

**Trade, Innovation and Growth:  
The Case of the New Zealand Agriculture Sector**

**Vangelis Vitalis**

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## Introduction<sup>1</sup>

Growth in the New Zealand agricultural sector depends on and is driven by the inter-relationship between innovation, trade and competition. This has, however, also intensified the pressure on countries with small domestic markets like New Zealand to engage in a continuous process of adjustment in order to maintain global competitiveness. In particular, innovation in the sector has been fostered and advanced by a combination of: domestic economic reforms (which particularly affected the agriculture sector); international export competition; and the emergence (and uptake) of new technologies over the past two decades. The emphasis on these inter-linkages, particularly between international competition and domestic economic reform, distinguishes the New Zealand agricultural sector from those in the wider OECD membership.<sup>2</sup> And this is what makes an analysis of the linkages and thus the wider policy implications particularly interesting.

This paper is divided into four inter-related parts. First, it begins with an outline of the relationship between trade, competitiveness and innovation with a particular emphasis on the New Zealand agricultural sector in general. Second, it considers the effect of size and distance on New Zealand, noting that these are important factors that help explain the sector's development over time. Third, it briefly details the economic reforms of the 1980s in New Zealand with a particular emphasis on those related to the agriculture sector. This section explores how these triggered significant efficiencies and changes in the agricultural sector that translated into enhanced trade-related gains and improved international competitiveness. In the context of these reforms, four short case studies (in text boxes) of New Zealand firms working in the sector are considered. These illustrate the paper's core argument that innovation in the New Zealand agriculture sector has been driven by a combination of domestic reform, uptake (not invention) of new technologies and the need to compete internationally. The paper concludes with the identification of key policy implications that may be of potentially wider interest.

## Competition, trade and innovation in New Zealand

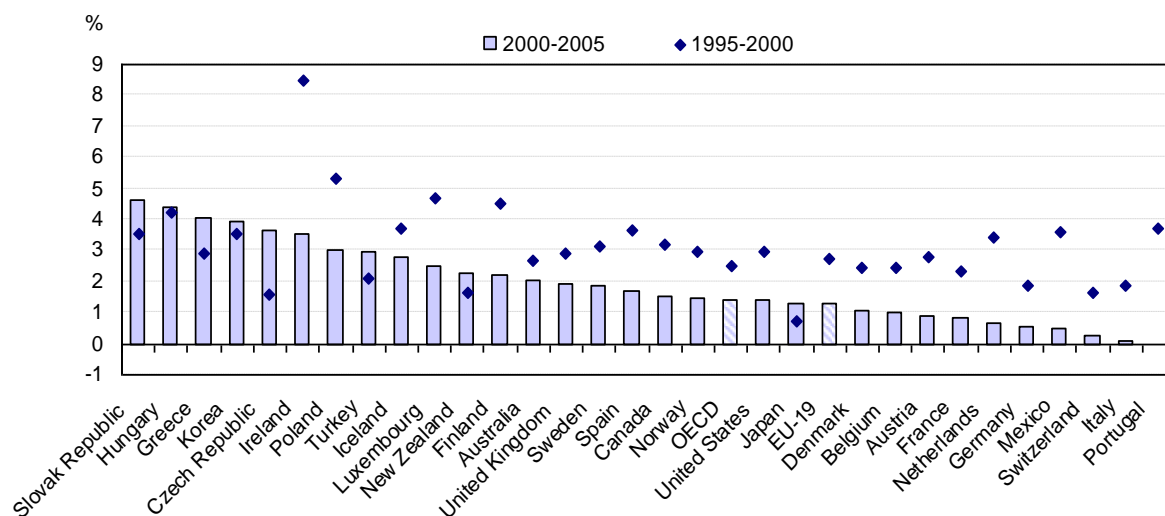
Despite the importance of innovation for economic growth, many OECD countries face difficulties in improving their performance in this regard. As noted in Figure 1 below, per capita GDP growth in New Zealand began to increase in the 1990s, and especially in the years from 1998 to 2004. It has not, however, approached the levels of the top performing OECD countries over an extended period of time.

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<sup>1</sup> Vangelis Vitalis works at the New Zealand Ministry of Foreign Affairs and Trade. The views expressed in this paper do not necessarily represent the views of New Zealand's Ministry of Foreign Affairs and Trade. The helpful comments and suggestions provided by Steve Cantwell and Kevin Guerin (both from the New Zealand Treasury), Roger Dungan (Ministry of Foreign Affairs and Trade), Neil Fraser (New Zealand Ministry of Agriculture) and Wilfrid Legg and Ralph Lattimore (OECD Secretariat), are gratefully acknowledged. All errors and omissions are the sole responsibility of the author.

<sup>2</sup> For the purposes of this analysis the wider EU is considered a single and therefore in effect a domestic market. In the case of other OECD members outside the EU (eg the United States, Canada, Japan, Australia, Korea and Mexico), their economies are sufficiently large to foster innovation as a consequence of local competition and the size of the domestic market.

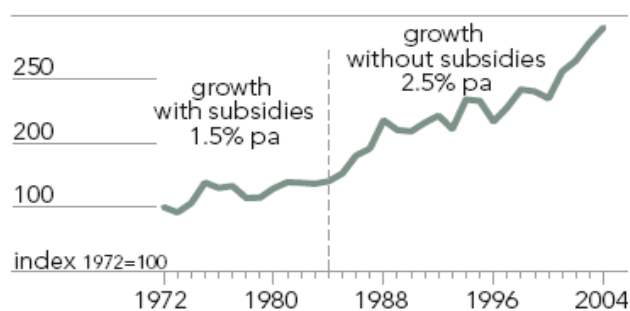
**Figure 1:** Growth in per capita GDP (total economy, percentage change at annual rate)



EU19 includes all EU members that are also OECD member countries.  
Source: OECD (2006b).

New Zealand's lagging per capita GDP is a consequence of its comparatively low level of productivity. Hourly labour productivity, for example, is significantly below the OECD average (OECD, 2006). That said, it is worth noting that the domestic reforms in the mid-1980s had a markedly positive effect on total factor productivity in the sector to average 2.5 per cent a year in the post-1984 period compared with 1.5 per cent before hand (New Zealand Ministry of Agriculture and Forestry 2006b). This is because the reforms enabled the sector to improve its allocation of resources and level of responsiveness to global market signals as well as to maximise synergies cross-sectorally (Figure 2)..

**Figure 2:** Total Factor Productivity Before and After the Reforms



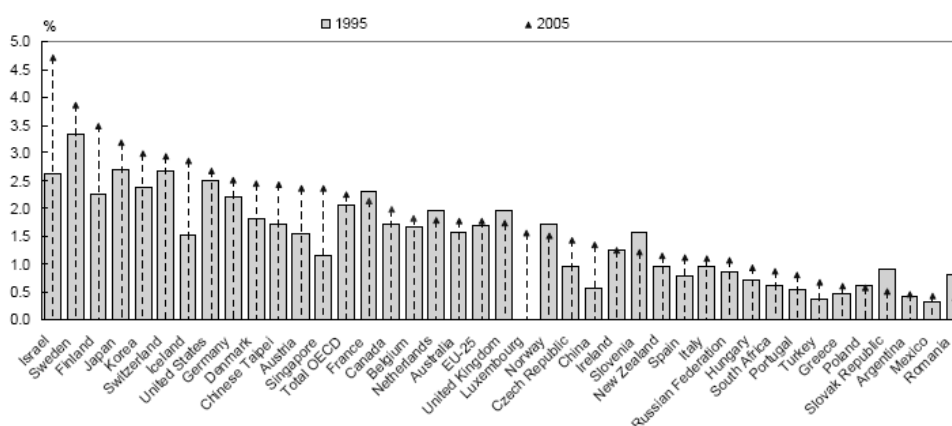
Source: New Zealand Ministry of Agriculture and Forestry (2006a).

While productivity growth, particularly in the agricultural sector has picked up in the second half of the 1990s, growth of labour productivity remained one of the lowest among OECD countries (OECD, 2005a). For these reasons there appears to be a consensus among domestic policy makers that boosting productivity offers the greatest scope to deliver sustainable real income gains and improving living standards in New Zealand. Not surprisingly therefore, increasing long-run productivity

– which can be addressed in a number of ways including by raising multifactor productivity and an increase of capital per worker (ie capital deepening) – is being actively pursued in New Zealand. Importantly too in policy terms, this is being done in conjunction with an evolved and expanded national innovation strategy. Moreover, it is widely understood that the economy’s openness (including in particular to trade) has supported growth, not least because external competition has encouraged firms to adopt (and absorb) new technology and to innovate, thereby enhancing productivity. Fostering innovation therefore is seen both internationally and domestically as a major, sustainable route to enhancing such productivity growth (Aghion et al, 2005; and, in the New Zealand context, Fabling and Grimes (2004) and Jackson (2002)). The New Zealand government’s *Growth and Innovation Framework (GIF)*<sup>3</sup>, for instance, emphasised the role of innovation in increasing labour productivity. More recently, the *Economic Transformation Agenda (ETA)*<sup>4</sup> which replaced the GIF in early 2006 continues to emphasise raising income per capita growth through innovation, but in particular points to the need to raise productivity and enhance innovation in an environmentally sustainable manner. Taken together, these matters have fed into the evolution of an economy-wide innovation strategy.

New Zealand has performed relatively well in terms of its growth in the intensity of its research and development (Figure 3). Innovative effort is on the rise as a share of economic activity in New Zealand. Like most (though not all OECD economies), investment in knowledge has grown more rapidly than investment in machinery and equipment since the mid-1990s (OECD, 2005d).

**Figure 3:** Growth in R&D intensity (GERD<sup>5</sup> as % of GDP), 1995-2005



Source: OECD (2007b). 2005 data for some countries is the latest available

<sup>3</sup> More information about the Growth and Innovation Framework (GIF) can be found at <http://www.gif.med.govt.nz/>. A report on the progress with implementation of the range of inter-related activities undertaken under GIF is contained in New Zealand Ministry for Economic Development (2005), *The Growth and Innovation Framework Sector Taskforces: Progress with Implementation*, Ministry for Economic Development, Wellington.

<sup>4</sup> The Economic Transformation Agenda (ETA) comprises a cross-departmental effort led by the New Zealand Ministry of Economic Development. It comprises five themes: growing globally competitive firms, world class infrastructure, innovative and productive workplaces, Auckland as an internationally competitive city, and environmental sustainability. More information about the ETA can be found at:

[http://www.med.govt.nz/templates/StandardSummary\\_22996.aspx](http://www.med.govt.nz/templates/StandardSummary_22996.aspx)

<sup>5</sup> GERD: Gross Expenditure on Research and Development

## Innovation and the New Zealand Agricultural Sector

Investment in knowledge, intellectual assets and new technologies, as well as the adaptation of existing business practices and technologies in new ways has always been the key to value creation in the New Zealand agricultural sector. In this sense, the sector's approach fits in well with the Oslo Manual's description of innovation (OECD 2005f). In particular, innovation under this definition encompasses product and process innovations, but also new marketing methods and organizational approaches, as well as implementation of advances in technology, including in new environments. In short, innovation is not simply restricted to a "global-first". The New Zealand agriculture sector is a good example of the application of this broader based definition. The sector is characterised by the rapid evolution and absorption from the mid-1980s onwards of new techniques in agri-technology, animal remedies (including genetics), software, agricultural tourism, machinery, and biochemical businesses. None of these were necessarily 'global firsts', but all had significant effects. This process was driven by a mixture of the domestic reform process and the need to be internationally competitive. Moreover, there have been important spill-overs to the wider economy as well. A major part of New Zealand's high value manufacturing and processing is, for instance, directly dependent on agribusiness, including state-of-the-art processing, packaging, agritech equipment, machinery and software (New Zealand Ministry of Agriculture and Forestry, 2003).

New Zealand's private sector research and development and investment is dominated by the agribusiness and forestry sectors. Fonterra, for instance, remains New Zealand's largest single private sector investor in research and development. Over time it is expected that a rise in sector investment in research and development is likely to be driven primarily by companies that are within homogenous, commodity-based sectors. This has the attendant effect of allowing these firms to move into more differentiated products which offer scope for increasing the value added component of the product. This trend is already observable, including in the rise of smaller dairy, food processing and agritech businesses, and to some extent in the solid wood products sector.

The homogenous nature of the New Zealand agribusiness and forestry sectors has resulted in a focus on research, development and innovation that has tended to emphasise a relatively modest number of major products and processes – particularly those which can improve the sector's export competitiveness. That is not surprising given that the sector is not able to rely on a domestic market to leverage its expansion. This focus has had positive implications for economies of scale. Costs, for instance, can be more evenly distributed over large production runs. While this tends to result in relatively modest levels of R&D intensity, it is important to note that this is also typically associated with high R&D *productivity* because attendant innovations are adopted widely and have larger aggregate effects. Conversely, more niche-oriented agriculturally focused businesses competing in lower volume, more differentiated markets often have high R&D intensity and are better placed to leverage high premiums over much smaller production volumes (New Zealand Ministry of Agriculture and Forestry, *ibid*).

Interestingly too, the agricultural sector has performed well over the past two decades in terms of the intensity of its investment in innovation even when compared with other parts of the New Zealand economy. This is particularly impressive given that the trend in global prices for commodities was generally downwards (though this has since reversed). Propensity to innovate was correlated with the size of the business, with the largest firms in New Zealand showing the greatest propensity to

invest (Table 1). In this respect, and as noted above Fonterra and companies like the Livestock Improvement Corporation emerge as major investors in innovation, accounting for a significant proportion of research and development activity both in the wider sector and in the economy itself (Statistics New Zealand, 2004). More generally, the agricultural sector had one of the highest ratios of research and development investment in total innovation investment in New Zealand. Again this is not surprising since the agriculture sector is the one which more than other parts of the economy is dependent on being externally competitive to ensure its long term survival. Table 1, for instance, reveals that only the large and generic business services category had a ratio that was greater than that of the agricultural sector (57.7% compared with 51.6%).

**Table 1:** Intensity of investment in innovation, 2002-2003

	Number of businesses with innovation activities	Ratio of R&D investment in total innovation investment	Ratio of innovation investment to total operating expenditure	
			\$1:\$100	
Industry				
Industry sector				
Agriculture, Forestry and Fishing	474	51.6	1.1	16.5
Mining and Quarrying	21	16.1	1.1	4.5
Manufacturing	2,004	44.9	1.6	31.6
Construction	297	35.3	0.4	9.7
Services sector				
Wholesale trade	819	45.3	0.5	36.2
Transport and Storage	336	29.9	0.8	8.2
Finance and Insurance	189	41.2	3.9	26.1
Business services	975	57.7	4.6	96.4 <sup>6</sup>

Source: Statistics New Zealand (2004)

The New Zealand agriculture sector's dependence on innovation has a lengthy historical tradition. It benefited enormously, for instance, from the innovation in refrigeration and shipping which in the 1880s helped transform New Zealand's economy into a major supplier of meat and dairy products to the United Kingdom (Easton 1997). Given the historic importance of agriculture in New Zealand, it is perhaps not surprising that the sector has been a primary focus for R&D activity in both the public and private sector. Indeed, they are strongly influencing the type of R&D demanded in New Zealand, including in new areas such as biotechnology. In 2004, 12% of Business expenditure on research and development (BERD) was in the primary sector. This is relatively high by the standards of most OECD countries. BERD in New Zealand is also concentrated in a small number of these firms, with the concentration most pronounced in the primary sector, with the top 5 performers accounting for 71% of BERD (OECD 2007b).

<sup>6</sup> This ratio is unusually high and suggests that there may be a measurement-related problem derived from the conflation of software and hardware used in the provision of the somewhat generic term 'business services' much of which is derivative, rather than innovative.

## Competition, trade and innovation – The effects of size and distance

The smaller the economy, the greater the benefits from trading, not least because the opportunities for ‘trading’ domestically are more limited. This is a somewhat tired truism, but holds nevertheless. Put simply, international trade provides small economies like New Zealand the opportunity to specialise including through innovating and adding value to products where they enjoy a comparative advantage. Obviously, this benefit is of a lesser magnitude for larger economies since the size of the domestic economy is such that it already offers scope for the development of simple exchanges and comparative advantage-related specialisation. (Small) size therefore has been a significant driver of New Zealand’s trade-related dependency and, importantly, its capacity to innovate and compete.

More generally, the relationship between trade and growth is well established (World Bank, 2001). Econometric analyses have demonstrated that there is a positive correlation between the role of exports in economic growth over time and this positive effect is further correlated with openness to trade. Moreover, trade is one of the more statistically significant variables in explaining differences in the economic growth of countries (Prasad and Gable, 1997). Even critics of the mainstream literature (eg Rodriguez and Rodrik, 1999) agree that there is a link between trade and growth although they consider that questions may remain about the direction of causality between trade and growth. Numerous cross-sectional analyses have, however, demonstrated the positive effect of trade on per capita income growth (Frenkel and Romer, 1999; Dollar and Kray, 2001). At least one econometric analysis is explicit on the point, noting that a rise of one percent in the ratio of trade to Gross Domestic Product (GDP) can be linked directly to an increase of 0.5% in income per capita (Frankel and Romer, *ibid*). Furthermore, one analysis in the New Zealand context suggests that a ten per cent improvement in the Terms of Trade may increase RGDP (measured on the production side) by 6.3 per cent (Easton, 2004).

The emphasis on international trade and thus global competition is not to suggest, however, that New Zealand’s domestic competition policy laws and regulations are somehow lacking. They are not. Overall New Zealand’s competition regime comes out well in international comparisons (OECD, 2005a). For the agricultural sector, however, the small scale of the New Zealand domestic market and thus local competition policy is considerably less important to it than external markets (and competition policy in other markets) in a way that is perhaps less pronounced for other OECD economies. Taken together this has had a profound effect on innovation and competitiveness in a range of New Zealand-based agriculturally-focused companies. Since the reforms of the 1980s, many of these have leveraged themselves to deliver enhanced innovation thereby improving their global competitiveness in a range of product and service areas – many of which extend beyond the traditional agriculture sector.

The main point to distil from the above therefore is an obvious one. Trade is a necessary and critical component of any growth strategy for an economy like New Zealand’s. The inter-relationship between trade and growth has important implications for both the agricultural sector in general and innovation in particular. An interesting question for New Zealand, however, is whether its situation as a small and distant economy is unique in OECD terms and what this might mean in terms of innovation and competition.

In fact, as Table 2 suggests New Zealand *is* unique. It is the only OECD member which faces both a size *and* a distance-related problem. It is worth noting, however, that Australia faces similar constraints in terms of being at the ‘extreme’ end of the

distance problem (though not of 'size'), but despite this, it has performed better. Since 1988, for instance, New Zealand's GDP per capita expanded by an average 1.5 per cent per year, compared with more than 2 percent in Australia.<sup>7</sup>

Gravity modelling<sup>8</sup> has underlined the somewhat obvious point that distance from markets, like size matters in trade. More recent work has noted that there is little evidence of the 'death of distance' and that for most industries the distance-related costs of exporting have remained broadly unchanged, though for a minority of industries there has been a move in favour of closer markets (Berthelon and Freund, 2004).

**Table 2:** OECD Economies: Size and Distance<sup>9</sup>

	'Small' Economy	Large Economy
Geographically Close <sup>10</sup>	Austria, Belgium, Czech Republic, Denmark, Finland, Greece, Hungary, Iceland, Ireland, Luxembourg, Netherlands, Norway, , Poland, Portugal, Sweden, Switzerland, Slovak Republic, Turkey	Canada, France, Germany, Italy, Mexico, Spain, United Kingdom, United States
Geographically Distant	New Zealand	Australia, Japan, Korea

The rise in the trend towards 'just-in-time' production methods, combined with a concomitant increase in the importance of 'face-to-face' contact, particularly for the delivery of high value and more complex niche-oriented goods and services (as opposed to simple commodity trade) may further reinforce some of the problems inherent in distance (McCann, 2003). Taken together, there is a sense therefore that size and distance may serve to limit New Zealand's ability to realise economies of scale and scope. This has an effect on its ability to leverage for gains from specialisation and raises costs for exporters (and importers) as a consequence of greater transport and transaction costs associated with accessing distant markets. Similarly, these may also be hurdles to information and knowledge flows. Certainly it can be argued that such impediments can be mitigated by modern means of transportation and communication. There is no doubt, however, that they remain present.

The difficulty with geography and the 'curse of distance' is that there is not much New Zealand can do about it. Indeed, New Zealand actually exports perhaps more than the theory underpinning gravity modelling predicts. This suggests that while geography cannot be changed, the challenges of distance while problematic may be overcome (Leamer and Storper, 2001 and Smith, 2002). In fact, it may be precisely

<sup>7</sup> While Australia's population is five times greater than New Zealand's and its economy is more than five times greater, its distance from its primary export markets is broadly comparable. See in particular the discussion in OECD (2003).

<sup>8</sup> It is worth noting that using linear gravity models is not necessarily a particularly persuasive way to establish an approximation of the impact of distance on trade (and its attendant distribution).

<sup>9</sup> The category of size is determined for the purpose of this matrix by country levels of GDP drawn from the World Bank (2002).

<sup>10</sup> It may also be worth noting that the concept of geographically distant may depend somewhat on the question 'geographically distant from what?' For the purposes of this analysis, the answer is: geographically distant from key high-value export markets (eg the US and the EU).

the fact of gravity that explains why New Zealand has escaped the 'curse of distance'. As Leamer notes (2007, p. 112), there is "scarcity value in being different" and, in particular, proximity to economies that are capital accumulation scarce may have its own benefits.

Moreover, there are obvious advantages to distance as well – not least in terms of the agricultural sector. This builds tangentially on Leamer's (idem) point about the value of "scarcity". New Zealand's separation by considerable distance from a range of biological invaders has helped ensure the establishment and maintenance of a burgeoning agriculture sector. Its particular ecological and geographic characteristics have made New Zealand unique and this is increasingly valued by consumers of a variety of agricultural products, as well as tourists. Distance has also meant a certain level of immunity to trans-boundary pollutants which has improved the credibility of New Zealand's 'clean and green' image. Again this has positive spill-overs to the agricultural sector.

Finally, it should not be forgotten that when considering the effect of distance on trade, there is an important nuance. That is, for countries like New Zealand with highly diversified markets relatively evenly spread around the globe, the distance problem may be broadly comparable with its competitors. In this way, for instance, as countries in Asia become of increasing significance as trading partners to Europe, the distance-related effects will be comparable (e.g. European competitors of New Zealand in Asia are as distant from the region as New Zealand is).

In sum, while the size and distance problem exists for New Zealand and may make it unique in the OECD, its impact is not mechanical. Certainly, its small domestic market limits the range of economic activities that can be undertaken on a commercial scale in New Zealand. This makes it difficult for firms to grow above a certain size without a high proportion of export sales. Moreover, and particularly acutely in terms of innovation, remoteness from major markets and knowledge centres poses great challenges in maintaining the international connectivity essential to innovation and economic growth. This has been only partly offset by reductions in the cost of marine transportation and the revolution in electronic communication. The wider effects will interact with New Zealand's basic comparative advantage. Indeed, the New Zealand economy has been shaped by the trade and development of agriculture, forestry and fishing, and associated processing and service activities. More recently, agro-food related biotechnology and tourism have emerged as new industries based on exploiting that natural comparative advantage. As the OECD (2007b) has recently suggested, the primary sector has to a considerable extent shaped New Zealand's innovation and R&D system. The relationship between the agriculture sector and innovation intensified in the mid-1980s when the wider industry underwent dramatic and far-reaching reform. Much of this helped stimulate further innovation in the sector and improved competitiveness globally, despite relatively low global commodity prices over the period.

### **New Zealand's Agricultural Reforms<sup>11</sup>**

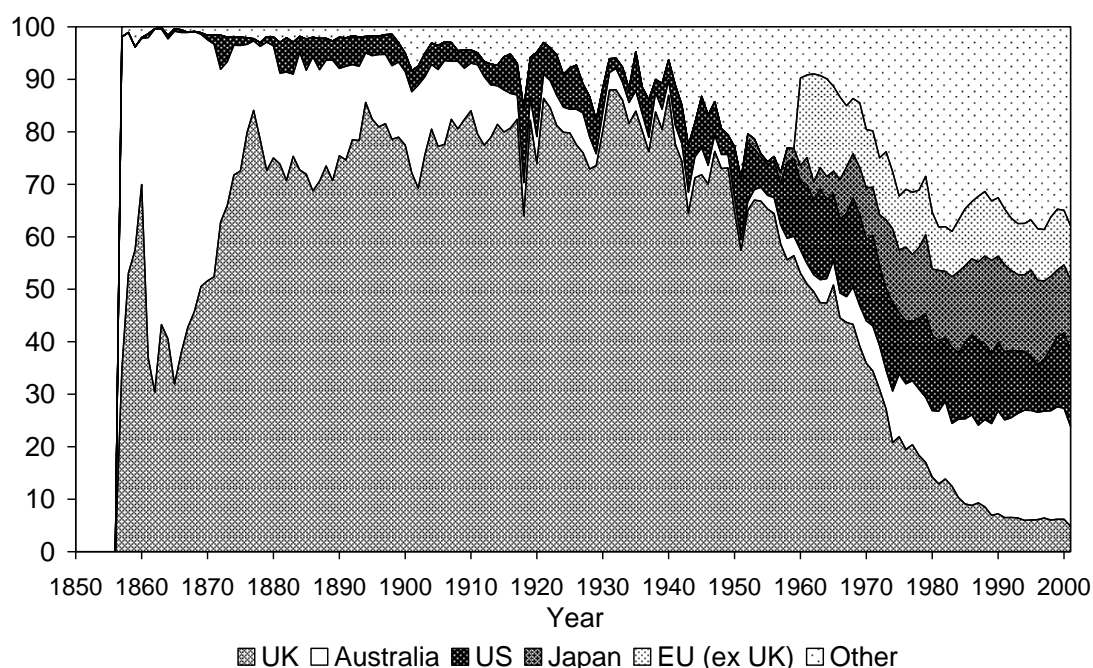
New Zealand's historical economic development since the late 1890s was stimulated by the opportunity to sell primary products like wool, dairy products and meat to the United Kingdom and other industrialised countries. The growth of manufacturing and the very sharp trend upwards in population in those countries after the Second World War increased the demand for food and industrial raw materials. This demand was met in part by New Zealand which, in aggregate terms at least, focused its

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<sup>11</sup> The following draws extensively on Vitalis (2006) and Lattimore (2006).

development (and macroeconomic policy) on its burgeoning commodity export sector (Lattimore, 1990) At the same time, and like most liberal developed economies over the past eighty years, New Zealand has pursued broadly orthodox Keynesian economic policies with limited nationalisation, social welfare and employment protection policies. Protection of the domestic market became standard practice, however, throughout much of the last century. Trade flows were narrow and focused on the United Kingdom, particularly over the first sixty years of the twentieth century. When the latter sought closer integration in the then European Economic Community, New Zealand's trade flows diversified, even if their composition (in broad terms) did not. External crises, including the oil shocks and the changing nature of international economic trends drove the demand for domestic trade liberalisation which culminated in the mid 1980s with the initiation of a series of far-reaching reforms which restructured both the domestic economy and fundamentally changed the country's trade policies. There was a marked shift away, for instance, from mercantilism to trade liberalisation in general and almost overnight the removal of a range of support measures, including for the agriculture sector.

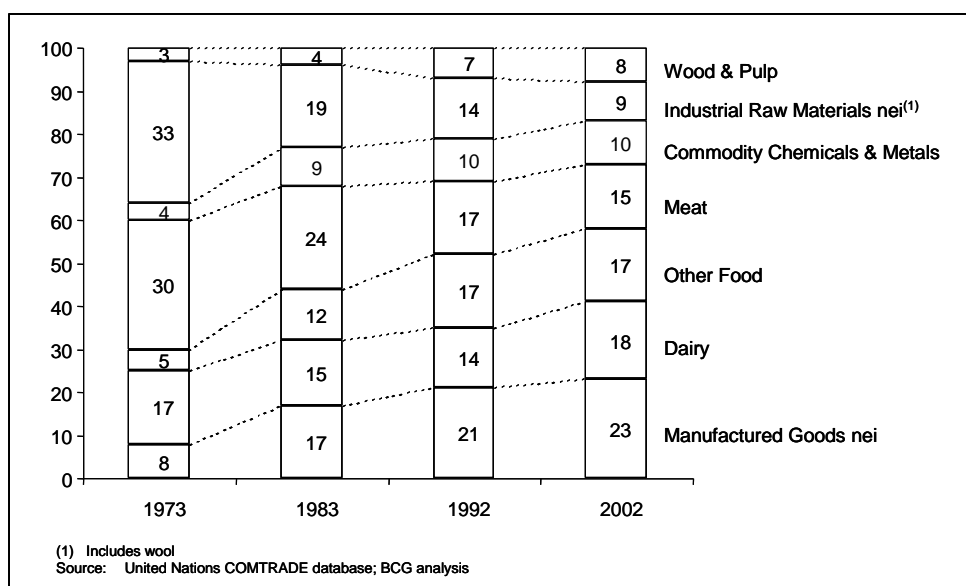
**Figure 4:** New Zealand's Export Diversification 1850-2000



Source Briggs (2003)

Arguably the single most important trade policy point to draw from the period since the United Kingdom signalled its intention to join the European Union is that, as Figure 4 demonstrates, New Zealand has diversified its range of trading partners, such that the distribution of its exports is more or less evenly spread among the EU, US, Australia, Japan and 'Other' (which comprises in particular ASEAN economies and China). As Figure 5, however, underlines, New Zealand has *not* diversified to any great extent beyond the primary products sector. That is not to say that in aggregate terms there has not been diversification. There has. This diversification has, however, been relatively narrowly focussed on primary products and food processing. Indeed, New Zealand is perhaps unique in the OECD in maintaining over time such a level of concentration. Turkey, Mexico, Poland and Slovakia for instance all have seen their export sectors diversify more rapidly in the past ten years than New Zealand's (OECD, 2003). Interestingly, initial work by the OECD (forthcoming)

on Brazil reveals a similar picture for that economy. Again, that is not surprising given its comparative advantage in a range of agricultural commodities.

**Figure 5:** Composition of New Zealand Exports of Merchandise Goods over Time

Source: Boston Consulting Group (2004)

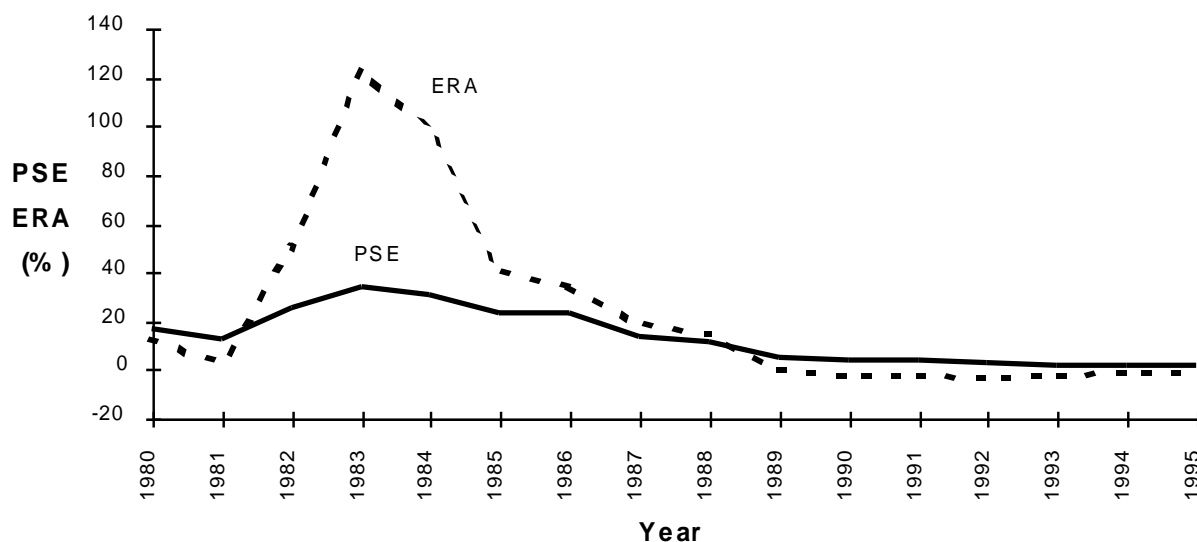
This limited level of diversification over time underlines the obvious point that New Zealand's comparative advantage remains primarily with agricultural products – including processed foods. These form the enduring core of New Zealand's ongoing trading relationship with the world. It is in this context that the New Zealand agricultural reforms in the mid 1980s, specifically the elimination or reduction of over 95 percent of subsidies, was a significant driver of change in the sector.

By 1983-4, New Zealand's general macroeconomic situation had deteriorated markedly. More specifically, some of the country's key economic indicators were signalling a serious problem, including inter alia, an inflation rate of nearly 21%, unemployment rate of nearly 10%, a ballooning fiscal deficit which by 1983 had increased to nine percent of GDP and real GDP per capita growth averaging barely 1 percent per annum between 1976 and 1984 (Wallace, 1990).

In the agriculture sector the economic situation had become similarly difficult (Tyler et al., 1990). The two decades to 1984 had seen a gradual acceleration in production grants and subsidies to the agriculture sector. In the 1960s agricultural support amounted to just 3 percent of farm income, by 1983 it was nearly 40 percent in the sheep sector alone. Taken together, this was equivalent to four percent of New Zealand's GDP. Initially relatively narrowly focused, the programmes rapidly expanded to include a range of production-related measures such as concessionary livestock valuation schemes; fertiliser subsidies; loans to farmers at below-market rates; generous tax rebates; and lucrative incentives for land development. At its height there were some 30 different forms of assistance to farmers. This was further boosted by a deficiency payment scheme (Supplementary Minimum Prices). By 1983, New Zealand's Producer Support Estimate (PSE) had peaked at 34 percent and the Effective Rate of Assistance surged to 123 percent (Figure 6)<sup>12</sup>.

<sup>12</sup>The Producer Support Estimate is an indicator of the annual monetary transfers to agricultural producers, measured at the farm gate arising from policy measures that support agriculture. The percentage PSE (ie Figure 6) represents the transfers as a share of gross farm receipts. The Effective Rate of Assistance (ERA) is the net value of assistance (i.e. less costs imposed by protection of sectors providing inputs) divided by value of production at world market prices at the border.

**Figure 6:** Percentage assistance to New Zealand Pastoral Agriculture before and after the Removal of Subsidies\*



\* Assistance figures are calculated with stabilisation payments spread over the years in which losses actually occurred, and not when settled

Source: New Zealand Ministry of Agriculture and Forestry (1996b).

While still moderate by world standards, the support levels were high for New Zealand (Smith and Montgomery, 2003). All of this had ominous implications for the sustainability of the agriculture sector and indeed the wider economy (Fraser et al 2005). Successive OECD Economic Surveys in the early to mid 1980s reported that the support being provided to the agriculture sector was no longer financially sustainable (OECD, 1983). In particular, the 1984-5 OECD Survey indicated serious problems with the SMP programme and a range of other production-related subsidies, noting that these were an effective brake on economic development (OECD, 1985).

By 1984-5, increased output from the agricultural sector was generally worth less than the actual costs of production and processing. Not surprisingly therefore the sector was the primary target for reform (Anderson, Lattimore et al 2007). The new (Labour) Government moved quickly by abolishing minimum price schemes for wool, beef, sheep meat, and dairy products. In addition, tax concessions for farmers were withdrawn. Free government services for farmers were also eliminated. Producer Boards had their access to concessionary Reserve Bank funding withdrawn. Land development loans; fertiliser and irrigation subsidies; and subsidised credit were also reduced and then phased out from 1987, as were assistance for flood control, soil conservation, and drainage schemes (Tyler, *ibid*). The scale and speed of the change is underlined in Figure 6 above. This shows the continuing decline from an average PSE of 24 percent in 1979-86 to 3 percent from 1989 onwards (OECD, 2005b). The Effective Rate of Assistance (ERA) shows even more clearly the decline in real assistance.

In general terms, the economic indicators for the agriculture sector improved across the board following subsidy elimination (New Zealand Ministry of Agriculture and Fisheries, 1996a). It is important, however, not to overdraw the causal relationship

between the removal of subsidies and the improvement in economic indicators. The removal of subsidies alone was not the sole contributing factor for the upturn in economic fortunes of the sector. Their elimination needs to be seen against the background of wider macroeconomic reforms taken across the economy (including the floating of the dollar, phased tariff liberalisation which lowered input prices and so on). Nevertheless, it is clear that the removal of subsidies was an important contributing factor to the changed and improved circumstances of the sector following the reforms of the mid 1980s (Chamberlain 1996). Taken together these reforms drove important innovations in the agricultural sector. A number of relatively small firms seized the opportunity to expand within the sector and internationally, with a number using their experience and comparative advantage in agriculture to leverage more innovative products that diversified and expanded their activities and opportunities. The Gallagher Group (Box 1) is a case in point. It is a company which benefited from a combination of the domestic reform process and the emergence and rapid uptake of new technologies. The company's original focus on electrical fences and farm gates had benefited from the subsidisation (eg to developing marginal land or sheep farming) and import-substitution policies that were a characteristic of the economy through until the mid 1980s. The removal of these subsidies drove the company to look more creatively at how it might leverage its knowledge and intellectual property in electrical fencing into other areas. The Gallagher Group's uptake of information technologies and the opportunities it saw to use this technology to develop its core products into, for instance, innovative security services to be traded internationally triggered a major expansion phase and considerable growth.

**Box 1: *The Gallagher Group: From Electric Fences and Farm Gates to Perimeter Security Systems and High-Tech Weighing machines***

Bill Gallagher, the founder of the Gallagher Group, made his first electric fence in 1937. By the 1970s, 'power fencing' had become an established element of animal management. By the mid-1980s, the core Gallagher products of the Gallagher PowerFence and Gallagher Franklin farm gates – both for animal management – appeared to represent the limit of the company's ambitions. With the elimination of domestic tariff protection and the termination of land-management subsidies (many of which had been used to offset the costs of purchasing electric fencing systems), however, the company was forced to work beyond the New Zealand and Australian market. By 2002-3, it had established distribution systems in more than 130 countries and was rapidly diversifying into other product lines – many of which were derived from the company's original product line – electric fences. Gallagher Group identified a new opportunity, for instance, in the expanding New Zealand livestock industry which grew rapidly in the 1990s once the full effect of subsidy removal was clear. It developed a unique range of weighing systems called SmartScale. These provide simple and easy-to-use data collection and weighing solutions for farms. Moreover, in response to the growing demand in new Zealand (and internationally) for traceability, the Gallagher SmartScale offers an interface to electronic livestock identification systems.

Like the Gallagher SmartScale, Gallagher Security Systems have been an innovative spin-off from the agriculturally-focused activities of the Group. These have experienced rapid growth internationally as a consequence of their highly sophisticated software that includes anti-intruder systems and allows security management remotely, ranging from basic card access systems to more sophisticated perimeter systems. The Gallagher PowerFence system for human security has been installed in a range of countries, including in the United Kingdom for British Gas and National Grid sites. The Gallagher Cardax FT system integrates access control and intruder alarm management – delivering one user interface and a single and thus easily manageable audit trail. By interfacing with systems from SAP and Oracle, organisations that use the Gallagher Cardax FT system can help improve occupational health and safety. Similarly, linking the Gallagher Cardax FT to Building Management Systems can assist in improving building energy consumption and efficiency. More recently, the PowerFence FT system provides for a WAN/LAN-based solution for unlimited site capacity and is believed to be a world's first. Source: <http://www.gallaghergroup.co.nz>

Perhaps the most dramatic change triggered by the reforms was to the sheep sector. Table 3 below shows the changes that took place in the sheep and dairy sectors in particular, as well as the development of the deer (venison) industry. The national sheep flock was sharply reduced from 70 million in 1983-4 to 40 million in 2004-5. There are now 31 percent fewer sheep and beef farms. There has been a shift in focus from quantity to quality; lambing percentages, for instance, have actually increased by 25 percent compared with the 1984-5 levels. Average carcass weights have also increased by a quarter. General agricultural productivity growth is three times greater than in the economy as a whole and some of the most spectacular gains have been in sheep breeding. In 2002, for instance, the export revenues from a sharply reduced flock exceed those generated by the 70 million strong flock extant in the early 1980s (Sherwin, 2004).

**Table 3:** Changes in Sheep, Dairy and Deer Numbers Before and After the Reforms.

	Pre –reform (1983-4)	Post-reform (2004-5)
Sheep	70 m	40 m
Dairy herds	16,000	13,000
Dairy cattle	2.3 m	5.3 m
Deer	-	2 m

Source: Statistics New Zealand, author's calculations.

As a direct result of the reduction in stock numbers, many processing companies were forced to close in the mid 1980s. Benchmarked relative to their international competitors, processing plants in New Zealand are now smaller on average, closer to sheep farming areas and much more modern and sophisticated than they were before the reforms. They have also managed to smooth processing across the year to a considerable extent. Particularly important perhaps is that processing companies have focused on adding value, through innovation. In 1982, carcasses accounted for 82 percent of New Zealand's global lamb exports. Now 90 percent of sheep meat exports are cut and pre-packed before they leave New Zealand. The reforms have also triggered the enhanced responsiveness of New Zealand producers to (international) consumer demand. The cutting and pre-packing of sheep meat and beef, for instance, is now undertaken in direct consultation with supermarkets in distant markets. New Zealand has also diversified its markets and many New Zealand companies have processing facilities located in overseas markets to better supply supermarket chains with specific cuts on request and on a 'just-in-time' basis.

While the decline of the sheep sector was one striking economic outcome of the reform, the change in dairying was no less profound. The number of dairy herds fell 17 percent from nearly 16,000 in 1983-4 to around 13,000 in 2004-5. Significantly, however, the national herd actually increased from 2.3 million to 5.3 million (see Table 3). Moreover, the average herd size has increased from 150 to 270 and there has been a 75 percent increase in the volume of dairy production. In 1984, New Zealand did not have a deer industry and there were no venison exports. Two decades later, the national deer herd is around 2 million (Table 3) and export earnings exceed \$US\$100 million.

It is also worth noting that the domestic reform process has had a positive impact on sustainability. In particular, the removal of subsidies for the development of marginal land into pasture for sheep grazing has meant that farmers have had less incentive to convert indigenous bush and other marginal land to other uses. Total area in various

forms of pasture has declined from 14.1 million hectares in 1983-4 to 13.5 million hectares in 1995 and 12.1 million in 2004-5. Concomitantly, the area of planted forest has increased from 1.0 million in 1983-4 to over 1.8 million hectares in 2003-4 over the same period. This occurred despite the removal of forestry establishment grants in 1984 (New Zealand Ministry of Agriculture and Forestry, 1993). More particularly, reduced government intervention has had environmental benefits since there is now a growing appreciation that sustainable land management is enhanced through diversification. Moreover, there is also a better understanding of the complementary nature of diversified land use to mitigate soil erosion, enhance general amenity values as well as producing a valuable crop. Clearly, however, other pressures have emerged in terms of land use, not least those associated with dairying (eg water quality and so on) and these will remain as recurring challenges in the future (Vitalis 2006).

New Zealand's extensive history and experience of sheep, dairy and beef farming has resulted in the development of a range of leading-edge science and technology-related innovation. The rapid expansion of the dairy sector in particular, in part a consequence of the domestic reform process described above and improving access to international markets, has laid the foundations for a world-leading innovator in pastoral livestock genetics. The Livestock Improvement Corporation benefited from the reform process by a rapid expansion in the sector's investment in research and development beyond its historical focus on milk production (Box 2). This has been further buttressed by significant investment by particular companies (both meat and dairy), the re-organisation of the country's research centres into Crown Research Institutes and the development of an enhanced and evolved national innovation strategy.

**Box 2:** *Livestock Improvement Corporation (LIC): From measuring and lifting milk production to genetic stock improvement and research*

For the past sixty years, Livestock Improvement Corporation has been investing heavily in genetic improvement programmes. Particularly dynamic growth and expansions of activity beyond simply improving milk production (LIC's sole focus until 1986) was experienced in the wake of the restructuring of the wider sector in the mid 1980s – with the company nearly trebling in size. The removal of domestic-level distortions improved farmers' abilities to assess the value of the work of LIC. Not surprisingly, it was during this period that LIC began to expand and focus its efforts on dairying and beef in the context of the reform period, since this is where the most significant export-led growth was occurring. Specific innovations launched by LIC in the post-reform period include:

- Development of a unique national database that offers farmers and, increasingly consumers, unparalleled traceability of livestock. The database contains the records of more than 16 million dairy animals, records 97% of cow locations and movement over time, lists all New Zealand dairy farmers, their farms and locations, and details over 90% of mating records nationally.
- Expanded genetic improvement which has been particularly important to both the beef and dairy sectors in maintaining New Zealand's global competitive edge. Once-a-day milking has been a highly prized objective (though in most economies unattained for grass-based dairy production). LIC's breakthrough research on a 'Once-a-day' Breeding index has helped bring this reality closer for many New Zealand dairy farmers. The index developed by and exclusive to LIC enables the identification of bulls which sire cows most suited to once-a-day milking. It also enables farmers to identify cows suitable for the mating programme. LIC has also identified and patented a range of genes that affect milk production and is engaged in gene-typing of livestock with a view to improving the databases on both meat and milk production levels.

- The enhancement of MINDApro which is a highly sophisticated and interactive herd recording system developed by LIC. This software enables farmers to design bespoke herd reports appropriate to their individual needs and circumstances.
- Development of an electronic identification system for cows (Protrack). Electronic identification and tracking has been a particular challenge for New Zealand in the dairy sector given its dramatic expansion. Protrack, which enables farmers to identify and draft cows, without moving from the pit of the farm dairy has improved efficiency and accuracy in terms of stock handling.
- Process automation robots have been an expanding feature of LIC activities. It has secured patents for both the robot and a manufacturing system with sales made as far afield as Belgium and Denmark.

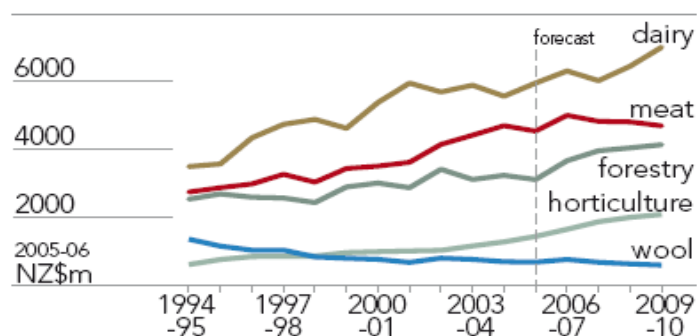
LIC has been critical to the development of herd improvement programmes both nationally and, increasingly since the 1990s, internationally as well (including inter alia, Brazil, Ireland, Australia, Argentina, Ireland, South Africa and the United States).

Taken together, the expansion of LIC has helped ensure that New Zealand dairy farmers enjoy the lowest cost milk production in the world, in no small part a consequence of the “high technology transfer rate (research to on-farm practice), national farm management and breeding strategies as well as the highest rate of genetic gain of any dairy industry in the world” (OECD, 2007b).

Source: [www.newzealandgenetics.com](http://www.newzealandgenetics.com)

The importance of maintaining a high quality livestock base, including through innovation in such areas as semen databases, DNA tracing and increasingly sophisticated genetic science is underlined in the projected growth and thus importance to the sector of the dairy and to a lesser extent meat trade (Figure 7).

**Figure 7: Export Values by Sector (April-March years)**



Source: New Zealand Ministry of Agriculture (2006a)

Perhaps more than almost any other OECD Member, New Zealand’s agricultural sector depends heavily and in some cases almost exclusively on international markets. Some 90% of all pastoral production is exported. The situation is particularly pronounced with regard to dairy products. More than 95% of dairy products manufactured in New Zealand are exported. New Zealand accounts for up to 33% of internationally traded dairy production.<sup>13</sup> New Zealand is also the world’s largest exporter of butter, skim milk powder and casein, and the second largest exporter of

<sup>13</sup> This figure excludes trade by EU Members within the European Union.

cheese and whole milk powder (excluding intra-EU trade). (New Zealand Ministry of Agriculture and Forestry, 2006b).

The experience and growth of the New Zealand horticultural and viticultural industries emphasises the importance of international trade to the wider sector. Before the reforms were launched, both sub-sectors were small and largely domestically focused. They exported relatively little and depended heavily on the local market, not least because subsidies to meat, wool and dairy production dwarfed assistance to both wine and horticulture, with farmers responding to these signals by focusing production where the subsidies were provided, including those supporting exports. In this context, it is not surprising to see that the wine and horticultural industries have been two of the primary beneficiaries of the removal of subsidies. Table 4 shows the expansion in the export of horticultural products and wine.

**Table 4:** Changes In The Export of Horticultural Products And Wine Before And After The Reforms.

	Pre –reform (1983-4)	Post-reform (real) (2004-5)
Exports of kiwifruit (US\$)	42 million	405 million
Exports of all horticultural products (US\$)	140 million	827 million
Wine (US\$)	< 10 million	125 million

Source: Statistics New Zealand and author's calculations

In 1983-4, New Zealand exported US\$42 million kiwifruit and US\$140 million worth of horticultural products in total. In 2004-5, it exported more than US\$400 million worth of kiwifruit alone and nearly US\$850 million worth of horticultural products more generally.

The New Zealand wine industry is an example of the way in which a combination of domestic economic reform, international trade and enhanced responsiveness, exposure (and vulnerability) to consumer preferences have driven growth. The industry had been characterised by small scale family enterprises producing largely fortified wines for an unsophisticated and highly regulated, and largely uninterested domestic market. Licensing systems favoured the more politically powerful beer producers at the expense of wine. Moreover, trade policy before 1984-7 shielded the domestic wine (and beer) sector from foreign competitors (Barker, 2001).

The removal of tariff protection and other forms of trade-distorting support was supplemented by a progressive reform of regulations over the period. This included the introduction of the export certification system, revised provisions regarding oenological practices, and the one off (non-trade distorting) Grapevine Extraction Scheme. Taken together the period was characterised both by consolidation which led to the growth of large producers *and* expansion in the number of new independent “boutique” producers of high quality specialised wines using innovative processes for production and marketing (OECD, 2005). In addition, and with a view to further building high-value brands, a number of New Zealand wine producers are responding to consumer demand by seeking to develop their credentials in terms of sustainability. Grove Mill Wine is one such example. It is a company which has implemented existing improvements in information technology (enhanced traceability) and other new technologies (cold cellaring, recycling water etc) to successfully attain certification as a member of the CarboNZero programme (Box 3). Grove Mill did not

invent any of these ‘innovations’. What it did, however, was absorb and apply these in its business to develop and enhance its own innovative practices.

The reforms had a significant impact on the sector’s development internationally. In short, it has been a growth industry. Exports were worth less than US\$10 million in 1984-5 and \$125 million in 2004-5. New Zealand wine is now exported to more than 74 countries. In 2005-06, the United Kingdom represented 39 per cent of total export volume, followed by the United States (25 per cent) and Australia (22 per cent) (New Zealand Ministry of Agriculture and Forestry 2006). Moreover, underlining the way in which New Zealand wine producers have targeted the high-value end of the UK market, New Zealand wines secure the highest return per litre in that market. Judging from the wine industry’s own recent comments, the process of ongoing innovation as a way of aggressively pursuing new export markets remains a central part of its strategy (Dominion Post 2007).

**Box 3:** *Grove Mill Wine and CarboNZero<sup>14</sup>: Sustainable, carbon-neutral and high-quality wine*

The Grove Mill winery was established in Marlborough in 1988 – almost at the end of the agricultural reform process and at the point where the horticultural and wine industries were beginning to expand as a consequence. The Grove Mill brand encompasses a range of wines, including Sauvignon Blanc, Chardonnay, Riesling, Pinot Gris and Pinot Noir. In 1993, Grove Mill began to export to the United Kingdom and Hong Kong. It successfully doubled production annually including through the implementation of a range of innovative grape-growing and winemaking techniques. Grove Mill’s expansion has been characterised by an emphasis on innovation. This has been deployed to improve efficiency, competitiveness and its global marketability, not least in terms of its brand image. In particular, Grove Mill has effectively developed for itself a niche as a world-leader in the sustainable production of high-quality wines.

Innovations have included a “cold cellar” that increased capacity to 3,100 tonnes of grapes (more than 150,000 cases of wine) and deployed a fully computerised ventilation system that helps conserve energy by minimising requirements for tank control. Grove Mill’s primary innovation perhaps has been its commitment to sustainability. It has restored the wetlands around the Grove Mill winery and the iconic Grove Mill symbol is the Southern Bell frog which is also found in the wetlands surrounding the winery. Grove Mill has also developed a unique waste-water facility to assist in conservation and recycling of water used in winemaking. A commitment to full insulation of both the winery and the warehouse has meant that no additional energy has been required either to heat or cool the warehouse. The company has also increasingly used organic fertilisers as part of its wider commitment to sustainability.

Perhaps most well known, however, has been Grove Mill’s achievement of carbon neutrality through its receipt of the CarboNZero award. It is believed to be the world’s first wine producer to have achieved carbon neutral status. The certification (managed by Landcare Research) process is a burdensome one and involves addressing all climate change-related impacts with the objective of not adding any net carbon dioxide emissions into the atmosphere through the production *and* distribution of Grove Mill wines. This commitment to innovation has had immediate and positive effects. It has improved the company’s competitiveness though, *inter alia*, securing the contract to produce the UK Supermarket

<sup>14</sup> More generally, it is worth acknowledging that Grove Mill is simply one of a growing number of New Zealand wineries with a commitment to sustainable production. The New Zealand Winegrowers’ Association has a stated objective of the entire industry operating under independently audited sustainability schemes by 2012 ([www.nzwine.com/intro/index.html](http://www.nzwine.com/intro/index.html)) and LandCare Research is currently helping more than thirty vineyards and wineries measure, manage and mitigate their greenhouse gases. Many of these are expected to attain CarboNZero within the next twenty-four months ([www.landcareresearch.co.nz](http://www.landcareresearch.co.nz)).

chain Sainsbury's house branded wines, largely because of the product's carbon neutrality

Source: ([www.grovemill.co.nz](http://www.grovemill.co.nz)).

One of the key effects of the reforms in terms of agricultural trade was the reduction in the relative importance of pastoral farming to merchandise trade exports. That said, the sector continues to dominate New Zealand exports at 38 per cent in 2005-6. This represents, however a sharp decline from the more than 60 per cent which the sector accounted for during the period of high levels of agricultural subsidisation. More particularly, the composition of merchandise exports has also been transformed over the period. This has been a result of the sector's greater responsiveness to global consumer signals regarding more profitable products such as fruit, vegetables and dairy products (New Zealand Ministry of Agriculture and Forestry, 2006b).

Across specific sectors too, the levels of responsiveness to market signals was improving with concomitant effects on trade and growth within specific sub-sectors in the New Zealand agricultural economy. In particular, the agriculture sector as a whole is now characterised by an ability to rapidly reallocate resources in response to market signals. While the sheep meat sector continued to struggle in response to the elimination of subsidies that had largely concealed its lack of global competitiveness, firms operating in the dairy and horticultural sub-sectors began to expand and diversify their trading relationships. From 1989 through to 2005, dairy farming and horticulture, for instance, experienced comparatively high average annual growth rates of 5.3 per cent and 2.8 per cent respectively. Interestingly too, both subsectors (dairy and horticulture) began to actively seek and develop external sources of supply to secure and expand export markets. In the case of horticulture, the kiwifruit industry became active in other markets (eg Italy and Chile) to source product to service a larger export base as well as to leverage its intellectual property rights on new varieties of kiwifruit developed in New Zealand. It may also be worth noting the impact of strict foreign sanitary and phyto-sanitary requirements on export quality - e.g. food safety and residual contaminants in, for instance, wool. The sector has generally chosen to export product that would be acceptable to all markets, with associated cost premia, as a response to risks in these areas. This compares to producers in countries dominated by significant domestic markets where external disciplines are less effective, with attendant effects on cost.

Over the same period, the rapid development and innovation in the food processing industry too showed immediate benefits. The food, beverage and tobacco manufacturing sector, for instance, enjoyed an average annual growth rate of 2.3 per cent, with primary food processing achieving growth of 3.7 per cent, higher than the rate for the wider economy. (New Zealand Ministry of Agriculture and Forestry, 2006b).

An interesting spill-over of the subsidy reform programme undertaken in the mid 1980s has been the way in which farmers sought to diversify their incomes in non-traditional ways. Initially, many had expected that the reform process would change farm sizes, forcing farmers to expand the size of their holdings to remain profitable. In fact, however, the elimination of subsidies had only a relatively modest effect on farm size. There was some consolidation and an increase in the size of some holdings (eg dairy herds expanded), though this has been primarily a consequence of a drive towards greater efficiencies of scale. The elimination of land development subsidies has meant the withdrawal of marginal land (i.e. land not suited for pastoral agriculture) from production. Much of this land has also been re-forested. Moreover, farm distribution has become increasingly bi-focated – more and larger farms (dairy, sheep and arable) and more smaller farms (viticulture, horticulture, venison). Interestingly, however, a number of relatively small dairy and sheep farms have continued to survive, in part through diversifying their primary sources of incomes. In an increasing trend, many are accessing the burgeoning tourism market for farm tours. In particular, a growing number of service providers have established themselves to deliver increasingly sophisticated value-added services incidental to agriculture (Box 4). This has in part been a consequence of the reforms where farmers could no longer rely on Government subsidies to survive and instead had to turn to new and innovative ways to supplement their incomes. In addition, the emergence of new technologies over the period, particularly the internet facilitated the enhanced delivery of such services. In line with the definition of innovation utilised in this analysis, Agri-tour innovated by applying existing technologies (the worldwide web) in a different environment.

**Box 4: *AgriTour: From farming to farm and agri- tour services***

In 1984-5, four “agriculturalists” with a diverse range of experience in New Zealand farming established AgriTour. The company is almost entirely web-based and all of its global (ie non-New Zealand) advertising is through the internet. It designs tours of farms offering both technical and non-technical tours “if you want to talk sheep, we speak the language.” The company offers tourists the opportunity to meet with farmers, farm advisers, consultants, scientists and lecturers, as well as politicians, senior civil servants and agri-business staff. In particular, AgriTour offers a range of “technical tours” that go well beyond the more traditional farm tours ‘pet the sheep and feed the cows’. Such tailor-made tours encompass sheep and deer production, animal breeding, nashi, melon, persimmon, kiwi fruit production, as well as further up the chain to include meat packing houses, dairy processing plants and agricultural waste control and disposal facilities. Moreover, the company can also assist in designing ‘add-ons’ ranging from hunting and fishing trips to white-water rafting and jetboating.

Source: <http://www.agritour.co.nz>

**Policy Implications**

It has become a truism to say that a feature of New Zealand's uniqueness is its geographic isolation and its small size. These all have had an impact on the economy's ability to innovate and grow, though the key driver has been a domestic economic reform programme, coupled with the sector's dependency on international markets for its products as well as the uptake of new technologies. Against this background, and in the context of the linkage between the reforms and trade, innovation and competition there are perhaps four key policy-related lessons:

First, reforms must be implemented according to an agreed and transparent timetable. Certainty of reform and its pace is essential for its success and does have a bearing on the ability of a sector to innovate over time. New Zealand farmers were given clear signals about the pace, breadth and depth of the reform. This was vital to their overall long term success. A policy that is too gradual, like the planned next phase of CAP reform in 2012 for instance, is likely to fall prey to conflicting signals and vulnerable to capture by special interest groups (Johnston 2000) with attendant implications for investments in innovation-related research and development. Notwithstanding this, transitional measures should be designed in sequence with the reforms. These must, however, be measures that assist the change, not delay it.

Second, sequencing is crucial. A holistic strategic overview of the reform process is required. Tackling a single sector in isolation may lead to increased suffering in that sector if other parts of the economy are not addressed simultaneously. In the case of New Zealand there were widespread reinforcing reforms in overall macro-economic management and micro-economic regulation, including measures which lowered input prices etc. Nevertheless, there were imperfections. The lowering of tariffs on inputs to farms and a range of other products of relevance did not proceed as quickly as the elimination of subsidies to the agriculture sector and this caused unnecessary hardship in terms of loss of income. This also had a bearing on the sectors' short term ability to be innovative when the costs of key inputs (eg wine-making equipment, horticultural technology) remained expensive as a consequence of high tariffs. In short, reforms that foster innovation need to be multi-sectoral and effectively sequenced.

Third, technology and, in particular information technology are increasingly powerful determinants of a sector's ability to innovate and thus compete internationally. This is an unsurprising conclusion. What is perhaps important to emphasise, however, is that innovation should not be defined simply as developing 'global firsts'. Rather, the New Zealand agriculture sector demonstrates that innovation can be the application and absorption of new and emerging business practices (including marketing etc) and technologies (produced elsewhere) in different environments to considerable effect. A feature of the New Zealand agriculture sector has been its ability to swiftly absorb new technologies and business practices that it has not produced itself and utilise these effectively in way that has enhanced competitiveness. That cannot, however, be taken for granted in the longer term, not least the potential for complacency against a background of rising global commodity prices. Moves to develop an evolved and integrated national innovation strategy – more particularly a 'living' strategy that can more swiftly respond to emerging needs over time - will undoubtedly assist that process and, in particular, facilitate absorption. The key will be to remember that innovation is about "adoption, absorption and adaption", rather than necessarily headline-catching new technologies (Enos and Park 1988).

Fourth, while quantitative work suggests that economic reform, particularly trade liberalisation delivers the greatest benefits when countries deregulate multilaterally, the New Zealand experience strongly supports the view that unilateral reform delivers substantive and worthwhile economic benefits which in themselves have a positive effect on innovation and the ability to compete internationally. This does not,

however, diminish the value of multilateral efforts at reform, including in particular the ongoing WTO negotiations launched in Doha in 2001.

## **Conclusion**

Far-reaching economic reforms have helped increase the New Zealand agricultural sector's incentives to respond more effectively and efficiently to global price signals by switching to new or different types of production and investing more heavily in innovation that can leverage international exports. Significantly, there were no incentives or subsidies to assist these changes which occurred during a period of generally declining global commodity prices. They were business decisions that no government would ever have had sufficient information to make. Risks have been diversified – and responsibility for commercial viability squarely accepted by the sector itself. This has been amplified by the sheer economics of a situation where the agriculture sector cannot rely on its domestic base for growth.

Taken in aggregate, the dependence on external trade combined with the reform process undertaken by New Zealand in conjunction with rapid changes in technology and IT more generally has been critical to the agricultural sector's improved ability to be innovative in a world where it must retain its competitive edge. That such innovation has occurred against a background of low global commodity prices makes the case of the New Zealand sector particularly interesting. Many New Zealand companies have demonstrated an ability to leverage their comparative advantage based on their experience in the agriculture sector. They have used that knowledge to improve their commercial prospects and indirectly those of the sector itself to compete internationally. In the context of increasing global commodity prices, the challenge for the sector will be to maintain and expand its levels of innovation as a way of cementing its credentials as a world leader. In short, the far-reaching reforms implemented over the past two decades combined with the uptake of new technologies in an increasingly competitive international environment have been the key drivers of innovation in the New Zealand agriculture sector. It is this combination of factors which have helped lay the foundations for the sector to craft for itself a sustainable future.

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