most recent annual results was the contrast between the growth within and without Australia. Sales at CSL Behring grew 11% in 2005 whereas sales from Australian operations fell by 2½%.

Australia remains an important market for CSL. We are unique for a pharmaceutical company in securing 16% of our revenues from Australia. Our head office and R&D are located in Australia, in contrast to our international competitors. But further downward pressure on local prices will inevitably make Australia a less attractive hub for CSL. Given the current environment, it is hard to see how smaller firms without CSL's presence would find Australia an attractive location for late stage development and commercialisation.

The government monopsony reduces the attractiveness of developing innovative medicines in Australia. In a more benign environment, biopharmaceuticals might be developed for the Australian market as a stepping stone to the global (particularly the US) market.

[18] As a case in point, as a result of the PBS, Gardasil will be made available in Australia at a considerable discount to the US price.

The Commonwealth Government recognised that the PBS would have a detrimental impact on pharmaceutical industry development in Australia, and in 1987 established the Factor f scheme which:

> *[I]s designed to compensate companies for the effects of low prices of pharmaceuticals supplied under the Pharmaceutical Benefits Scheme (PBS). In return for higher notional prices on some of their PBS products, companies are required to increase their research and development (R&D) expenditure, as well as their domestic manufacturing and export activity in Australia.*[19]

And as CSL noted in 1996

> *... it is important to recall the origin of the Factor f scheme and place its objectives into context…The Factor f scheme was, and remains, a pragmatic initiative to partly counter the negative impact on the pharmaceutical industry of Government health and welfare policies, particularly the subsidy of medicines to consumers through the exercise of its monopsony power over pharmaceutical pricing.*[20]

One of the attractive features of Factor f was that it effectively targeted the firms that would be most likely to be able to take innovative products through to the market.

R&D support through a universal flat rate tax concession does not address this problem well. To the extent that R&D projects merit government support, a generalised tax concession for R&D will likely be set on the basis of the average R&D project across the economy. The object of the concession would be to get projects that develop spillovers 'over the line.' However, that average project does not face monopsony buyers, and hence is likely to have a greater capacity to fund its own fixed costs than is a project whose buyer has monopsony power. As a result, the implied contribution to fixed costs that would be needed to make such an average project viable is less — potentially much less — than that required given monopsony conditions downstream.

That is, the efficient subsidy should close the gap between the social return on an R&D project and the private return on that project. The greater the market power of the buyer, the greater that gap is likely to be. As a result, where innovators face monopsony buyers, the allowed subsidy rate should, all else equal, be higher.

A similar situation arises in the defence industry. This is overcome by either directly funding R&D (as is done under the post-Kinnaird reforms, through funded studies to clarify costs and reduce development risks) or through cost-plus contracts. However, the more diffuse

---

[19] Industry Commission (1996) *The Pharmaceutical Industry* Australian Government Publishing Service, Melbourne. The report goes on to say that "S*ince the inception of the Factor F scheme in 1988, companies have committed $1.9 billion in export value added, $1.9 billion in domestic value added, and $538 million on R&D expenditure. In addition, they have undertaken $604 million of investment expenditure. The Government has allocated approximately $1 billion in funding.*"

[20] *ibid*

nature of the biotechnology sector and its R&D projects means that direct procurement can probably only play a small role.[21]

Provision of basic science

Australia is at the world forefront in a number of areas of research in biological and human health research including, for example, the inflammatory cytokine pathway work undertaken at WEHI and the Ludwig Institute. This expertise has developed in part as a result of State and Commonwealth Government funding of basic science through the university system and a number of research institutes. Government expenditure targeted at basic science is, in our view, highly productive and should remain a priority.

The primary value of basic research derives not from the commercial value of individual projects, but from the foundations it lays for future research. Crick and Watson's discovery of the structure of DNA was not of any immediate commercial value. But 50 years of basic research building first on their discovery, and in turn on successive rounds of new discoveries, has bought us the human genome project and the potential of valuable gene therapy products that could ease the burden on the sick.

To use the language of the Commission, basic science gives rise to substantial spillovers, which can be intergenerational in nature. Accordingly, basic science is likely to be under-supplied in the absence of government support.

Scientists working in this environment cannot be motivated by earning commercial returns from their discoveries because they rarely have any. Instead, they appear to be motivated through a reputation model based on the quality of work that they do. That quality is determined through publication, citation and peer review. One of the challenges that CSL faces is providing a working environment for its research scientists that supports rigorous and cost effective R&D, but which offers some of the attractive features of a university science environment (such as freedom to publish and a degree of latitude over the direction of research). We see continued links to basic research as an important in sustaining a stimulating working environment.

It is important that this model of basic science continues to operate. The alternative model, in which research is based on some immediate notion of commercial value, would have to remunerate scientists on the basis of the apparent commercial value of their work and would, as a result, remove these immensely valuable spillover effects. There has been an increasing push for universities and research institutes to earn a greater share of their revenues from commercial activities, including from any intellectual property that they may develop through their basic research. There is a risk that this could harm basic research in Australia.

---

[21] A good example of direct procurement working well is the Commonwealth grant to CSL for the clinical development of a pandemic influenza vaccine. But pandemic vaccine is a public health product that protects against an unpredictable and infrequent event. As such, it would probably not be produced if governments were not involved.

*CSL therefore endorses the Commission's caution over increasing the proportion of funding universities and research institutes secure through commercialisation of their research. Rather, we believe that increased **government** funding of basic research would deliver significant social benefits.*

CSL relies upon the Australian university system for its skilled scientists. On this additional basis, CSL would welcome further funding of university science and technology that resulted in more high qualified scientists entering the work force. We also believe that Australia benefits from Australian trained scientists working in overseas markets, most notably the US. Most Australian scientists that work overseas choose to return to Australia at some stage in their career (often for family or lifestyle reasons), and return better trained and with valuable experience. Our Chief Scientist is one such example, having worked at Genentech for a number of years before returning to CSL. In a similar way, but on a smaller scale, CSL trained scientists disseminate across the industry in Australia.

Although basic research should remain largely government funded, and commercial development should remain private, there are considerable benefits from close links between the scientists working in the two sectors. From an Australian perspective, close links will make it more likely that an Australian company will develop an idea from Australian basic research. And from a broader perspective, the two sectors can learn from each other. Thus, there is considerable merit in developing one or two biotechnology hubs in Australia, where academic, small and large commercial players are in close proximity and can interact. Government funding is pivotal in developing such hubs.

Current government incentive schemes for R&D

Further government support would increase the amount of innovative R&D that we undertake. This additional R&D would, we believe, have important spillovers to the wider science and biotechnology sector. Further support would help to offset some of the impediments to undertaking high risk R&D in Australia, particularly those faced by larger pharmaceutical firms.

The current incentive schemes do not compensate for the some of the unattractive features of the local market, and therefore do not encourage firms to base the high cost, high return, high risk stages of product development in Australia. The Australian market discourages 'intelligent receptors'. Without these, the better ideas that emerge from early stage development will be lost to Australia, as will the substantial spillovers from having world scale pharmaceutical companies that centre their operations in Australia.

CSL currently participates in four government funded innovation incentive schemes: the 125% tax concession on Australian R&D, the 175% concession on incremental R&D,[22] the P3 scheme (the successor to PIIP and Factor f) and the CRC scheme. The benefits we gain from the CRC scheme have already been mentioned, and it is hard to place a monetary value on them. The benefits from the tax concession and P3 are easier to quantify.

[22] Under limited circumstances this credit can be extended to a small proportion of offshore R&D expenditure.

We estimate that the tax concession is worth approximately $5m a year to CSL when compared to a total R&D budget in 2005 of $161m. This does not take account of the costs involved in administering the system.

The P3 scheme typically contributes less than $1m to CSL. Furthermore, it is complex and time-consuming to administer,[23] and results in a clawback of the R&D tax concession. It is poorly suited to profitable biotechnology companies involved in more costly and risky late stage development. As a grant based incentive scheme, it is more obviously of benefit to small biotechnology firms starting from a low initial level of R&D expenditure who do not expect to make profits.

CSL believes that these are small sums set against the broader contribution that CSL's R&D effort makes to the biotechnology sector, little of which we can directly recoup. They do little to encourage CSL to place more R&D in Australia when we have a choice over where it is done.

Improving the system

Australia is somewhat unusual in not setting a specific percentage target for the R&D intensity of the economy. We feel such targets are likely to be counterproductive since effective R&D by the business sector cannot be driven by national targets, but has to be driven by the imperatives of the market. Where government can be of great importance is in overcoming externalities (such as spillovers) that would otherwise lead to inefficiently low levels of investment.

The Commission presents a comparison of Australia's R&D performance against its OECD counterparts. Australia, broadly speaking, sits somewhere in the middle. CSL's view is that Australia's is seeking (and should seek) to establish an education and basic research environment that is towards the top end of the OECD spectrum. Developing a complementary business sector that can derive value from it and also contribute to its development is equally important. On that basis, perhaps we should assess the benefits of greater government support sufficient to move Australia up the OECD rankings, to the extent that this generates identifiable spillovers.

CSL's view is that there would be substantial economic benefits from increasing government support of high risk, long duration R&D of the type undertaken by CSL and by a number of the larger Australian biotechnology companies. This would undoubtedly increase the quantum of such R&D and would result in benefits to basic science and the broader biotechnology sector.

As a general matter, incentive schemes that operate through the tax system will be more effective in encouraging the high value late stage development in Australia, simply because such late stage development is the province of profitable companies. Schemes such as P3 are of little help in this regard. We recognise that many firms in the biotechnology sector do not make significant profits, so some consideration should be given to allowing firms to

[23] For example, it took some years to agree a formula for the P3 related claw back of the R&D tax concession.

monetise the *incentive* component of the tax concession, i.e. converting the concessional element into a tax credit.[24] A tax credit would, in effect, amount to a direct subsidy. Given the Commission's concerns over the existing 125% concession, a 25% tax credit would appear to be somewhat untargeted: it might be appropriate to confine the tax credit to firms that would otherwise be eligible for the incremental (i.e. 175%) tax concession.

According to the Commission, a little under half of the government support for business innovation is delivered through the tax concession. CSL believes that increasing this proportion would deliver social benefits. The Commission also expressed some doubt as to whether the 125% tax concession delivered net social gains (i.e. spillovers and additionality). They were particularly concerned that it 'subsidised' R&D that would take place without the concession. It is certainly our experience that efficient firms face a minimum level of non-discretionary R&D expenditure, consistent with the Commission's view. But we accept that this will vary across firms, and there are undoubtedly some efficient firms that do undertake additional R&D on the back of the 125% concession.

Notwithstanding this, there are grounds for rebalancing the tax concession towards a higher concession rate on truly additional R&D, R&D that is most likely to be innovative in nature. Unfortunately, the current 175% increment tax concession can only reward firms that exponentially increase their R&D expenditure and have development lifecycles as short as a few years. This is an unrealistic base for any firm's innovation strategy, and perhaps explains why the 175% concession represents less that a quarter of the government assistance through tax.[25] If the higher rate concession is to deliver social benefits, it must lock in the higher rate for longer periods that reflect realistic project development timescales.

The Commission should also give consideration to extending the quantum of overseas R&D expenditure that is eligible for the concession. At present overseas expenditure of up to 10% of project costs is eligible, provided it can be demonstrated that the work cannot be done in Australia. Pharmaceuticals registered in the US — the most important international market by value — require costly US clinical trials. Recognition of this would enhance the prospects of maintaining the development and manufacturing phases of new drugs in Australia.

The Commission recognises this, and suggests several metrics that could be used as a base above which the incremental tax concession would apply. One suggested metric is a fixed share of Australian sales. The Commission might also consider extending the duration of the rolling average base from its current very short duration of three years to, perhaps, ten years. We suspect that an extended incremental tax concession would preferentially assist firms involved in long-term high risk discretionary R&D. Most medical science companies are of this type. As a result, a well designed incremental concession would be effective in offsetting some of the difficulties that arise from government health procurement policies.

---

[24] That is, a loss making firm that receives a 125% tax concession on R&D should be able to monetise the 25% i.e. convert the concession into a tax credit. Monetising a greater proportion of tax losses (in the presence of well functioning capital markets) risks subsidising inefficient firms.

[25] The short base period may also result in perverse behaviour. It will encourage firms to sculpt their R&D into short 3 year bouts of activity followed by similar periods of inactivity.

Conclusions

In summary, CSL broadly welcomes the Commission's Draft Research Report as a valuable contribution to science and innovation policy. We believe that there are grounds for increasing the level of government support, particularly to ensure a complementarity between basic research and the business sector.

In respect of basic research, we concur with the Commission's cautious approach to increasing funding from commercialisation, as we are concerned that this could undermine its effectiveness. We also believe that increased funding for basic research would deliver social benefits.

The Commission suggests that government support of business should result in spillovers and additionality. These are sound principles for such support. CSL believes that there are substantial spillovers from business R&D, particularly from the high risk long-term innovative R&D that is fundamental to the biotechnology sector.

There are impediments to undertaking R&D in the medical biotechnology sector in Australia. CSL believes that additional government support would help to overcome these, and stimulate CSL to increase it Australian R&D expenditure aimed at innovative products.

The Commission suggests that more emphasis is placed on the 175% tax concession. If the incremental concession stays in its current form, this would not deliver social benefits. However, if the higher rate concession is more closely aligned to the actual development cycle for innovative biotechnology products, the change in emphasis would be a significant improvement. There would also be benefits if the larger non-profitable biotechnology firms could monetise the concession component.