

Developing the food industries through focus on intangible capital

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New Zealanders seem to have a belief that we were always a rich country. This is not the case. We were very poor until the 1860s. The first exports, predominantly gold, brought about change, and then with the advent of refrigeration in 1882 we started to become well-off. However, only briefly were we truly world-leading.

Figure 1 shows the changing mix of our exports. After World War II there was a boom in fibre export income, driven by lack of fibre elsewhere in the world. It both increased our global ranking in itself, but as a corollary also significantly increased sheepmeat exports. This phase lasted until about 1970. For a period that most 50- to 60-year-olds remember, we were indeed rich but this was an exception in the economic life of post-1840 New Zealand.

Our position and the associated challenge has changed little since 2000 – to enter the top half of the OECD or to reach parity with Australia we need to increase our income per person by 30%. New Zealanders think we are great exporters, when in fact work carried out by the New Zealand Institute¹ showed we do poorly in this respect. In order to achieve sufficient earnings to pay for our imports we badly need new export income – an increase of about one-third is required.

The wealth of nations

What are the essentials of becoming prosperous? Work undertaken by the World Bank in 2005 helps enlighten us (*Where is the Wealth of Nations? Measuring Capital for the 21st Century*). The Bank set out to quantify the relative prosperity of nations and the factors that contribute to this wealth:

- The first is natural capital – the sum of both non-renewable resources (e.g. oil and coal), and renewable resources (e.g. water, wind, and forests).
- The second is produced capital – infrastructure, structures, and urban land. It represents the value of things created through use of technology. A big part of it is engineering.

What is remaining to explain the total wealth was called intangible capital – defined by the World Bank as the human capital and the quality of institutions in society. What is surprising is that, across 130 nations, intangible capital makes up 78% of total capital, whereas produced capital is 18% and natural capital is 4%. These figures vary to some extent across low-, middle- and high-income countries – but even in the low-income countries the figure for intangible capital averages 59%.

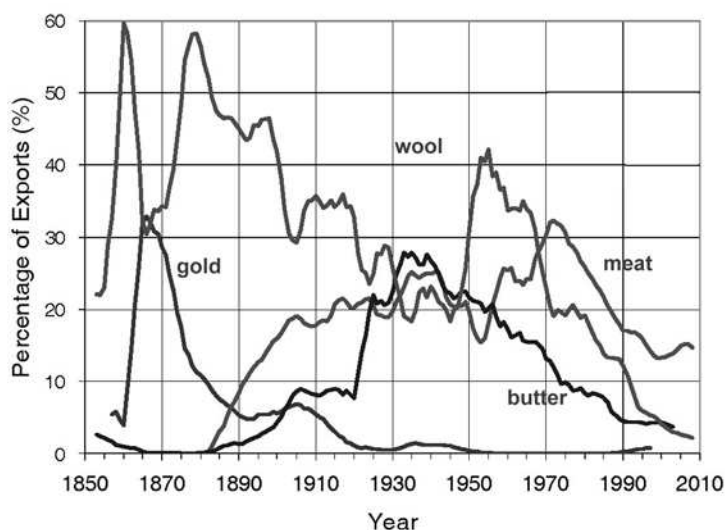


Figure 1. Changing mix of New Zealand exports from 1850 to 2010.

¹ See: <http://www.nzinstitute.org/>



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According to the World Bank, intangible capital is the key ingredient of the wealth of nations.

Human capital is the stock of economically productive human capabilities – and the proxy measure used for this was ‘years of education’. Quality of education was considered as a measure but has proven to be too difficult to assess.

The other component of intangible capital, institutional quality, was defined as a combination of:

- Voice and accountability – related to free speech and the accountability of public institutions
- Political stability and absence of violence
- Government effectiveness and how easy it is to introduce new policy and legislation
- Regulatory quality – the extent to which regulation constrains development, business and the regulation of professions
- Rule of law - citizens having confidence in the law and to what extent they abide by the rules of society, and
- Control of corruption.

Looking at some data from the study (Figure 2), we can see that Australia is richer than New Zealand, not so much because of its natural wealth in minerals, but because it has higher intangible capital. Naturally rich countries like South Africa and Columbia fare poorly for intangible capital. Fiji has probably scored lowly for quality of institutions.

To consider New Zealand’s total wealth, data have been drawn from the Treasury website, and in particular papers on labour productivity prepared for the incoming government in 2008², in order to use internally consistent data to the greatest

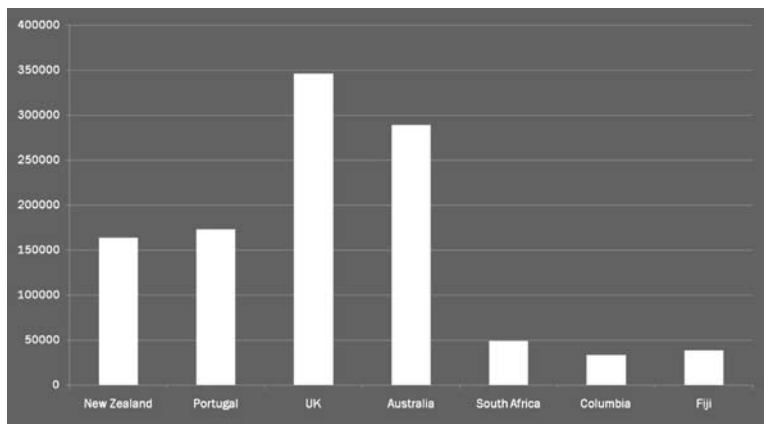


Figure 2. Intangible capital compared.

extent possible. Figure 3 shows our overall prosperity, measured as GDP/capita. It confirms that New Zealand is close to falling off the list of well-to-do countries.

Even though we think New Zealand has a plethora of great resources, in themselves they will not make us rich. The answer to New Zealand becoming rich is not to rely solely on natural wealth, or on the produced capital, but to take positive steps to develop our intangible capital. A major part of this is our educational system, but also having good institutions is important. The work of the current National-led government scores quite well in respect of the latter. Their main policy platforms tackle the institutional quality components of intangible wealth, e.g. reducing red tape, improving the tax system, and improving infrastructure.

The Government’s emphasis on skills is important, as educational quality is a major contributor to intangible wealth. However, New Zealand has an educational ‘tail’ of students who do not succeed – this may contribute to our relatively low intangible capital.

² See: <http://www.treasury.govt.nz/publications/briefings/2008/> and <http://www.treasury.govt.nz/publications/briefings/2008efs/>

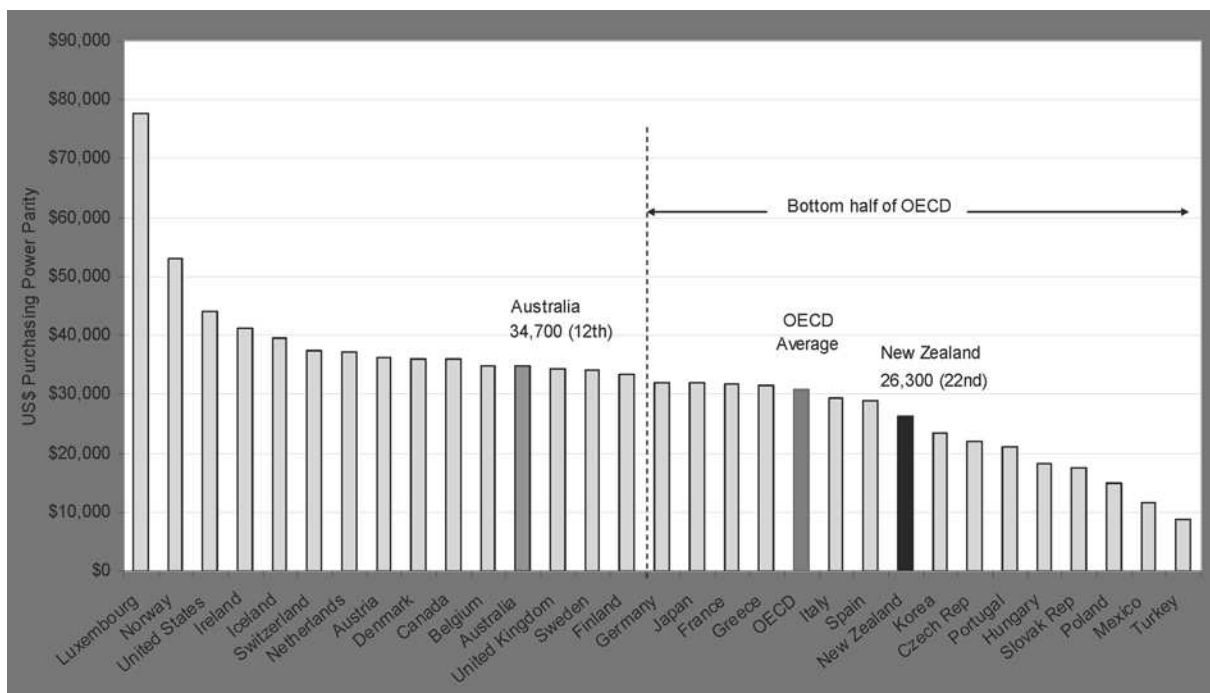


Figure 3. GDP per capita for various countries.

Intangible capital is also a reflection of our ability to generate and use ideas. Is New Zealand good at this? We think so, but are we correct? Are we simply good improvisors making do?

We are left with the inescapable conclusion that it is what we do rather than what we own that matters. The quality of the way we use our financial capital and our people is all-important.

Figure 4 is drawn from an IPENZ publication *Prosperity through Productivity* which was released in 2005. It attempts to explain how a modern economy works. At the top is an economist's view of the world and at the bottom the view of a technologist or business owner. The central shaded box represents the economy. As just stated, our focus is on intangible capital. The inputs to the left of this box are people and finance. These can influence the quantity of an activity or if we invest in education we can improve the quality of the activity. The alternatives to using capital for education are to use it to create infrastructure (to increase circulation rates in the economy), to purchase technologies from others – ideally as a fast-follower adopter, or lastly to undertake research and development.

In the economist's view of the world the financial capital is measured directly and feeds into the capital:labour ratio. The quality of the activities turns up in a catch-all term called 'multi-factor productivity'. This also includes the influence of government, shown on the far right. Multiplying the capital:labour ratio by multi-factor productivity gives the labour productivity – basically how much New Zealand earns per hour worked. To get GDP/capita, one multiplies labour productivity by hours worked per person, which is a function of labour available and use. The regulatory environment can affect this, e.g. labour market legislation.

The bottom of the diagram is much more mechanistic. Circulation rate improvement is clearly important for efficiency, but ultimately we depend on the quality of the products and services we create, and the quality of our processes, e.g. our ability to make things cheaply. These latter two things define the value created per hour. That value can then be defined as the product of a potential achievable value, which may or may not be achieved, and of an index of business capability. Many have argued that in New Zealand it is our business capability that is low. I will seek to refute that argument and show that it is low potential value created that is the cause of New Zealand's relatively poor performance.

The situation of New Zealand

Where is New Zealand deficient? If different parts of the economy are separated and the labour productivity of each examined compared to the rest of the world, our poor performers on a relative basis are manufacturing and construction.

Interestingly, tourism has a low labour productivity – it creates poorly paid service jobs like those in the retail sector. Increasing tourism is useful for generating external income, but makes the average income per New Zealander lower – a mixed blessing!

Professor Sir Paul Callaghan gave his views on how to build our wealth in 2008/2009 as part of a national lecture series. He pointed out that businesses like Fonterra were strong contributors to lifting average labour productivity, but that the rise in income New Zealand needed to reach parity with Australia was so great that if we depended on the biological sector alone we

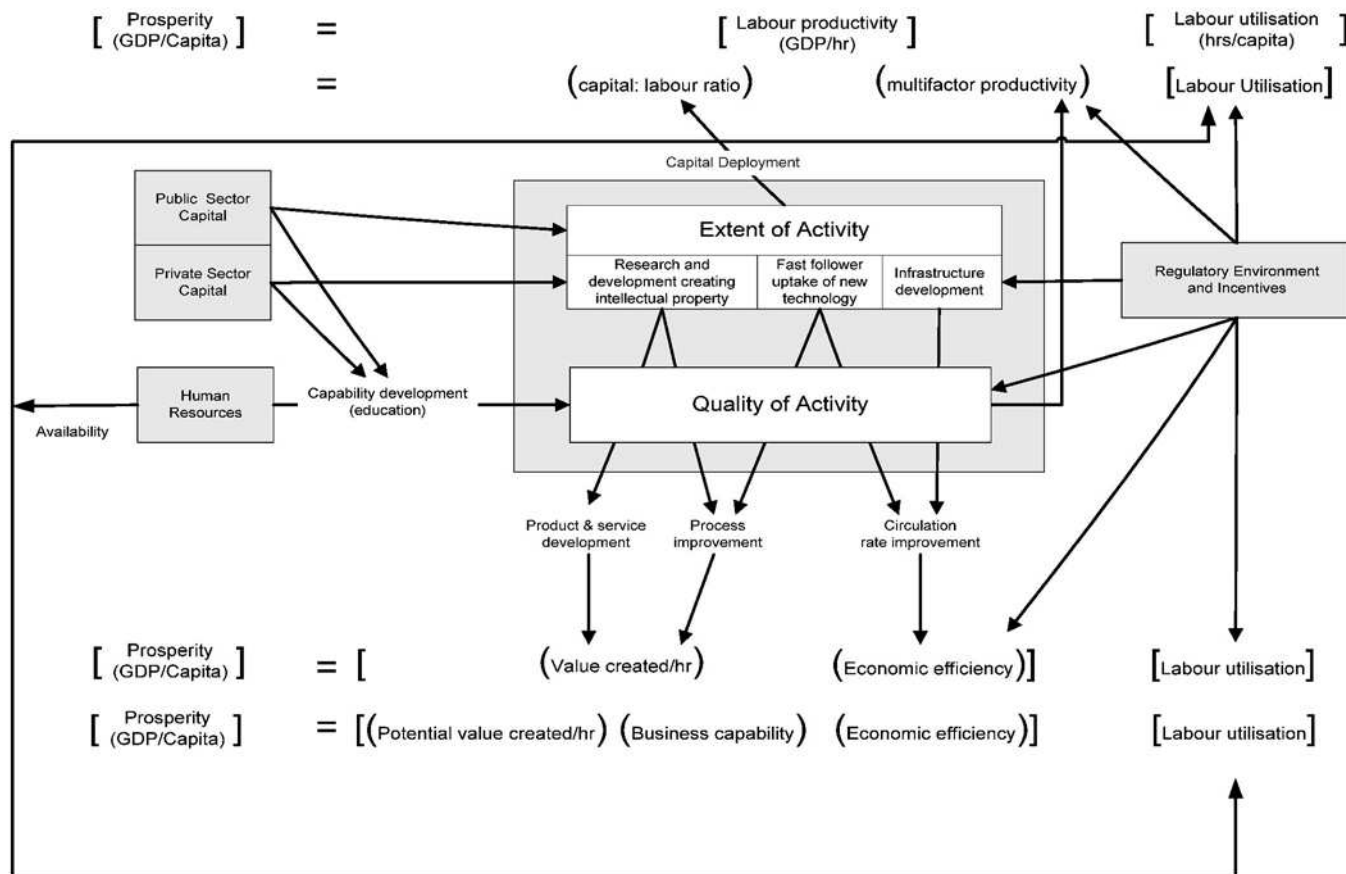


Figure 4. Different views of how a modern economy works.

would hit hard environmental limits before the sector could add enough new value to the economy.

His argument was that we needed to maximise the returns from the biological sector but also to diversify.

I want to strongly reinforce his comments. The powerful advocates for building the biological sector who want to do so by stripping resources away from diversified industries are actually doing New Zealand a great disservice. We need a strong physical and virtual technology industry as well as a strongly performing biological sector. This is further illustrated by looking at what other countries have done.

What the big movers have done

Most of the tiger economies have got rich by investment in engineering – they took existing products and re-engineered them. This is why the car industry has moved so strongly to Japan and then more recently to Korea. Ireland is an unusual and special case – it used large capital injections from the European Union to create incentives to buy-in large businesses who wanted a cheap base from which to export into the European market. With that capital gone, Ireland has been especially badly hit by the 2009 economic crisis. Finland is the best example of transformation of a small nation – innovation at the fringe of its forestry industry led to Nokia.

What has been common to the fast movers has been investment in skills and particularly engineering and technology skills.

Sadly for New Zealand there is no history of anyone else in the world ever getting rich by biology alone. That does not mean it is impossible, but one has to question why New Zealand would restrict ourselves to biology when history says that diversification to include a physical/virtual technology sector as well as a biological sector would give us a vastly increased chance of success.

Figures 5–7 are also from the Treasury reports. They illustrate the following matters:

- New Zealand’s low capital intensity (Figure 5). I will sidestep the issue of whether it is too little capital or capital misplaced into real estate – I suspect it is both.
- Low R&D spend overall (Figure 6).
- Even lower (in relative terms) business R&D spend.
- Poor fast follower adoption of new technology (because increased capital expenditure does not lift our labour productivity as much as it should) – this indicates a skills issue.
- Poor capability in the private sector to take up and use research – the Ministry of Economic Development published the best study in 2003, but it has largely been ignored by others.

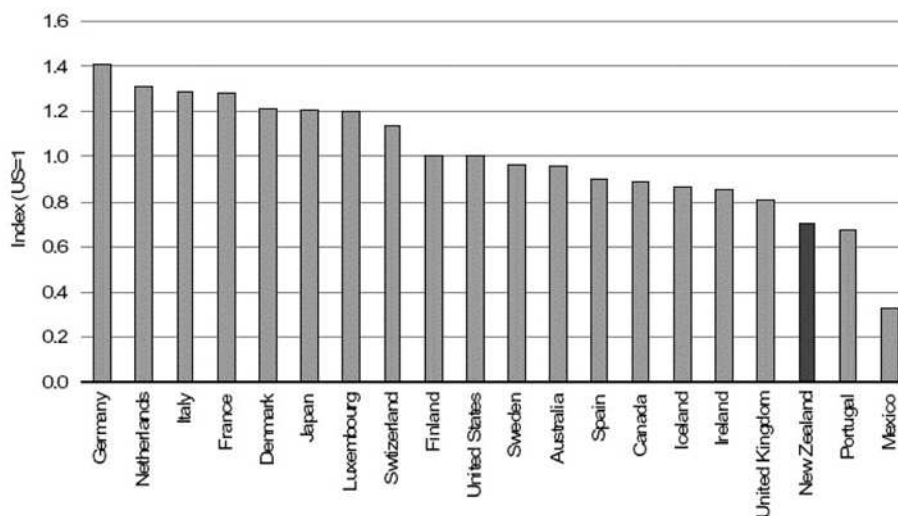


Figure 5. Capital intensity of different countries compared.

Figure 7 looks at knowledge investment in a number of countries. We do not do too badly. It seems we are quite good at acquiring knowledge generally but not so good at the knowledge that is worth something! You will note our relative strength in software compared to Australia.

The data shown in Figure 8 are not from Treasury, but drawn from the OECD. They are for bachelor and above degrees. The data are a little old (2002), but are used because in later data computing and mathematics are placed together, which is less helpful. Nevertheless, the more recent picture has not changed much. Comparing our proportions of graduates by disciplines with the OECD mean it seems we educate more graduates in business but far too few in engineering, manufacturing, and construction. This latter category also includes food technology. The only change of note since these data were published is that the proportion in computing has come back to the OECD norm. Surprisingly, we are not that strong in agriculture.

The data shown in Figure 9 are again from the Treasury. What is disturbing here is that almost all our skills improvement has been in lower-level skills. New Zealand has a large educational ‘tail’ of underachievement that Australia does not seem to have. I wonder whether the greater responsibility we take in regard to the Pacific Islands compared to Australia has contributed. We have a large immigrant population from the islands many of whom enter with low educational achievement.

We now have a picture of New Zealand’s overall performance. We all want to change that picture but how? My view is that we need to go back to basics in our thinking if we are to make progress. Sir Angus Tait had a very simple way of saying it: *No-one gets rich unless they make something that some-one else wants to buy.* He would then go on to say that a successful business has three legs – production, marketing, and research and development. He would point out that the stool could not be stable unless proper care was given to all three legs. In New Zealand the R&D leg is weak, but the weakest leg may be the marketing one. Our stool is imbalanced badly in favour of production thinking. The food industry is probably the worst offender in this respect.

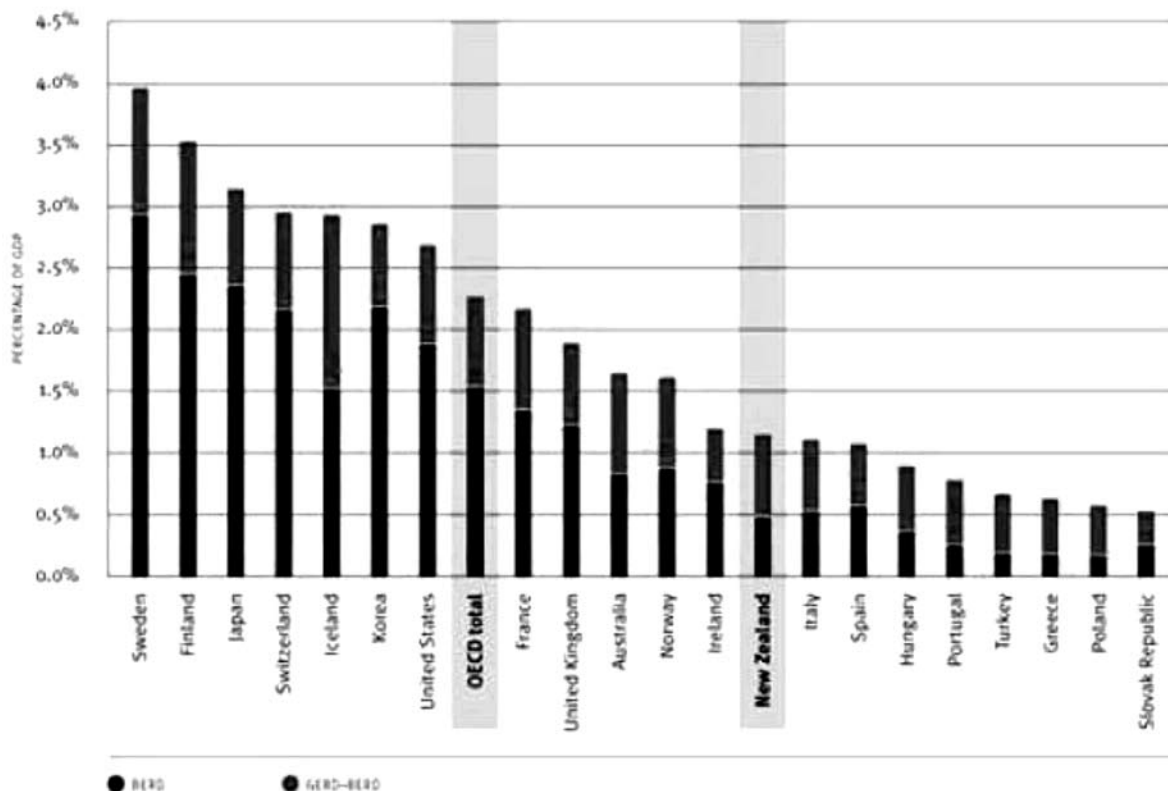


Figure 6. R&D expenditure of different countries as a percentage of GDP, 2004.

Key issues for the biological sector

In my view the following are the key issues for the biological sector. Some of these are obvious and well-known, but I have included them so the picture is complete:

- Commodity markets too dominant. Commodity dominance is well-known – we argue about how to tackle it.
- Internal competition for existing markets in some industries. Competition between New Zealanders for the same market is also an issue – we fight for shares of the cake rather than trying to enlarge it.
- New production is assumed to be (and paid?) at the average price, not the marginal value in market. It is often not realised that our pricing signals to new production might be wrong – new production should be priced at the marginal cost of the last item sold, not the average if we are to avoid creating perverse signals.
- Developing new markets for advanced biological products is hard work. The degree of difficulty of developing new markets for biological produce is poorly understood by New Zealanders – Fonterra has worked hard for many years to increase its added value business, but it is hard work.
- Functional bio-products can encounter significant barriers to market entry in developed economies. Real or artificial approval barriers take the price of entry to market

very high, which requires large amounts of capital, and sophisticated marketing to capture sufficient market share to pay the cost of market entry. In contrast, for physical and virtual technologies the barriers are normally much lower.

- Changing climate.
- Political response to perceived climate change.

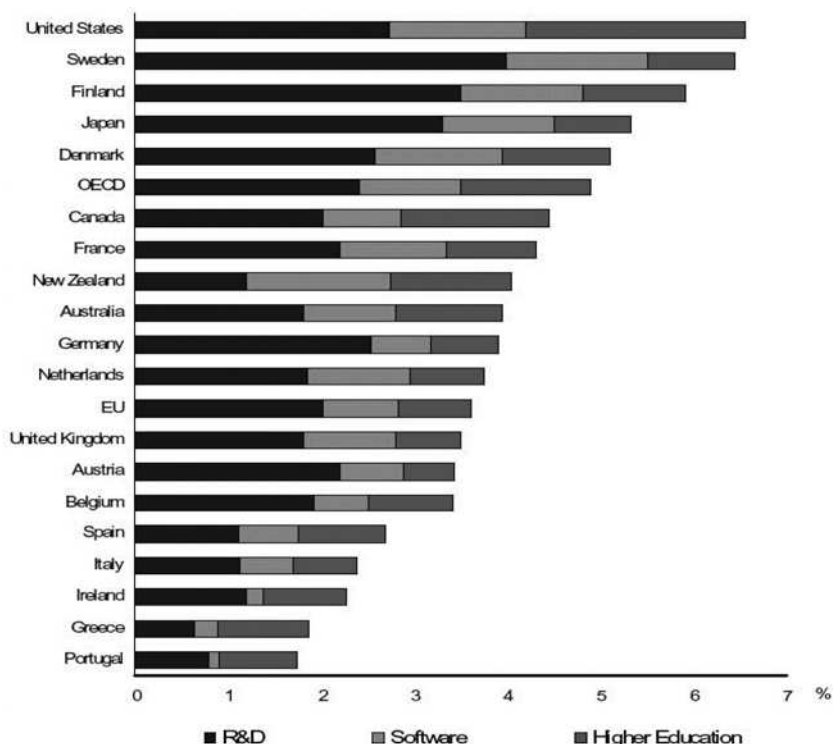


Figure 7. Knowledge investment of different countries compared.

Figure 8. Comparison of graduate numbers (2002) by discipline between New Zealand (left-hand columns) and the mean for OECD countries (right-hand columns).

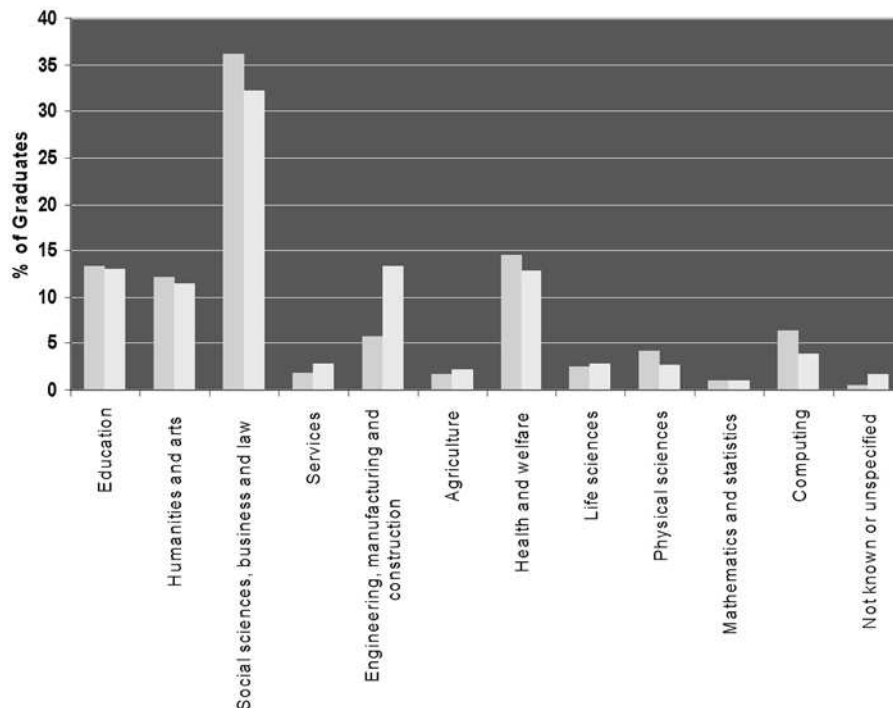
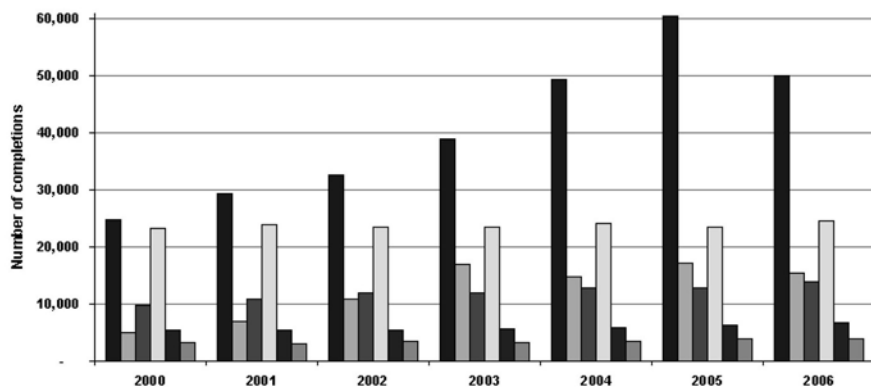


Figure 9 (below). Skill base in New Zealand, 2000–2006 (Treasury data). Columns from left to right: Level 1–3 Cert; Level 4 Cert; Level 5–6 Dipl; Level 7 Bachelors; Level 8 Hons/Postgrad; Level 9 Masters; and Level 10 Doctorate.



Climate change

The data shown in Fig. 10 are from the University of East Anglia. They are widely regarded as the best measured data of global temperature. The heavy black curve is the trend line. The conclusions being drawn from these data, extrapolations of them, or mathematical models predicting future temperatures trouble me and in my view represent a big risk to the New Zealand biological sector.

The first concern I hold is that the agreement between models and measured data remains very poor. We must acknowledge there is still substantial uncertainty as to the extent to which human activity is forcing temperature upwards. We may well be experiencing the commencement of a period of natural cooling, to which the anthropogenic effect must be added. The accuracy with which the extent of anthropogenic forcing can be determined is still poor, which leaves a wide range of possible future temperature scenarios. New Zealand must ensure it is well placed economically irrespective of what the actual measured temperature does over the next

few decades. To illustrate this I pose the following question. What will be our approach if in 2015 we find 1998 was still the warmest year, implying that the extent of anthropogenic forcing is much less than currently predicted? I will not attempt to answer the question, but pose it to illustrate the issue we face.

In my view New Zealand needs to adopt a risk management approach. In this approach, research results would be used to establish lower and upper bounds on the future temperature change due to anthropogenic forcing. With a sound risk management approach, whatever the extent of forcing, New Zealand (and the biological sector) can make decisions to be well-positioned for the future.

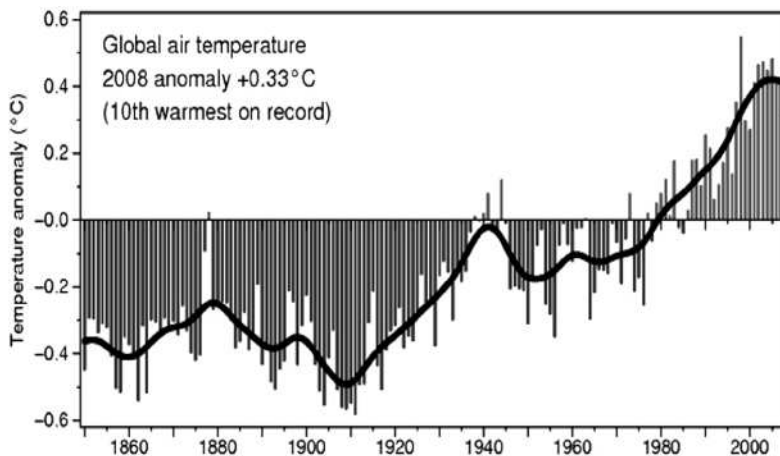


Figure 10. Global temperature record.

Political response to perceived climate change

I also wish to caution about creating an industry on the basis of political response. Political response can change overnight and lead to stranding of an industry. I see no point in pursuing forestry solely to capture the temporary benefits of emission trading schemes that, when an engineer's logic is applied, seem certain to fail in the near future.

Irrespective of what is the cause, the food industry does need a response to changing climate, whatever the extent it may be. One thing we do need to do is work on the ruminant animal. Simple engineering analysis says there is a huge inefficiency in a reactor that exports a fuel source (methane) to cool the reactor. There must be potential for improvement that will be beneficial to our biological economy.

Many people talk about the competition for water and whether this will create economic advantage. I doubt it. Engineering logic says that getting more water to the right places is actually an energy-limited issue.

I also doubt that competition for land against biofuels or the political planting of trees to take advantage of the financial incentives arising from the present political response to climate change will really matter in the longer term.

The reason I say these is that the technology change for future energy supply will be so massive and disruptive to the present economy that small biologically-based contributors to improved global energy systems will matter little.

The world protein shortage is a similar issue – in a world of plentiful renewable energy the likelihood of protein shortage would become much less. We would use the plentiful energy to produce protein.

I do not want to debate these issues, as undoubtedly many would disagree with me. However, I wish to pose a further question – will we get poorer if we wait for one of these things above to give New Zealand an advantage? On that question I am unequivocal. If we stop and wait for the world to offer us a window of advantage we will simply continue to get poorer.

Commodities

In a practical sense (rather than a strict economic theory viewpoint), commodity trading conditions start to apply whenever three conditions are met:

- More than one capable supplier,
- Ability to oversupply,
- The need to continually take out costs from the production chain to remain competitive.

Commodities can be either consumer or industrial products. Commodities are not necessarily low-tech. The personal computer is largely a commodity now. Agricultural commodities fluctuate much more in price than industrial commodities due to natural variability in supply rates, and some traditional commodities are hedged in their markets. These factors do not change the decreasing margin earned year by year from commodities unless the production costs are continually reduced.

How does an industry break out of the commodity cycle?

Firstly, the industry needs to focus on markets which offer premiums through higher valuing of services by consumers – health and safety, fashion, entertainment are the best examples. Secondly, the industry needs to use market information to lead in deciding the future pathway. Thirdly, and I believe this is the approach of Fonterra, the industry needs to develop and exploit confidential intellectual capital to stay ahead of the game – it innovates to keep ahead, but generally does not formally protect that advantage. Seeking to become a dominant supplier early on in a new market to discourage competitor entry is also important. Lastly, for a small country, finding narrow niches or marketing to a small number of purchasers as an industrial supplier lowers the costs to market. Gallagher Industries is perhaps New Zealand's best example of these last two points.

Many people claim that the reason for the low R&D spend in New Zealand is because of the nature of the products. Commodities, they claim, can only support a small R&D spend. I want to challenge that. The IT sector spends 10–15% of turnover on R&D but the product life is very short, often only months. In comparison, biological commodities have a product life of decades – it is highly likely that over the entire product lifetime the R&D spend is not that much different!

To break the commodity lifecycle requires extraordinary R&D investment!

Investment principles

What is good practice in choosing where to invest financial capital in industrial development? Whether the investment opportunity is in the biological sector or not, the basic success factors are much the same.

- The first success factor is to allow those with knowledge of markets where there is opportunity to drive the decision-making process, rather than allowing suppliers of raw materials to dominate decision-making.
- The second is to eliminate competition from your friends i.e. other New Zealand producers – they need to cooperate to grow the market for the benefit of all.
- The third is that successful companies build the capability to undertake their own R&D and draw it in-house, supported to some extent by public institutions. This is a good outcome, not a problem.
- The fourth success factor is development of a confidential know-how strategy on which the business is based and then nurtured.
- The fifth success factor is inwards transfer of competent personnel – the most effective means of technology transfer.
- The sixth is that the wise investor will place his or her investment where competitive advantage is most needed and/or has highest rate of return.
- Lastly, the investor would want to place the best talent where the biggest risks are so those risks can be managed.

This might sound rather obvious, but in my view the New Zealand biological sector does not do these things consistently well.

In fact, in attempting a report card on the biological sector I would report:

- Our investment pattern mirrors the shape of industries we have had, not where we want them to be in the future – a bad score in this respect.
- We focus our research too much on reducing production cost, not on creating high-value products matched to market opportunity.
- As a consequence we often do incremental research rather than look for disruptive technology breakthroughs.
- Worst, our systems for allocating the public R&D investment have tended to allocate much of the money to the safest research programmes, often with experienced researchers – the inexperienced are assigned the low-budget high-risk and high-gain research.
- We compete amongst our friends.
- Our research providers are inadvertently incentivised to avoid transferring their best people to the private sector.
- To get strong research output scorecards our research providers patent new knowledge when they should not, and waste much of the opportunity.

In short, we do not do very well, and in this respect the biological sector is actually much worse than our physical technology industries!

Opportunities to move forward

So how would we change things?

Firstly, the CRI taskforce gives us one step forward – complementary roles for CRIs and universities, and the CRIs working closer to industry than the universities, each CRI with different key performance areas.

Secondly, we need to learn to use our public investment as a lever to draw out increased private sector investment.

Thirdly, we need to adopt a different model for performing co-funded R&D for market-led companies than for performing research for those industrial sectors which can be united around the supply of a raw material and its use.

Fourthly, we need to recognise the huge potential for gain through upskilling the private sector in the doing and using of research – we need new skills in place.

Fifthly, we need to recognise that building private capability to undertake market-led research is not the same as rolling out research from the public sector to the private sector. That latter technology-push process is important, but it needs the strong market-led pathway happening in parallel.

By recognising and using the complementary attributes of universities, on the one hand, and CRIs (and research associations and university-based dedicated research centres), on the other, a cooperative strategic approach is possible.

In universities there is a focus on people development, and publication is necessary to achieve organisational goals, whereas in CRIs there is a focus on useful outcomes, and fitness for purpose is the dominant quality measure. Universities are best able to carry out technology-push research, while CRIs are best suited for market-led economic development – again highly complementary roles are apparent! The management issues are also quite different. Rank and file researchers in the main decide what to research in the universities, whereas

management decides what to research in the CRIs, where the commercialisation strategy is dominated by industry partnerships. Finally, in universities, project-based research is measured academically, whereas in CRIs, programme-funded research is measured by its fit to the national strategy or a supplier-driven industry strategy.

An industrial development agency

The way in which the CRI taskforce sees CRIs and universities working should fit the biological sector well. However, the fit is not so good for physical technologies and the so-called ‘new’ economy (primarily those companies producing high-tech products or services). For these companies a different model is needed – a special kind of CRI which might be called an industrial development agency.

The major weakness in New Zealand that stops many new wealth-creating companies growing is that our private sector remains generally poor at doing and using research. To overcome this issue we need an agency that focuses on building this capability in companies. The agency should be distinct from the other CRIs that are expected to form strategic partnerships with supplier-driven industries like the biological sector.

We want the industrial development agency to be incentivised as its core purpose to make the private sector more capable. The key measures of success in this are the willingness of the private sector to co-invest in R&D and the people transfer. Also important is whether the agency produces research with potential commercial value.

Such an agency would provide an important career stage for researchers whose long-term career is in industry, often as a technical or even a general manager.

The agency needs to focus on markets and individual companies, not increasing or cheapening production in an industry sector. It needs to aim to build capability in companies through transferring confidential know-how. It could aid the advanced biological sector as much as it assists physical technology or virtual technology companies.

To succeed there needs to be a human supply chain from the relevant university schools of engineering and ICT, and possibly parts of the schools of science.

In my view the absence of such an agency is New Zealand’s biggest weakness.

Recommendations for the food industry

Against this background, what would I specifically recommend for the food industry? Some suggestions:

- Redefine the enemy as being off-shore and eliminate our internal competition in the marketplace.
- Focus our R&D investment on market-led initiatives to place new higher-value products in the market much more than production cost reduction.
- Look at costs to market in making investment decisions. There are some types of products that a small country will be unable to afford to fund through the various stages of getting to market – we need to divest any advances we make in these areas to others in return for a licence fee.

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- Build platforms of confidential know-how from which product ideas and advances can be spun off on a regular basis.

Do we have the right people in the food industry? Disturbingly, our best educational programmes in food technology and food engineering fail to attract enough students – this is a long-standing problem, as the industry delivers too little recognition and standing for professional people. The entry quality of students to relevant tertiary study is not good – the school dux might turn up in engineering, medicine or law, but not in food technology.

Moreover, the best students do not proceed to postgraduate studies – the stipends are too low to compete with the market. Rather, disciplines of science with oversupply of graduates have the highest postgraduate numbers, as a low stipend for postgraduate study is better than being unemployed!

As a result, those entering the food industry are relatively poorly prepared. Our most important industry fails to attract our top talent – because the industry has not built sufficient recognition and standing as an employment field for outstanding people.

Additionally, we do not have sufficiently good educational programmes in logistics and international marketing. I do not believe that general business skills are really the issue, because as I showed earlier, we produce plenty of graduates in business studies. So overall, there is plenty of room for improvement!

Conclusion

The biological sector needs to get over the view that it is the national saviour – it is a very important economic sector but if it demands all resources be drawn to it and limits economic diversification, it inadvertently holds the nation back.

The factors that build intangible capital need attention by our policy makers – particularly in developing practical skills and applying them to use new technology in a vastly upskilled private sector.

The public sector R&D spend needs to be moved more quickly from incremental improvement to the search for transformation.

Lastly, how the food research sector is organised needs re-thinking to eliminate competitive behaviours.

I am absolutely pro-food industry; it is a vitally important and necessary part of New Zealand's economic future. I do wish it would stop pretending it is the key to the future – it is necessary but not sufficient. It does have major issues to address – I have tried to set these out here today. I believe that those issues can be resolved, but only by clear strategic leadership. Perhaps that leadership will only come about if the industry can attract and retain the nation's top talent.