

## **Australia - a knowledge future?**

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Firstly, I'd like to thank Geoff for inviting me this morning.

As I am sure the audience will appreciate, Australia presently faces challenging economic times. After more than a decade of dependence on the investment phase of the mining boom, slowing Chinese growth and declining resources prices have ended what economist Ross Garnaut termed Australia's "salad days".

A period of budget surplus, repeated tax cuts and increasing middle-class welfare. A period where the high Australian dollar, high labour costs and declining productivity has cut a swathe through Australian manufacturing. After a 2014-15 Federal budget deficit of \$41bn the deficit for 2015-16 is forecast to be around \$35bn. Based on the figures we hear from both political parties, the budget will return to surplus around 2020.

However, does any thinking person actually believe such projections?

Commentators have pointed out that such projections are predicated on the economy returning to trend GDP growth of 3.5 per cent. I'm sorry, but noting what is happening around the world, that is simply a fantasy.

Seven of the last eight years have seen GDP growth below that figure. It is hard to see revenue growth being able to meet increased demand for spending in the foreseeable future.

Ross Garnaut in his book "Dog Days" raises similar concerns and focusses on the need for Australia to significantly enhance productivity if we are to maintain living standards close to what we are used to. Of course, economists trade on pessimism.

As a non-economist I find it interesting that the public debate about solving these budget challenges seem to focus largely on narrow monetary solutions – tax changes and fiscal restraint. What about developing industries which actually generate wealth? When we do look at our industrial base, it tends largely be a look in the rear view mirror – enhancing our coal, minerals, education and agricultural exports. Of course these traditional industries are

important, and they will remain important for many years to come. But all have their challenges and there are few nations we would want to compare ourselves with which would build their economy on such a mix.

So what should Australia's economy be built on if we want an affluent, egalitarian, socially cohesive modern society? Perhaps it would be good to look for exemplars in the major economic powers of North America and Europe – namely the United States and Germany. To this group one could also add smaller economies such as Scandinavia and Canada and emerging economies such as China. However, for simplicity let's look just at the US and Germany.

These are industrialised countries and much of their wealth has been built on high technology manufacturing. Moreover, they have been able to manufacture sought after exports in societies with a relatively high cost base (certainly in Germany). Here, technology is key to success.

It is telling to look at the investments made by these countries and compare these with Australia. Germany and the United States have a Gross Expenditure on Research and Development (GERD) of 2.85% and 2.73% of GDP respectively, considerably larger than the official 2.13% for Australia.

More telling is where this expenditure occurs. Gross R&D expenditure occurs in a number of places – government, universities, industry etc. The Business Expenditure on R&D (BERD) in the United States is 1.98%, Germany – 1.93% and Australia – 1.24% of GDP. That is Australia spends only about 60% as much in industry on R&D.

We see the same trend if we look at the number of PhD qualified people working in industry – Germany 20 per 1000, United States – 11 per 1000, Australia only 8 per 1000.

These numbers should not be news to anyone. It is well publicised that interaction between industry and universities in Australia is poor. In fact we rank last (33 out of 33 countries) in the OECD. This does not bode well if we are hoping that high value-add technology based industries may help address our looming budget challenges. I'll come back to the reasons for this a little later.

The flip side for these numbers is the research expenditure in universities and government, and here Australia does better – Germany – 0.95%, United States – 0.75%, Australia –

0.88% of GDP. The numbers are comparable and we often comment on the fact that our universities rank well internationally and that we “punch above our weight” in research.

The previous Chief Scientist, Ian Chubb has however given us reason to temper our enthusiasm. The Office of the Chief Scientist has analysed scientific publication data. They look at both measures of publication volume – publications per capita and measures of publication quality – citations per publication or citation rate. Both of these numbers are above the world average. Hence, the comment that we “punch above our weight”. However, as Professor Chubb points out, it would be worth considering who is in your weight class.

The world average is biased low because of the many emerging nations, particularly in Asia. Our citation rate is in fact, below the European average – Germany, Norway, Belgium, Canada, Finland, Great Britain, Sweden, Denmark, Switzerland and particularly the United States all rank above Australia. Our volume of publications is fine, but there is a question over the quality.

Results of the 2012 Excellence in Research Australia (ERA) assessment provide greater insight into these numbers, as they are based on largely the same data used by the Chief Scientist. The ERA analysis shows that 70% of the research areas ranked 4 (above world average) or 5 well above world average are concentrated in just 8 of our 39 universities – the Group of Eight. That is, there is excellent research conducted in Australia but there is also a considerable tail.

In a sense, this outcome is not surprising when we consider how Australia funds research across our universities. My estimate is that each year, the Federal Government spends about \$5.5b on research in our universities. This number is made up of about 0.9B for each of ARC and NHMRC, \$1.77b for Research Block Grants and finally (and perhaps controversially) \$1.95b which is the cross-subsidy from teaching revenue to research.

This cross-subsidy has been widely discussed as part of the fee-deregulation debate over the last couple of years. I have calculated it by assuming 30% of Commonwealth Grant Scheme (CGS) funding, supplied by the Commonwealth on a per student basis is used for research. Clearly, this figure can be debated, but it is the number arrived at by the Dewar Committee established by the Commonwealth to advise on some of the elements of the fee-deregulation package.

The issue here is that, much of our research funding is not distributed based on demonstrable research quality. Rather, it is distributed on the basis of research volume or on the number of undergraduate students, which is not directly related to research at all.

ARC and NHMRC grants are peer reviewed through a rigorous process. I believe this is of the highest quality and allocates project funding to areas and researchers of world quality. However, much of the research block grants are distributed on volume measures – number of publications, number of Higher Degree Students and the rate at which they complete, volume of research dollar income. Admittedly, this will change somewhat in the future.

The advent of ERA and the Sustainable Research Excellence (SRE) funding it drives, were intended to address these issues. However, SRE was cut or delayed three times over the last few years and now phased out completely.

My concern is that we don't target our research investment in areas of demonstrable excellence and hence our average research performance trails our national peers – certainly the US and Germany that I used as comparators.

So what do these nations do? Starting in 2005, Germany commenced its Excellence Initiative. A total of \$5.3B is being invested in three rounds to enhance research at German universities. This funding has been quite concentrated. In the final round, 11 Universities of Excellence were selected for focused funding.

This funding was awarded based on clear plans for growth and excellence. Germany also has a tradition of defining disciplines of importance, often in its core advanced manufacturing areas for focussed differential funding.

The US system is quite different with both Government and philanthropic funding playing a significant role in supporting university research. Unlike Australia, US competitive grants include full on costs. These costs are allocated as part of the grant, rather than indirectly through block grants. This means that there is greater research funding concentration than in Australia.

Philanthropic funding also tends to be concentrated in the top US institutions. One might feel that Harvard and Stanford already have endowments which are sufficiently large. However, this does not stop their alumni continuing to give to their respective alma mater. People like to invest in demonstrable strength.

Other countries have followed similar research concentration strategies. For instance China with its 211 and 985 strategies to build a relatively small group of elite universities and the United Kingdom which, through its repeated Research Excellence processes have concentrated research funding in a selective group of institutions.

One has to ask if Australia's more egalitarian approaches represents good use of scarce research funding and whether it yields the country the best outcomes? The data would question whether it does.

But let me come back to the main theme of this talk, it is not about funding research excellence but building economic prosperity for Australia. My argument is however, that to do that, to build the high technology industries Australia needs to remain an affluent nation in the face of the almost certain decline of our traditional industries, firstly requires world-leading basic research.

Great basic research may be a pre-cursor to industrial affluence but by itself it is not enough. Of course, what is required to kick-start innovation in Australia has been debated for many years. Commonly, it is seen as a problem of our universities.

We do great research, but we can't collaborate with industry. As I have just discussed, perhaps our basic research is not as great as we often claim. What about collaboration with industry? The data is clear, our collaboration with industry is poor – but why?

I obviously welcome the push by the present PM for an innovative nation. However, the solution to make this happen is all aimed at changing university behaviour. It seems that the solution is to tweak block grant funding formulas and the problem will be solved. If only it were that simple!

We commonly hear that the incentive structures in our universities don't support industry-relevant research. That we value peer-reviewed basic research, national competitive grants, ERA assessments and hence our promotion and reward structures drive our staff and institutions accordingly.

Although I agree that Australian universities can do much more in enhancing our industry interaction and providing the appropriate incentives, I am not convinced the answer is so simple.

I have worked in institutions in both Germany and the US. Although there are differences with the Australian system, I do not believe the basic drivers and incentives are fundamentally different. I am convinced that incentive structures are not the whole answer and changing things like the formulas which drive block grant allocations will have little impact.

Let's look for a moment at the industries with which Australian universities might interact. The European Union Industrial Scorecard lists the R&D investment by companies around the world. Based on the 2012 scorecard, Toyota has the largest R&D spend at \$11.7b.

Australia has only 9 companies in the top 1000. Telstra is the highest ranked Australian company at 125 in the world with a spend of \$1.2b. After this, the magnitude of the R&D spend trails away quickly.

The reality is that even if Australian universities are keen to collaborate with industry, there is very little Australian industry with an interest or need of research input. This is not surprising, as I have stated earlier, we simply do not have an economy which is structured in a way that needs such research collaboration with universities.

Do we have little high technology industry because of the inability of our universities to collaborate and commercialize their research or do we have little research collaboration because there is little high technology industry? Clearly a circular argument.

Other issues are almost certainly at play here. The truth is, we have not needed to build a high technology manufacturing sector. We have historically been able to build an affluent society by exploiting our natural resources – agriculture and mining. I think there are also additional broader societal factors at play.

Here, comparisons with the US and Germany are again interesting. Compared with the US, we are clearly much less entrepreneurial and risk taking is far less acceptable. The US free-enterprise focus rewards risk taking. This means that the US has both a more entrepreneurial culture (a positive) but also far greater disparities of wealth (a negative) compared to Australia.

One can't use this same argument with Germany, with its strong social security system and apparently much weaker incentive structures for risk taking and entrepreneurship.

A year ago I accompanied the Finance Minister Mathias Cormann on a trade delegation to Germany. The thing that struck me in the many meetings with industry, government and universities was the high degree of collaboration in German society. This begins at the political level where consensus politics is the norm in the German system. It also, however, permeates industry.

The German cluster system seems to involve remarkable collaboration not just between industry and university but between industries. The system is highly focussed, building clusters of real scale in areas clearly focussed on the industrial future of the nation.

Areas such as Biotech, Silicon and Solar, Aviation, Automotive, Software and Carbon and Composites have not been chosen arbitrarily. The level of genuine collaboration between the industry partners was remarkable. I doubt this would occur in Australia where I suspect the Intellectual Property issues would prevail.

The same observation could also be made about universities in Germany. Acceptance of differential funding through programs like the Excellence Initiative, seems greater than I would expect in Australia. There is a recognition that building excellence in major clusters has a benefit for the whole nation.

I would not be so presumptuous to believe that I have a recipe that could provide Australia with a high technology future. However, I believe the points outlined above do provide some guidance which we should carefully consider.

Let me try and summarise these issues.

Firstly, I believe that Australia needs truly world-leading basic research. Noting that the conversion rate between research breakthrough and viable industry is low, we need a long stream of world-leading original technology flowing from our research laboratories. We can't expect to be able to adopt other nations' technology.

Increasingly we need to lead the world in breakthrough science. The difference between good science and great science is significant. The major industries of the future will increasingly come from cutting edge breakthroughs. I do not believe we can expect such science to develop at scale without funding focussed on clear excellence.

This could be achieved in a number of ways. My preference would be an excellence initiative which identified a small number of institutions and differentially funded these institutions. Although institutional autonomy is important, I believe the reality is that the funding would need to be targeted.

As I noted earlier, I do not believe we presently spend our research funding in the most efficient manner. However, the political reality is that any attempt to reallocate the existing funding would lead to a fractious debate of university against university, regions against cities etc. Therefore, I believe new funding would be required for this purpose.

As I have indicated, existing levels of research funding within Australia are not generous by international standards. There is an argument for additional funding. It must be at scale, it must be focussed and it must build world class research.

I appreciate this is a time of fiscal restraint. However, we elect leaders to lead. This is a time when our leaders need to do exactly that. To identify a vision for the future industries of Australia and invest in the underpinning science to enable that vision.

Secondly, I believe there is a requirement to achieve the sort of changes envisaged through a broad social and political consensus. A consensus that sees Australia developing such a high technology future and that it will be in the best interests of the whole country. This requires a broad recognition that great research underpins the future of the nation and that it is to our collective benefit to invest in that future and to see our world-leading research generate industrial outputs for the nation.

This consensus would need to span all levels of society – political, business, academia and the general public.

A good example of such commitment would be the Obama 2013 State of the Nation speech. As he spoke before a hostile congress, the President said:

“In a few weeks, I will be sending a budget to Congress that helps us meet that goal (*prosperous future*). We'll invest in biomedical research, information technology, and especially clean energy technology - an investment that will strengthen our security, protect our planet, and create countless new jobs for our people.”

Imagine if Australia had bipartisan political views similar to these. But such views would need to go further, they would also need to capture groups such as the BCA. At present, too many of our business leaders see universities as training providers for future employees but not as a knowledge resource to build new industries.

Perhaps I am politically naive, but the opportunity and the reasons for driving such change seem compelling.

A consensus like this would also require a recognition that the industries of today will not be those of tomorrow and that we need to take active steps to position the country to be a leader in emerging technologies. This will sometimes be uncomfortable – change often is!

A good example of such technological change is the present debate about renewable energy. I am both a technologist and an environmental scientist. One of my research interests is the role that oceans play in climate change. As such, I am confident in the science of global warming and believe that anthropogenic climate change is the single greatest challenge presently facing humanity. I also believe it is an issue which will be solved by technology.

Alternative and renewable energy will eventually become so cost efficient that it will simply sweep expensive carbon based solutions away. My own view is that this is not a question of “will” this happen rather “when” will this happen. Prices on carbon and renewable energy targets will make it happen earlier.

There is good reason to make it happen as soon as possible, as the damage being done to our climate will take centuries to address. We may be running out of time.

As such, I support debate on emissions trading, carbon prices and renewable energy targets. However, if we met our renewable energy target by importing German, US and Chinese wind turbines and solar panels I would be most disappointed. Until recently, a significant number of the Chinese and US solar panels actually used Australian technology. But over the last few years we seem to have seen such technology as a threat to our coal industry and hence a research area we should not encourage.

Renewable energy is an example of one of those step changes in technology that disrupts the political and social structure of the world. It could result in the existing industrially strong nations reinforcing that strength. It is, however, an opportunity for new players to build the

new technology that would represent a major disruption to the economic order. A clear example of where Australia could take a leadership position and support the development of a major Australian industry built on excellent Australian research.

The third element which I believe will be important is the social licence for individuals and companies to prosper and build major industries. This goes to the issues of risk and reward and building an entrepreneurial society. As I indicated earlier, these new industries will need to be built on the back of world-class basic research largely funded by government – the tax payer. Industry needs to understand this. If they do not, I doubt they will acquire the social licence to achieve the technology future described.

As any economist will tell us, business builds wealth in society. Successful businesses, create employment, pay taxes and underpin a modern society. That society has to believe, however, the system is fair. In a system where business more and more leverages from the investment of government we need to be diligent to ensure the public/private contributions and benefits remain balanced.

The narrative around this risk and reward equation will be important to developing the social licence which celebrates entrepreneurs rather than denigrates them – we all know the odium of the “white shoe brigade” of the 70s and 80s.

Building a culture where society sees business giving back will be important. Approaches such as enhanced corporate philanthropy and more industry support in the form of loans (perhaps income contingent loans) rather than direct government handouts will go a long way to changing Australian society. To developing the new structures required to build a more entrepreneurial society.

As I said at the outset, Australia faces a challenging period. We do, however, still have a solid base to build from. As many of my European colleagues still comment, they wish they had Australia’s challenges. That said, our traditional industries must change. They will not disappear overnight which does enable an ordered approach to our future.

Our university system is a great strength of this nation. It is a system which has been resilient and innovative. After all, it has built one of the major export industries of this country – international education. My view is it could underpin and nurture another – a high technology future in which we transition from depending on the natural wealth of our land to the intellectual wealth of our people. I do not accept that we do not have ability, desire and

direction to build such a future for Australia. Australia has innovated in the past, it can do so again.

I believe it is time for us to seriously question how we make such a transition. How we do this at scale and how we use it to unpin our economy. How we do this in a way which will build a broad consensus.

Our politicians understand Australia must make this transition, however, their solutions to date have been very superficial.