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Ministry of Agriculture and Forestry

**The Effect of Industry Structure and Institutional
Arrangements on Growth and Innovation in the
New Zealand Agriculture Sector**

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Exchange rates as at 31 July 2007:

1 NZD = 0.8879 AUD = 0.5627 EUR = 0.3802 STG = 0.7716 USD = 92.03 YEN

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
BRC	British Retail Consortium
BTA	Bilateral Trade Agreement (see also FTA and RTA)
CAP	EU Common Agricultural Policy
CER	Australia and New Zealand Closer Economic Relations
CFAA	Crown Forest Assets Act
CFL	Crown Forestry Licence
CO ₂	Carbon Dioxide
CoRE	Centre of Research Excellence
CP1	First Commitment Period under the Kyoto Protocol, being 2008-12 inclusive
CRI	Crown Research Institute
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DIRA	Dairy Industry Restructuring Act
DoC	Department of Conservation
DTA	Double Taxation Agreement
ERMA	Environmental Risk Management Authority
ETI	Ethical Trading Initiative
EU	European Union
EU ETS	European Union Greenhouse Gas Emission Trading Scheme
EurepGAP	Euro Retailer Produce working Group Good Agricultural Practice
FAO	United Nations Food and Agricultural Organization
FoRST	Foundation for Research, Science & Technology
FDI	Foreign Direct Investment (see also ODI)
FSC	Forest Stewardship Council
FTA	Free Trade Agreement (see also BTA and RTA)
GAP	Good Agricultural Practice
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GE	Genetic engineering
GFSI	Global Food Safety Initiative
GHG	Greenhouse Gas
GMO	Genetically Modified Organism
HACCP	Hazard Analysis at Critical Control Points
HASNO	Hazardous Substances and New Organisms
HEA	Horticulture Export Authority
ICT	Information and Communications Technology
IFP	Integrated Fruit Production
IMF	International Monetary Fund

IP	Intellectual Property
ISCR	New Zealand Institute for the Study of Competition and Regulation
JV	Joint Venture
LEB	Life Expectancy at Birth
LIC	Livestock Improvement Corporation
LINZ	Land Information New Zealand
MAF	Ministry of Agriculture and Forestry
MfE	Ministry for the Environment
MFP	Multifactor Productivity (see also TFP) – also known as “Solow Residual”
MNE	Multinational Enterprise
MoRST	Ministry of Research, Science & Technology
NGC	New-Generation Cooperative
NIS	National Innovation System
NZAX	New Zealand Alternative Exchange, run by NZX
NZDB	New Zealand Dairy Board
NZFSA	New Zealand Food Safety Authority
NZSX	New Zealand Stock Exchange, main listed share board run by NZX
NZX	New Zealand Exchange
ODI	Outbound Foreign Direct Investment (see also FDI)
OECD	Organisation for Economic Co-operation and Development
PBRF	Performance-Based Research Fund
PFSI	Permanent Forest Sinks Initiative
PPCS	Primary Producers Cooperative Society
PPP	Public-Private Partnership, or Purchasing Power Parity
QMS	Quota Management System
R&D	Research and Development
RMA	Resource Management Act
RS&T	Research, Science and Technology
RTA	Regional Trade Agreement (see also BTA and FTA)
SFI	Sustainable Forestry Initiative
SOE	State-owned Enterprise
SPS	Sanitary and Phytosanitary agreement
TEC	Tertiary Education Commission
TFP	Total Factor Productivity (see also MFP) – also known as “Solow Residual”
TIMOs	Timberland Investment Management Organisations
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
USDA	United States Department of Agriculture
WTO	World Trade Organization

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1. Introduction and Summary

“... institutional design is analogous to driving down a four-lane highway looking out the rear-view mirror. We are better at making course corrections when we start to run off the highway than at using foresight to navigate the transition to sustainable growth in agricultural output and productivity.” Ruttan (2002, p. 180)

“Is it not quite remarkable that millions of independent farmers have been so responsive to new and improved opportunities to save resources that they have had a higher rate of productivity change than the industrial sector? True, farm people have benefited from research (much of it undertaken at public expense), from the supply of non-farm inputs, from improvements in infrastructure such as roads and communication, and in the industrial countries from a significant degree of protection. Even so, the record is a remarkable one.” Johnson (1997, p. 10)

1.1 Purpose of the Report

How do industry structures and other institutional arrangements affect growth and innovation in the New Zealand agricultural sector? Put another way, how can those structures and arrangements be improved to better facilitate growth and innovation in the New Zealand agricultural sector? Addressing such questions is the ambitious aim of this report.

The aim is ambitious in at least three respects:

- It involves a very broad set of relevant considerations, ranging from macro-level international and domestic institutions at one level, all the way down to an examination of the particular business forms adopted by agricultural sector actors;
- The relevant literatures on growth and innovation are not settled, meaning that any consensus on the key considerations – except at a high level – cannot be taken as given; and
- New Zealand’s already relatively flexible institutional environment, and existing institutions that are internationally rated as being among the best in the world, mean there are unlikely to be any obvious prescriptions for markedly improving existing arrangements.

The challenge is made all the greater by the fact that considerable inquiry into growth and innovation in New Zealand has already been undertaken. Examples of such inquiry include work on the determinants of New Zealand’s contemporary growth performance (e.g. Galt (2000), Treasury (2004)), and on factors contributing to the agricultural sector’s productivity performance

in particular (e.g. Hall and Scobie (2006)). Considerable work has also been undertaken looking at the determinants of New Zealand's productivity performance more generally (e.g. Lawrence and Diewert (1999), and Drew (2007)), and also on how best to organise New Zealand's national innovation system (e.g. Smith (2006)). For this report to add any new insight is therefore quite a demanding task.

This report adds to these inquiries, however, by focusing in particular on the roles of institutions and industry structures on growth and innovation – as opposed to the myriad other possible explanations for economic growth and for innovation. It also directs the inquiry towards agriculture in New Zealand as opposed to the country's wider economy, taking into account the particular circumstances and challenges facing New Zealand's agricultural producers. This is achieved by considering the theoretical and empirical literatures of relevance (both international and domestic), as well as details of New Zealand's relevant institutions, and of each of the selected sub-sectors.

Wherever possible, suggestions are made as to where New Zealand's arrangements might merit change or further inquiry. In formulating such suggestions, however, care has been taken to identify potential blockages to desirable institutional or structural innovations, rather than to presume the authors know better than sectoral actors who have the strongest information and incentives to make such changes. Given the broad nature of this inquiry, we have been hesitant to make strong recommendations, but instead prefer to identify possible avenues for fruitful further inquiry.

1.2 Agricultural Sub-Sectors Considered

This report focuses on industry structure and institutional arrangements as they relate to or affect the following seven agricultural sub-sectors (including both production and processing):

- Apples and pears;
- Dairy;
- Forestry;
- Kiwifruit;
- Sheep and beef;
- Wine; and
- Wool.

A theme emerging from our analysis of these sub-sectors is the growing importance of New Zealand agricultural land being used for multiple, sometimes non-agricultural, purposes. Accordingly, the conventional definitions of industry boundaries may in practice become blurred. An example of this blurring includes the increasing use of agricultural land for tourism activities to

complement “traditional” farming activities. Another is off-farm agricultural actors operating across multiple types of agricultural activity (e.g. dairy, horticulture and meat processing).

A different kind of boundary blurring is also increasingly apparent – the projection of New Zealand agricultural activity into the multinational space. By this we mean more than the simple exporting of New Zealand agricultural produce – processed or otherwise – to a multitude of export markets. Such has been the history of New Zealand’s agricultural sector in recent decades. Instead we refer to the growing trend for New Zealand (foreign) producers, either directly or through their downstream entities and partners, to procure supply from agricultural producers in other countries (New Zealand), and to process and/or export that supply, along with their own products or in its own right.

Our report therefore considers industry structures and other institutions affecting growth and innovation involving more than just New Zealand-sourced agricultural produce. We also consider how such structures and institutions affect growth and innovation involving globally-sourced produce that is processed and/or marketed by entities partly or completely controlled by New Zealand agricultural actors. As such, our focus is on improving the efficient economic use of New Zealand’s agricultural land-based resources, whether that use is solely agricultural or otherwise, as well as the economic performance of New Zealand-based multi-national agricultural operators.

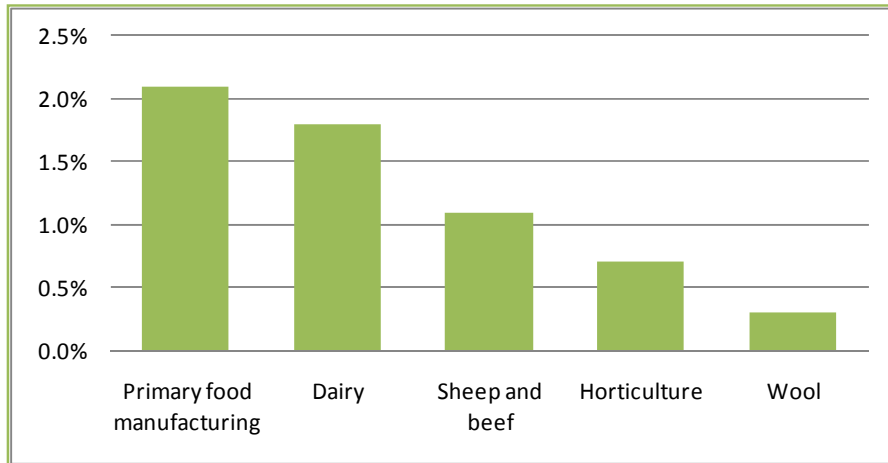
The following table and figures provide snapshots of the agricultural sub-sectors considered in this report. As can be seen, the dominant agriculture land users are dairy, and sheep and beef. These sectors (including processing) also contribute the most of any agricultural sectors to GDP, and also to New Zealand’s exports.

Table 1.1 – Extent of Selected Agricultural Sub-Sector Activities

Sub-Sector	Area (m ha)	Active Units	Production	World Export Significance
Apples and pears	c0.012	920 orchards	474 kt	5% of world exports
Dairy	2.0	12,000 herds	1,213m kg milk solids	33% of world exports Fonterra 40% of cross-border
Forestry	1.8	Top 5 = 39% Top 20 = 63%	18m m ³	Fourth largest softwood logs Fifth largest softwood timber
Kiwifruit	c0.011	2,760 growers	86m trays	32% of world exports
Sheep and beef	10.3	15,000 farms	Lamb: 427 kt Beef: 640 kt	Lamb: 75% of world exports Beef: 8% of world exports
Wine	c0.025	516 wineries	102m litres	0.4% of world trade
Wool	8.1	13,900 farms	158 kt	Largest crossbred producer Second to Australia overall

Sources: www.statisticsnz.govt.nz, www.fas.usda.gov, www.mfat.govt.nz, ABARE/MAF (2006), HortResearch (2006), New Zealand Forest Owners Association (2007).

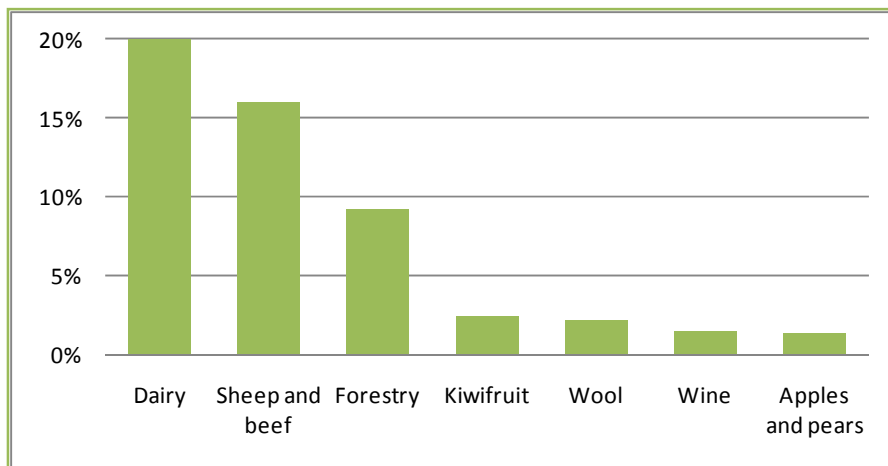
Figure 1.1 – Agriculture Sector Contribution to GDP



Source: ABARE/MAF (2006).

Sherwin (2007) estimates that the food and beverage industry is New Zealand's largest manufacturing industry, contributing around 30% of that sector's output. Wood and furniture manufacturing industries are estimated to contribute 15%.

Figure 1.2 – Agriculture Sector Direct Contribution to Exports



Sources: ABARE/MAF (2006), www.statisticsnz.govt.nz, HortResearch (2006).

1.3 Terminology

Table 1.2 overleaf sets out the key terms adopted in this report. Further discussions are provided below.

Table 1.2 – Key Terms

Term	Meaning
Growth	Increase in gross domestic product (GDP) per capita.
Industry Structure	The organisational, market, regulatory and other institutional arrangements applying to suppliers and consumers of a particular class of goods or services.
Innovation	“[T]he implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.” OECD (2005) – <i>Oslo Manual</i>
Institutions	“[T]he humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights).” North (1991, p. 97)
R&D	“[C]reative work undertaken on a systematic basis in order to increase the stock of knowledge. It is characterised by originality, where investigation is a primary objective.” OECD (2002a) – <i>Frascati Manual</i>
Total Factor Productivity (TFP) Growth	Growth in output per capita not attributable to growth in factor inputs (also known as multifactor productivity growth)

1.3.1 Institutions and Industry Structure

Scope of Definition

North’s¹ definition of institutions encompasses an extremely wide range of constraints. It clearly encompasses very high-level constraints such as constitutional rules, laws, and regulations. But it also clearly extends to lower-order constraints such as government policies, as well as simple conventions such as norms of business conduct, to name but a few. As such, industry structure can be thought of as a subset of institutions, since it defines how actors in any economic sector interact and coordinate their conduct. Accordingly, wherever we refer to institutions we will also be referring to industry structure, whereas references to industry structure may be more particular.

... cont’d

¹ Douglass North is a Nobel Prize-winning economist and major contributor to institutional economics.

Institutional Change

In any case, institutions are not immutable, although clearly some are harder to change than others. How institutions do or do not evolve has important implications for whether their evolution and persistence can be interpreted as economically beneficial or harmful. Fama and Jensen (1983a, 1983b) and Hansmann (1996) argue that, left to natural forces, the productive organisational forms that survive are those that best meet their consumers' preferences while minimising the combined costs of production and organisation (e.g. ownership/governance costs). However, such organisational evolution and survivorship might also reflect institutional biases, or vulnerability of the political process to capture by interest groups. Hence, to infer the superiority of an organisational form by virtue of its persistence requires the elimination of such explanations.

Richter (2005, p. 18) observes that “[i]nstitutional change comes about through ‘entrepreneurs in political and economic organizations’ who realize that they could do better by changing the institutional framework.” Such entrepreneurs, in bringing about new forms of institution, may be behaving opportunistically, but they may also be contributing to dynamic economic efficiency. Competition in product, factor and capital markets is thus important to ensure that such institutional change brings welfare gains, recognising there is no one ideal organisational form.

Of note for this study's purposes, North (2005, p. 50) cautions that “[w]hile formal institutions can be changed by fiat, informal institutions evolve in ways that are still far from completely understood and therefore are not typically amenable to deliberate human manipulation.” Hence the ability of policy practitioners to effect institutional change is likely to be constrained.

Criteria for Assessing Institutional Desirability

From a policy perspective it is important to retain what North (2003) terms “adaptive efficiency”, allowing for the maximum of institutional choices and room to experiment, while providing institutions (such as bankruptcy laws) that enable failed solutions to be eliminated. Recognising that hypothetical ideals are rarely achievable, Williamson (2000, p. 601) therefore proposes a “remediableness criterion” for public policy analysts to apply when considering the desirability of an organisational form:

“an extant mode or organization for which no superior *feasible* alternative can be described and *implemented* with expected net gains is *presumed* to be efficient. . . . [public policy] analysts can no longer condemn extant modes because they deviate from a hypothetical ideal” [original emphasis]

This criterion “presses the public policy analyst to display a superior feasible alternative”, allowing also for any costs of implementation in the net benefit calculation.

1.3.2 Growth and TFP Growth

While our primary focus will be on growth in GDP per capita (sometimes simply called economic growth), many studies consider the impact of institutions and other explanatory variables on levels of GDP per capita (i.e. income per capita). Clearly, any institutional innovation that results in an increase in output per capita should be beneficial, but it is a sustained increase in the rate of growth in output per capita that is commonly considered the proper focus of growth and development policies.

Factors of production such as land (and other natural resources), labour and capital can be thought of as being combined in some form of “production function” to produce output. TFP growth is the source of economic growth not related to increases in such factors. As we will see in Section 3.3, TFP growth has been found in many studies to be the dominant source of growth, although its precise makeup remains unresolved and hence its usefulness as a concept is yet to be unravelled. It is sometimes alternatively referred to as multifactor productivity, or as the “Solow Residual”, since it first arose in Solow’s 1957 paper as the unexplained component of his groundbreaking growth modelling. Solow described this residual as “technical change”, by which he meant any kind of shift in the production function that combines factor inputs to produce economic output.

As we will see later, subsequent explanations for TFP growth include those suggesting a role of institutions in influencing innovation.

1.3.3 Innovation and R&D

Innovation can be thought of as one of the engines of growth. To the extent that innovation explains TFP growth, it is conceivably the dominant source of growth. Innovation can lead to economic growth by expanding the range of goods or services produced and consumed, and/or by enabling existing goods or services to be produced with fewer factor inputs, among other ways.

Four Types of Innovation

The *Oslo Manual* (OECD (2005)) identifies four types of innovation:

- *Product innovations* – new or significantly improved goods or services;
- *Process innovations* – new or significantly improved methods for production or delivery (operational processes);

- *Organisational innovations* – new or significantly improved methods in a firm’s business practices, workplace organisation or external relations (organisational or managerial processes); and
- *Marketing innovations* – new or significantly improved marketing methods.

R&D and Non-R&D Types of Innovative Activity

Clearly product and process innovations might be the product of the activity most commonly associated with innovation – R&D. Indeed, organisational and marketing innovations might also be the product of R&D. Such types of R&D can include firms doing the following (*Oslo Manual*, p. 36):

- Engaging in basic and applied research to acquire new knowledge and direct research towards specific inventions or modifications of existing techniques; or
- Developing new product or process concepts or other new methods to assess whether they are feasible and viable, which may involve development and testing, and further research to modify designs or technical functions.

However, while R&D is certainly one type of innovative activity, there are many non-R&D types of innovation. They include (*Oslo Manual*, p 36):

- Identifying new concepts via marketing and user relationships, from own or others’ basic or strategic research, from own design and development capabilities, by monitoring competitors, or by using consultants;
- Buying technical information, or know-how and skills through consultancy services;
- Developing human skills through formal or informal internal training (including “learning by doing”), or by hiring;
- Investing in equipment, software or intermediate inputs that embody the innovative work of others;
- Reorganising management systems and business activities; and
- Developing new sales and marketing methods.

Hence, just as the term “institutions” encompasses a very broad range of constraints, the range of possible innovative activities is also very broad.

Three Types of R&D Activity

New Zealand's Ministry of Research, Science and Technology (MoRST) identifies three types of research in New Zealand R&D surveys (MoRST (2006, p. 25)):

- *Basic research* – experimental or theoretical work undertaken to acquire new knowledge with either a broad underpinning reference to a likely application or with no particular application in view (including both pure basic research and targeted basic research);
- *Applied research* – original investigative research directed primarily towards a specific objective, to determine possible uses of basic research or to determine new ways of achieving a pre-determined objective; and
- *Experimental development* – systematic work that draws on knowledge gained from research and practical experience directed towards the creation of new materials, products or services.

As we will see in Section 3.3.4, empirical studies on the contribution of R&D to economic growth show that any such contribution depends not just on the type of R&D, but sometimes also on whether it is publicly or privately funded.

1.4 New Zealand Environment

1.4.1 Institutional Snapshot

New Zealand inherited many of its institutions from Britain as a consequence of its colonisation in the nineteenth century, and subsequent strong cultural, legal, social and economic ties. Like other “Neo-Europes” such as Canada, Australia and the US, its general institutions rate among the best in the world (see Table 2.1). It has developed its own idiosyncratic institutions – notably the treaty of Waitangi – and others directed at addressing issues arising in its particular circumstances over time.

In Section 2 key pieces of legislation are identified affecting New Zealand's electoral and judicial systems; property rights protections; fiscal and monetary policies; business practice, regulation and governance; employment and environmental regulation; resource management, and international trade. The interdependence and context-dependence of New Zealand's institutions is noted. Examples of important governance bodies created for the administration of New Zealand's high-level institutions are also mentioned.

Other specific institutions relevant to the selected agriculture sub-sectors considered in this report can also be identified. These include legislation reforming New Zealand's former producer board structures; bodies and rules governing certification of food standards, quality and safety; agriculture-specific property rights such as those to do with animal identification, and forestry and plant variety rights; and industry governance/coordination arrangements. The latter include bodies such as ZESPRI and Fonterra which take a lead role in coordinating their sub-sectors' agri-food supply chains internationally. Others administer market access rights where trade barriers are in force, or impose quality assurance requirements to ensure market access and positioning is maintained (e.g. wine). Others still coordinate industry good activities, funded by industry levies. An important institution affecting agriculture in its own right is the New Zealand Ministry of Agriculture and Forestry (MAF). MAF not only has a policy brief, but through its various business units is also active in activities relating to biosecurity, quarantine services, and food safety.

1.4.2 National Innovation System Overview

Another important set of institutional arrangements discussed in Section 2 relates to New Zealand's national system of innovation (NIS). Key structures in this system include the Ministry for Research, Science & Technology (MoRST), its principal purchaser of research, science and technology (RS&T) – the Foundation for Research Science & Technology (FoRST) – and New Zealand's nine state-owned Crown Research Institutes (CRIs) which undertake the lion's share of national R&D.² To varying degrees these bodies interact with university researchers, specially-created inter-institutional research networks known as Centres of Research Excellence (CoREs), and research entities that are industry-funded to varying degrees (Research Associations and research Consortia). New Zealand's NIS is unusual in that the country's total annual R&D expenditure as a share of GDP is low compared with other OECD countries, is largely agriculture-focused, and government-funded to a greater degree than elsewhere despite not having large defence or aerospace R&D budgets. The benefits of the CRIs' agriculture focus can be seen in terms of the commercialisation of agricultural innovations they help to develop either alone or in concert with industry.

1.4.3 New Zealand's Growth Performance

An enduring conundrum has been New Zealand's laggard economic performance over the past three decades as compared with other OECD countries. While New Zealand's average growth rate has recently caught up with OECD average levels, for the past thirty years it has fallen well below that average (see Figure 2.3), despite having largely sound institutions, and the now-orthodox

² It is worth mentioning that until 2007 New Zealand firms enjoyed no specific tax incentives for R&D expenditure, leading to possible a under-reporting of private R&D.

structural reforms of the 1980s. In part New Zealand's relatively poor performance might be thought to be due to the country's small domestic market and distance from export markets, and some evidence supports these explanations. However, long-term trend declines in shipping costs, improvements in communications technologies, and increasing economic activity in more proximate parts of the world (i.e. Asia) suggest these cannot be the whole explanation. Despite this conundrum, however, the more positive news is that New Zealand's agriculture sector has for many years experienced growth rates in excess of those in the national economy, growing at an average rate of 3.6% per annum over 1988/78 – 2004/05 compared with a national average of 2.5%.

1.4.4 Agriculture Sector Overview

Sheep (and hence wool) farming, and mixed sheep and beef farming, account for most of the agriculture and forestry land use in New Zealand. Forestry and dairy farming involve significant but much smaller land areas, while wine, apples and pears, and kiwifruit involve only small overall areas of land. Following the structural reforms of the 1980s significant changes in agricultural land use have arisen, with sharply falling sheep numbers being balanced by rising forestry and dairy land usage. Significant productivity gains have been enjoyed in the pastoral sector since the 1980s, coinciding with increases in average farm size, reduced labour inputs, and higher stock yields.

Changing land use has also been associated with more diversified land uses. Tourism and recreational activities on farm land have become more common since the 1980s, although remain small contributors to most farmers' overall incomes. Growing interest in lifestyle blocks and overseas interest have also led to an increasing decoupling of rural land prices from underlying farm profitability.

Productivity gains have in part arisen due to major innovations in the agriculture sector since the nineteenth century. Refrigerated shipping, use of phosphate fertilisers and aerial top-dressing, addressing cobalt deficiencies in the central North Island, milking machines and milk tankers, and artificial insemination have all led to large gains in the sector. However, continued innovation is required for the agriculture sector to successfully respond to market imperatives. Significant among these are more discerning global customers, new forms of trade protection, increased competition from low-cost producers, demographic changes, and growing supermarket buyer power. Rapidly rising shipping costs, climate change policies, competition for water resources and farming sustainability also require urgent attention by the sector.

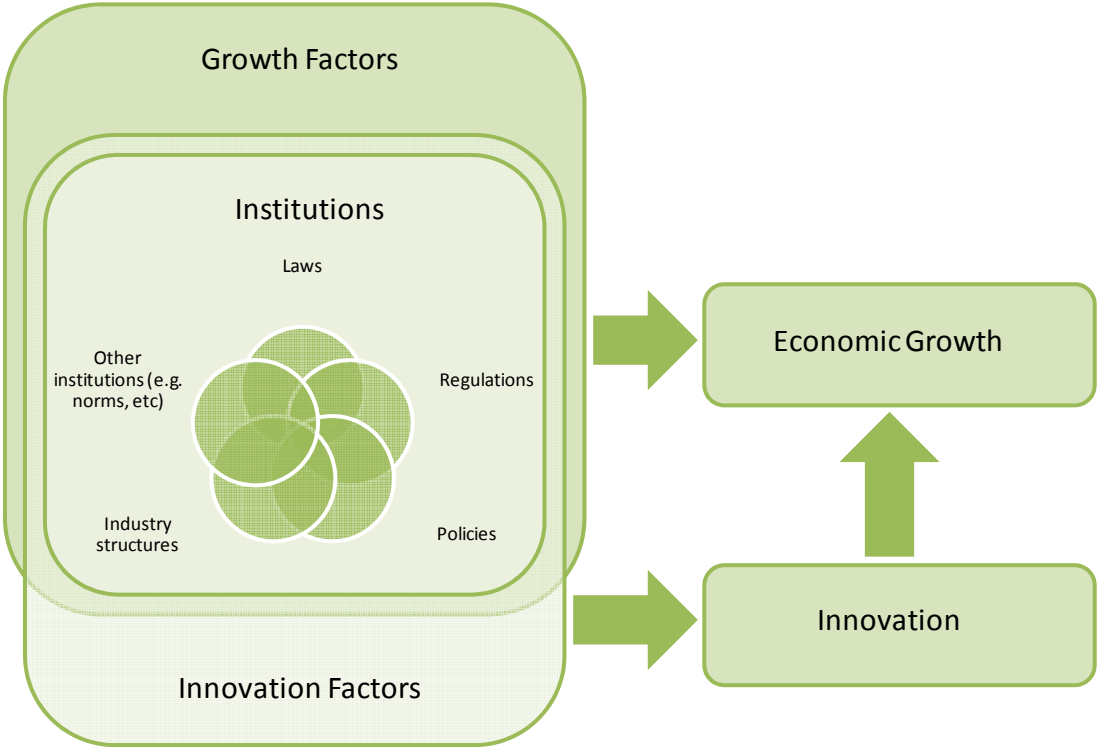
In Section 2.4.6 a high-level overview is provided of the industry structures, trends and issues associated with each of the sub-sectors considered in our report. Common themes are highlighted,

in particular how most of the sectors considered are significantly changing their mode of international competition, to respond to the imperatives highlighted above. Notable among these are greater coordination along the supply chain, sourcing raw product from competitor nations, and increasing resort to intellectual-property based multinational enterprise (“multinationalisation”). Diversifying both sources of existing products and the range of products offered is emerging as an important component of this changing pattern of competition. This particular theme is explored in more detail throughout the report.

1.5 Conceptual Framework

Figure 1.3 provides a schematic overview of the conceptual framework adopted in this report.

Figure 1.3 – Conceptual Framework Linking Industry Structures and Institutions to Growth and Innovation



As discussed earlier, in this report we take industry structures to comprise a subset of the institutions that may have a bearing on both growth and innovation. Alongside institutional factors there is conceivably a set of other factors affecting growth not related to either institutions or innovation. Similarly, aside from the institutional factors affecting innovation, there may be other factors affecting innovation, which may or may not include factors also affecting growth. Finally,

innovation itself can be expected to also influence growth. Figure 1.3 attempts to capture the overlaps and disjunctions between the institutional and other factors affecting growth both directly and indirectly through their influence on innovation.³

Institutions are arguably at the heart of both growth and innovation, if only because they will one way or another exert some influence over the non-institutional factors affecting either. For example, growth should be expected to depend to some degree on factors of production such as labour, capital, and land and other resources (e.g. water). In the case of labour, for example, institutions might influence investments in human capital, thus affecting both labour productivity and innovative capacity. Conversely, institutions might affect the availability of water resources for production, or access to financial capital for investments in physical capital (thus affecting the rate of technology diffusion through the acquisition of new technologies embedded in capital equipment). Hence it is conceivable that “all roads will eventually lead to Rome” – a theme which is developed in the Section 3.3 discussion of the evidence on causes of growth.

It should be emphasised that the institutional and other factors affecting growth and innovation will themselves be affected by both supply-push and demand-pull considerations. In Section 3.2.1 we discuss the ideas of Schumpeterian competition, in which firms innovate in order to survive in a battle for technological (in the broadest sense) ascendancy. In a simplistic sense such a battle is won when firms’ innovations best meet consumer demands. Given the growing role of consumer preferences – as mediated by increasingly powerful international supermarkets – in dictating agricultural product qualities and production process attributes, such ideas should be especially pertinent to our analysis of New Zealand’s agriculture sector.

1.6 Main Findings

1.6.1 Findings from the Literature on Growth and Innovation

Acknowledging the limitations of empirical studies, certain findings seem clear. First, while factor accumulation contributes to economic growth, TFP is commonly found to be the more important source of growth. Untangling the drivers of TFP growth remains unfinished business, however, although there appears to be clear support for high-level institutions being important. Indeed, institutional variables are often found to provide the stronger explanation for growth, dominating or even eliminating the role of policies and other explanatory variables such as geography and economic integration. In other cases, good institutions reinforce the growth impacts of other variables, such as trade.

³ It is also conceivable that economic growth also affects innovation, for example by changing the likely returns to innovation. This feedback loop is treated as implicit in our framework.

Key among institutional variables found to be important for growth are secure property rights and good governance. A role is also apparent for “economic freedom” more broadly defined (which should not be confused with democracy per se). The size of government per se is of ambiguous influence on growth, but variables measuring the extent of distortionary taxation (e.g. income taxes) and expenditures (e.g. social transfers) are found to be negative for growth. Conversely, non-distortionary taxation (e.g. consumption taxes) and expenditures (e.g. infrastructure investments) are generally found to be positive for growth to varying degrees. In terms of the agriculture sector, more specific findings are that agricultural growth is positively (negatively) affected by government expenditures of public good (private good) nature.

Financial development is important for growth, but structural differences between economies will influence whether growth will tend to be financed more by equity than debt. Regulation is generally found to be negative for growth, particularly where it impedes competition, the destruction of failing firms and factor market flexibility.

In terms of innovation – which we are treating as a proximate cause of growth – institutions are once again found to play an important role, although at a more micro level. The factors found to positively influence business R&D are found to include previous R&D, direct R&D subsidies and tax incentives, real GDP levels, protection of IPRs, firm size, collaboration, and quality of research institutions.

While much of the growth contribution of R&D can be attributed to business R&D, public R&D plays an important underpinning role. Both contribute to a nation’s absorptive capacity, encouraging diffusion of technologies developed overseas, which for smaller countries tends to be the dominant source of innovation. International trade and FDI are also important channels of such diffusion.

The public role in R&D is emphasised by the systemic nature of innovative activity. Increasingly, innovation occurs on an open basis, involving importing or exporting of technology across firms, and is driven by collaboration among firms and even across borders. Underlying such activities are coordinated research efforts among universities and other higher centres of learning (which are found to be more important for countries operating close to their technology frontier). The importance of social and technological infrastructures, allied with access to markets for innovative outputs, and quality-of-life factors for internationally mobile high-skilled workers, are also emphasised.

Competition is generally conducive to innovation, though the relationship is non-linear, and the optimum is unlikely to occur at the textbook ideal level of atomistic competition. This implies welfare tradeoffs for consumers, who face higher prices from concentration, but lower prices from

innovation. Competition laws and their enforcement can therefore serve to support or hinder innovative activity depending on how they traverse such complexities.

Unlike for growth in general, the role of regulation on innovation is not as clear. Certainly product market competition is associated with productivity growth, and flexibility to adopt and adapt to new technologies is also important. However, the role of labour market flexibility is more nuanced, though it is positive for R&D intensity where labour markets are decentralised.

Access to external finance is also important for innovation, as are incentive arrangements conducive to the exploration of risky research. The strictness or leniency of bankruptcy laws may play a role in either supporting or dampening innovative activity.

In respect of agricultural R&D and growth, New Zealand research confirms the importance of international technology spillovers. Similar cross-country research finds the same, though it reveals that spillovers occur more easily for countries in temperate climates, reducing the need for such countries to make their own investments to boost productivity in agriculture.

1.6.2 Findings from an Assessment of New Zealand's Industry Structures and Institutions

A general theme we identified early in this report is that while New Zealand's high-level institutions are commonly rated among the highest in the world, this is not cause for complacency. New Zealand's high ratings are not uniform across different classes of institution. Even if they were, a case can be made for New Zealand needing to have superior institutions to other countries not so affected by issues of scale and distance. Moreover, any such ratings are merely snapshots, and for New Zealand to remain internationally competitive it is important that its institutions continue to evolve at a rate that maintains or enhances their relative position as institutions evolve and improve in other countries.

The priority areas we identified for further inquiry relate primarily to a few, higher-order institutions. In particular, we suggest that further research be undertaken into exploring institutional innovations that ensure New Zealand's property rights protections are adequate to support emerging strategies in the agriculture sectors surveyed. Enforceable constraints on the expropriation of private property are one area to explore, as is the optimal degree of alignment with, and monitoring and enforcement of, international property rights agreements. Another area relates to the quality of New Zealand's regulatory institutions, and the processes for making, amending and removing regulations. Improving the country's openness to trade was also identified as an important area, although only to the extent this does not interfere with emerging strategies to side-step trade barriers (such as multinationalisation).

In respect of institutions affecting innovation, the priority areas for further inquiry relate to the extent of government's role in research, the focus of public research, and the arrangements

concerning Land Information New Zealand. Among the first set of questions are issues to do with whether government should involve itself beyond basic research, whether it should seek to influence research towards particular objectives or sectors, and the identification of coordination failures hindering innovation and policy instruments that best alleviate them. The ongoing critical appraisal of research programmes to ensure their alignment with economic growth and other innovation objectives is also suggested. Finally, the ownership of selected CRIs by their New Zealand customers, or by universities, is also raised as an important issue to further explore. A review of the Crown Research Institutes Act to ensure clarity surrounding CRI objectives appears worthwhile, as would be the ongoing review of the appropriate funding arrangements for CRIs.

In terms of institutions affecting productive factors, our priority areas for further inquiry all relate to land. Of particular interest is how to better align objectives and coordination among the major institutions affecting land management in New Zealand – notably Land Information New Zealand (LINZ) and the Department of Conservation (DoC) and their respective legislation, and the RMA. Other RMA-related inquiry would consider improving the security and tradability of resource consents, the cost-benefit analysis of environmental regulation, and the greater use of market-based instruments to manage environmental issues. A particularly important area for further research relates to the institutions affecting the ownership, control and financing of Maori-owned land, given the productivity issues, data deficits, capital constraints and other problems associated with the productive use of such land.

Other notable areas for further inquiry include innovations in water ownership and management, as are changes to the current approach towards climate change policy. In each case improving the security of long-term property rights and striking the right balance between centralised and decentralised resource management are important considerations affecting investment, innovation and growth. Another area of potential property rights insecurity relates to export market access rights, particularly in the dairy and meat sub-sectors, thus warranting further inquiry.

Examination of how DoC land management (including its policies towards the use of DoC land for tourism activities) affects the productivity of adjacent land is also suggested. The size and structure of government expenditure and financing would merit further inquiry, alongside further consideration of greater private sector involvement in infrastructure provision. Flexibility in the design and application of competition laws, and in industry restructuring, is recommended in the light of the increasing use of hybrid organisational forms, multinationalisation and horizontal diversification in the agriculture sector. The use of covenants instead of transferring land into DoC ownership and management to achieve reform objectives in the high country tenure review process is proposed. Examination of measures to mitigate investment hold-up problems inherent in Crown Forestry Licenses under the Crown Forest Assets Act is suggested. Finally, testing the advantages of corporate farming through performance benchmarking against Landcorp Farming, or its sale by government, is also proposed.

The role of MAF in supporting emerging agriculture sector strategies deserves particular mention. With multinationalisation of New Zealand food concerns becoming a growing theme, MAF's mission may require revisiting. The possibility of greater cross-country agriculture sector coordination potentially complements this trend. Furthermore, how MAF engages with other government agencies affecting these areas, such as New Zealand Trade and Enterprise and Investment New Zealand, may also become increasingly important, and hence merit further examination. Finally, how and whether MAF can export some of its regulatory know-how to other countries so as to enhance the benefits of multinationalisation, or cross-country coordination, is another question worth particular exploration.

1.8 Structure of the Report

The themes discussed above will be amplified on in the following sections. Section 2 begins by surveying the New Zealand environment, both at a national and agriculture sector level. A snapshot and brief discussion is provided of the key institutions operating at the economy-wide and agriculture sector levels, followed by a description of New Zealand's national innovation system. Further detail is provided on the composition, history and performance of the agriculture sector. This includes a survey of the industry structures applying in each of the sub-sectors we are considering, and a summary of the key trends and issues confronted by each. Common themes emerging from this survey are highlighted and discussed.

Section 3 then changes gear by surveying the international literature on the determinants of growth and innovation. As discussed in Section 1.5, this will involve separate appraisals of the empirical literatures concerning:

- The general factors found to influence growth;
- The particular influence of institutions (including industry structures) on growth;
- The influence of institutions (including industry structures) on innovation; and
- The influence of innovation on growth.

As a prelude to this assessment of the evidence on growth, leading growth theories will also be summarised. The section is concluded with a summary. With the New Zealand context from Section 2 lessons from Section 3 in mind, Section 4 then provides an assessment of New Zealand's institutions as they affect growth and innovation. General institutions such as those affecting innovation and productive factors (i.e. land, labour, capital, water) are first considered, and then specific institutions affecting our selected agriculture sub-sectors are also assessed. This section is also concluded with a summary. Finally, Section 5 concludes the report with a brief and high-level discussion of some of the most important themes emerging from our analysis.

2. The New Zealand Environment

2.1 Institutional Snapshot

2.1.1 General Institutions

New Zealand was colonised by the British in the nineteenth century, so it should come as no surprise that many of the country's constitutional norms, its parliamentary system, laws, legal traditions, judiciary and system of property rights draw much of their content from England. Similarly, many of New Zealand's inhabitants are of Anglo-Saxon origin, and thus subscribe to many of the cultural, social and religious norms of England, Ireland, Scotland and Wales. Accordingly New Zealand shares many institutional features with Australia, Canada and the US – so much so that these countries are described by Acemoglu et al. (2001) as “Neo-Europes.”

Clearly New Zealand's domestic institutions – both formal and informal – have taken their own paths over the century and a half since colonisation. Furthermore, the Treaty of Waitangi represents a very early institutional innovation in the New Zealand context that sets the country apart from its fellow colonies. Cultural and social norms in New Zealand also reflect Maori influences, as well as influences from non-European immigrant groups. However, while these deviations have certainly imbued a distinctive New Zealand flavour in the country's institutions, at their heart they remain characteristically British (certainly by contrast, for example, with those with Civil, German or Scandinavian Law origins, or those with Asian or other non-European origins).

Table 2.1 summarises New Zealand's international rankings according to differing measures of its institutions (which will be further explored in Section 4.1.1). As can be seen, New Zealand is often “at the top of the class” according to these various measures, although later in the report we will see that this is not uniformly so across all the sub-categories used in their compilation. This variation is cause for some hope that there might be steps New Zealand can take to improve its institutions – even if at a very high level – and thereby its growth and innovation performance.

Table 2.1 – Selected International Rankings of New Zealand's Institutions

Index	New Zealand Ranking	Source
Ease of Doing Business	2 nd of 175	World Bank
Global Peace Index	2 nd of 126	Economist Intelligence Unit
Economic Freedom of the World Index	3 rd equal of 130	Fraser Institute
Index of Economic Freedom	5 th of 161	Heritage Foundation
Global Competitiveness Index	23 rd of 125	World Economic Forum

Source: www.doingbusiness.org, www.visionofhumanity.com, www.fraserinstitute.ca, www.heritage.org, www.weforum.org.

We emphasise that snapshots such as these should not be cause for complacency. Given New Zealand's distance from export markets, and scale diseconomies associated with its small domestic market, it can be argued that New Zealand needs institutions that are at least as good as those of other nations (e.g. Bates (2001)). Furthermore, a theme recurring in our analysis is the importance of New Zealand maintaining its competitiveness relative to other agricultural producers *over time*. As other countries' institutions evolve and improve, New Zealand's institutions must also improve in order to maintain the country's competitive position.

2.1.2 Legislative and Commercial Environment

Table 2.2 overleaf highlights some of the main institutional features of New Zealand's general legislative and commercial environment. The institutional features more specifically relating to agriculture are discussed below.

Unlike many other countries New Zealand has no formal constitutional protection of property rights. General legal principles and explicit legislation such as the Public Works Act create the presumption that New Zealanders' assets should not be taken by the Crown without compensation, except in extreme circumstances (e.g. times of war). However, takings in the absence of extreme circumstances can and do arise, and the inconsistent treatment of Maori property rights is one cause of the current process directed at settling claims by Maori against the Crown for its breaches of the Treaty of Waitangi.

Various New Zealand enactments regulate the ownership and transfer of land and other resources. In some cases specialist bodies are created to administer such processes – e.g. the Maori Land Court in respect of Maori land, the Environment Court in respect of the Resource Management Act (RMA). The RMA is mentioned as an institution affecting property rights in that it both impacts upon the exercise of property rights (i.e. the ability of landowners to use their land) as well as creates de facto property rights in the form of resource consents (e.g. to abstract water). The Conservation Act also creates property rights in the form of concessions to use land in the conservation estate for commercial purposes (e.g. tourism).

Other specialist bodies arise under institutions affecting governance and business practice. These include the Commerce Commission under the Commerce Act, and the Securities Commission under the Securities Act and Securities Markets Act (with the latter providing for regulatory responsibility to be shared with New Zealand's main stock exchange, New Zealand Exchange Limited (NZX)). The Ministry of Economic development (MED) is important in the formulation of regulatory policy, as is the Treasury and Reserve Bank in fiscal and monetary policy development.

Table 2.2 – Key Legislative and Commercial Institutions

Institutional Element	Examples of Related Institutions
Electoral System	Electoral Act
Judicial Rules	Contracts Enforcement and Privity Acts Contractual Mistakes and Remedies Acts District Court and High Court Rules Supreme Court Act
Property Rights	Crown Forest Assets and Pastoral Lease Acts Crown Minerals Act Copyright, Patents, and Trade Marks Acts Public Works Act, Land Transfer Act, Te Ture Whenua Maori/Maori Land Act Resource Management Act Treaty of Waitangi
Governance	Companies and Co-operative Companies Acts Financial Reporting Act
Fiscal Policy	Income Tax Act Public Finance Act
Monetary Policy	Reserve Bank of New Zealand Act
Business Practice and Regulation	Commerce and Fair Trading Acts Insolvency and Receivership Acts Securities and Securities Markets Acts Serious Fraud Office Act
Employment Regulation	Employment Relations Act Health and Safety in Employment Act Holidays Act Immigration Act Injury Prevention, Rehabilitation, and Compensation Act
Environmental Regulation	Environment and Climate Change Response Acts Hazardous Substances and New Organisms Act Resource Management Act
Resource Management	Conservation and Reserves Acts Land and Crown Forest Assets Acts Resource Management Act
International Trade	Closer Economic Relations (CER) Customs and Excise Act New Zealand Trade and Enterprise Act Trade rules (e.g. WTO rules, FTAs, BTAs, RTAs)

In respect of environmental management, the relevant bodies include the Ministry for the Environment (MfE), as well as associated entities such as the Environmental Risk Management Authority (ERMA). The Department of Conservation (DoC) has a major role in managing New Zealand land resources in the form of the conservation estate, as does Land Information New Zealand (LINZ) in respect of other Crown land.

While many of these high-level institutions are defined by statute, others arise through entities created by statute exercising delegated authorities. These authorities are sometimes exercised in accordance with policy directions from government. Yet other institutions arise without statutory force (e.g. industry self-regulation), or exist without any statutory enactment although requiring legislation to give them force (e.g. Treaty of Waitangi).

The institutions described in Table 2.2 are clearly prominent features of the New Zealand institutional landscape. They are far from a comprehensive survey of the relevant constraints on actors in New Zealand. Importantly, such institutions cannot be considered in isolation, as they often complement or possibly even conflict with each other (in either productive or unproductive ways). They also rely on other domestic institutions (such as cultural norms) for their effective operation, and must also be considered in terms of their interface with institutions in other jurisdictions (e.g. the World Trade Organization (WTO)).

It is this type of institutional interdependency that has caused a re-evaluation of the so-called “Washington Consensus” on development policies advocated by agencies such as the International Monetary Fund (IMF) in the 1990s (e.g. see Rodrik (2006)). Experience has taught that institutions cannot simply be cut and pasted from one environment to another and expected to operate as they did in their original context. The wider institutional picture should always be considered when determining the efficacy of any given institutional feature or proposed institutional innovation.

2.1.3 Agriculture Sector Institutions

New Zealand’s agricultural producers share the general institutions surveyed in Sections 2.1.1 and 2.1.2. The institutions relating to environmental regulation and resource management (e.g. RMA) are especially pertinent, as is the Crown Forest Assets Acts for certain forestry operators. In addition they have a great many other institutions relating either to agriculture, or to their own particular agriculture sub-sectors. A number of the institutions affecting agriculture arise from the reform of previous producer board structures, while others arise to address food safety, animal welfare, biosecurity or other requirements. Some of these imperatives originate domestically, while others respond to formal (e.g. WTO obligations, EU regulations) or informal (e.g. consumer demands) international requirements.

Table 2.3 illustrates the range of major institutions affecting the agricultural sub-sectors considered in this report. Later, Section 2.4.6 surveys the particular industry structures of each.

Table 2.3 – Examples of Key Institutions for Selected Agriculture Sub-Sectors

Institutional Element	Examples of Related Institutions
Industry Organisation	Apple and Pear Industry Restructuring Act Repeal Act Commodity Levies Act Dairy Industry Restructuring Act (DIRA) Irrigation Schemes Act Kiwifruit Industry Restructuring Act Meat Board Act New Zealand Horticulture Export Act Primary Products Marketing Act Wine Act Wool Industry Restructuring Act
Certification and Systems	AgriQuality New Zealand and Asure New Zealand Bio-Gro NZ, Forest Certification New Zealand Growsafe, IFP, Kiwigreen Overseas schemes – BRC, ETI, EurepGAP, FSC, GFSI, HAACP, SFI
Property Rights	Animal Identification Act Forestry Rights Registration Act Plant Variety Rights Act
Governance/Coordination	Fonterra Pipfruit New Zealand Horticulture New Zealand Meat and Wool New Zealand Meat Industry Association Merino New Zealand New Zealand Forest Accord New Zealand Forest Industries Council New Zealand Forest Owners Association New Zealand Kiwifruit Growers Incorporated Kiwifruit Export Regulations Wine Sector Council Wine Institute of New Zealand Wood Council of New Zealand ZESPRI

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Table 2.3 (cont'd) – Examples of Key Institutions for Selected Agriculture Sub-Sectors

Institutional Element	Examples of Related Institutions
Regulation	Agricultural Compounds and Veterinary Medicines Act Animal Products Act Animal Welfare Act Biosecurity Act and Biosecurity New Zealand Food Act and Amendments Forests Act New Zealand Food Safety Authority Plants Act
Foreign Agricultural Policies	EU Common Agricultural Policy (CAP) US Farm Security and Rural Investment Act

Post-Restructuring Industry Coordination

While New Zealand has essentially dismantled the producer board structures that previously dominated the marketing and sometimes the processing of agricultural commodities, varying degrees of centralised industry coordination of these functions still remain, e.g.:

- ZESPRI is a marketing company owned by kiwifruit growers that remains – at the industry’s request – the single point of entry to overseas markets other than Australia. Any organisation can export kiwifruit to Australia provided they obtain authorisation from the Horticulture Export Authority (HEA) and collaborate with Zespri on their marketing plan.
- Fonterra processes and markets 95% of New Zealand’s milk supply, but has no power to control export marketing by other dairy producers. It retains, however, control of dairy tariff quotas into the EU under the DIRA until 2010, after which they will be reallocated by the Crown, and other tariff quotas into the US.
- New Zealand Meat Board similarly controls allocation of US beef quota and EU lamb and beef quotas, while not otherwise controlling or coordinating export meat marketing.
- Meat & Wool New Zealand coordinates industry good activities for the meat and wool sectors, such as R&D and market development.
- Under the Wine Act all winemakers must have wine standards management plans to ensure the quality and safety of New Zealand wine sold locally or overseas, and export licensing requirements can be imposed.
- The apple and pear, meat, forestry, wine and wool sectors have relatively uncoordinated processing and marketing, though greater marketing cooperation is emerging.

Ministry of Agriculture and Forestry (MAF)

An obvious institution of significance to the agricultural sector is the New Zealand Ministry of Agriculture and Forestry (MAF), constituted under the State Sector Act. According to the MAF website the Ministry's mission includes contributing "to the prosperity of New Zealand through its focus on land-based industries and rural communities ... [and] to New Zealand's sustainable development ... enhancing its natural advantage."

MAF does this through "the outcomes it seeks to achieve with respect to:

- The economic, environmental and social performance of the sectors.
- Maintaining and enhancing New Zealand's biosecurity status.
- Providing health assurances to foreign governments for animals, plants and their products.
- Protecting the health of consumers by ensuring the safety and suitability of food."

Table 2.4 overleaf summarises the main MAF business areas of relevance to this report. Its activities range from agriculture and forestry policy development and implementation through to asset management, verification and safety certification services, and biosecurity and quarantine services.

Of particular interest is the New Zealand Food Safety Authority (NZFSA), which is the New Zealand controlling authority for imports and exports of food and food-related products. It administers legislation covering:

- Food for sale in New Zealand;
- Primary processing of animal products and official assurances related to their export;
- Exports of plant products and the controls surrounding registration; and
- Use of agricultural compounds and veterinary medicines.

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Table 2.4 – Main MAF Business Areas

Business Area	Activity
MAF Policy	Provides information, analysis and advice to the Government on issues affecting the economic and environmental performance of the sectors. Its six business units are: International Policy, Sector Performance Policy, Sustainable Resource Use Policy (includes the Indigenous Forestry Unit and the East Coast Forestry Project), Innovation and Research, Natural Resources Policy and Management Services.
New Zealand Food Safety Authority	A semi-autonomous body attached to MAF, existing to protect and promote public health and safety and facilitate access to markets for New Zealand food products and by-products. Its six business units are: Agricultural Compounds and Veterinary Medicines, Animal Products, Dairy and Plant Products, Communications and Business Services, Policy and Regulatory Standards Programme Development and Processed Foods and Retail Sales. The NZFSA also provides evaluation, verification and certification services, through its Verification Agency.
Biosecurity New Zealand	The lead agency in New Zealand’s biosecurity system, tasked with a “whole-of-system” leadership role, encompassing economic, environmental, social and cultural outcomes. It also has international trade and animal welfare responsibilities.
MAF Quarantine Service	Identifies and manages any potential biosecurity risks at the border and provides domestic and offshore technical inspection and clearance services.
Crown Forestry Group	Manages the Crown’s interest in a number of commercial forests and forestry-related leases. Operational management of the forest estate is contracted to forest management companies with audit, strategic planning and administration carried out by Crown Forestry staff.
Biosecurity Strategic Unit	Supports the leadership and governance of the biosecurity system ensuring biosecurity-related marine, agriculture, forestry, conservation, health, economic, social and cultural objectives are fully integrated with the whole-of-system biosecurity approach. The Biosecurity Strategic Unit and Biosecurity New Zealand work closely together to support the effective development and implementation of the Biosecurity Strategy.
Maori Strategy Unit	Implements the MAF Maori responsiveness strategy – designed to promote a greater awareness by MAF of Maori issues and concerns, increase MAF’s understanding of the Treaty of Waitangi and help MAF develop more effective relationships with Maori.

Source: www.maf.govt.nz.

2.2 National Innovation System

The *Oslo Manual* suggests that the following institutional components affect innovation by firms (OECD (2005, p. 37)):

- Basic educational system for the general population;
- University system;
- Specialised technical training system;
- Science and research base;
- Common pools of codified knowledge;
- Policies directly or indirectly affecting innovation;
- Legislative and macroeconomic settings – e.g. patent laws, taxation, corporate governance rules, and policies relating to interest and exchange rates, tariffs, and competition;
- Infrastructure – including roading and telecommunications networks;
- Financial institutions – e.g. affecting ease of access to venture capital;
- Market accessibility – including closeness of customer relationships; and
- Industry structure and the competitive environment.

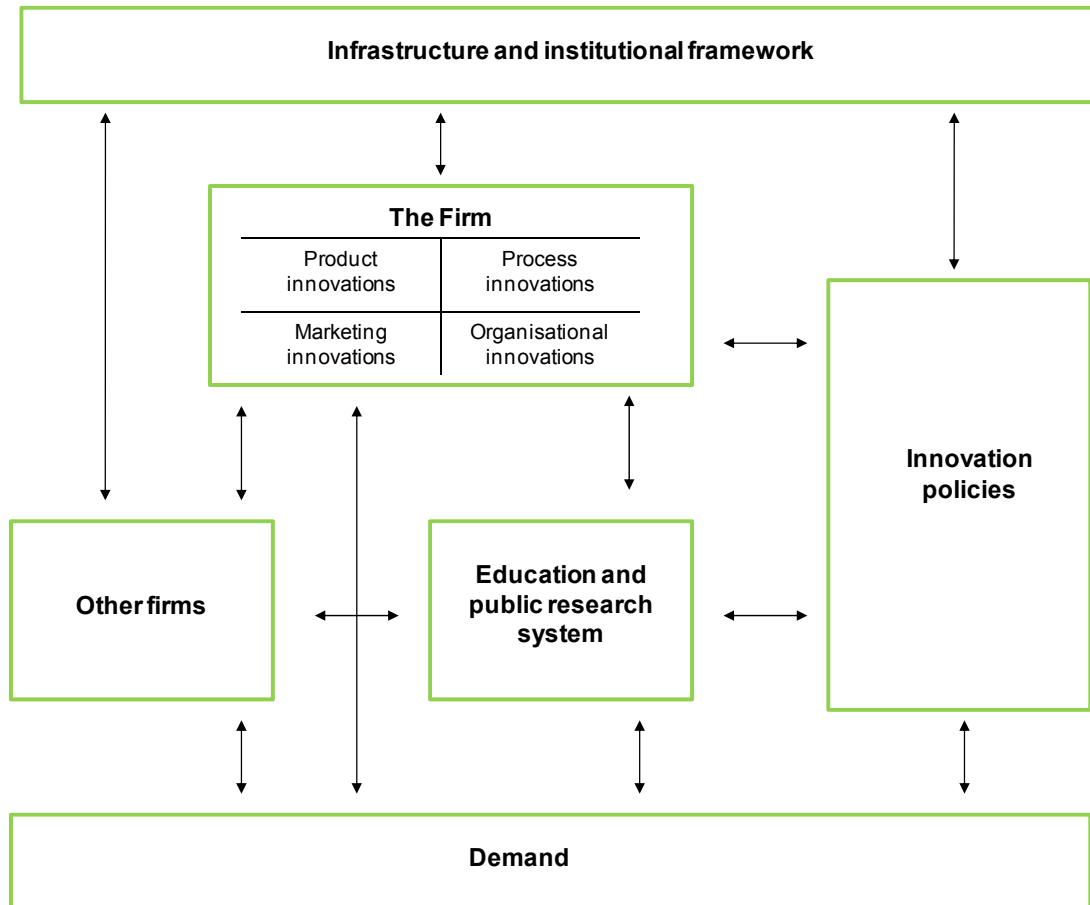
Clearly this list shares many of the key institutions traversed in Table 2.2. Indeed, its emphasis on these shared institutions, as well as human capital development and infrastructure also overlaps with factors often suggested as important for economic growth at a more general level, as we will see in Section 3.3. Yet this list also identifies institutional components not often identified as important for growth per se, but which might be expected to at least indirectly affect growth via their impacts on innovation. These components include the university and specialist training systems, the science research base, common pools of codified knowledge, and policies directed at or affecting innovation.

How these components interrelate in a country, and are coordinated and fostered, is often described as that country's national system of innovation, or National Innovation System (NIS). Lundvall (1992, p. 2) describes a system of innovation as being a social and dynamic system:

“...constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... a national system encompasses elements and relationships, either located within or rooted inside the borders of a nation state.”

At a schematic level any country’s NIS can be characterised as in Figure 2.1.

Figure 2.1 – Schematic Representation of Institutions Affecting Innovation by Firms



Source: OECD (2005, p. 34).

The key components of New Zealand’s NIS are summarised in Table 2.5 overleaf. According to MoRST (2006), distinctive features of the New Zealand system include:

- A greater share of government funding than other OECD countries (45% versus an OECD average of 30%), reflecting New Zealand’s industry structures and research needs;
- Science and research strengths in biology, agriculture, horticulture, environmental science, earth science, materials science, health research and indigenous knowledge; and

- Separation of policy, purchase and provider roles, with predominantly grant-based output and outcome-focused contestable funding.

Added to MoRST's list of distinctive features should also be the lack of any significant defence or aerospace research funding by government, which commonly forms a large part of publicly-funded R&D in other developed countries. Of note is the fact that New Zealand possesses little comparative advantage in "high-tech" industries such as information and communications technology (ICT) and nanotechnology.

Table 2.5 – Overview of New Zealand's National Innovation System

Component	Role
Ministry of Research, Science & Technology (MoRST)	Overseas public sector investment in research, science and technology (RS&T). Formulates policy, and ensures alignment of activities and objectives across public and private RS&T bodies. Constituted under the State Sector Act.
Foundation for Research, Science & Technology (FoRST)	Government's principal purchaser of RS&T, managing a variety of RS&T investment funds. Constituted under the Foundation for Research, Science & Technology Act.
Crown Research Institutes (CRIs)	Largest providers of science research in New Zealand. Undertake basic and applied research, and technology R&D. All nine CRIs are constituted under the Crown Research Institutes Act.
University Research	Eight universities undertake around 30% of publicly funded R&D. Funding is allocated through the Performance-Based Research Fund (PBRF) administered by the Tertiary Education Commission (TEC) constituted under the Education Act.

... cont'd

Table 2.5 (cont'd) – Overview of New Zealand’s National Innovation System

Component	Role
Centres of Research Excellence (CoREs)	Inter-institutional research networks. The seven CoREs are hosted by universities with partnership linkages to other institutions, particularly CRIs and other universities. Funded by TEC’s Centres of Research Excellence Fund, to promote research contributing to economic development and knowledge transfer into training.
Research Associations	Predominantly funded by industry, with some also receiving government research funding.
Research Consortia	Public-private partnerships created to improve interface between researchers and end users, and to promote collaboration between universities, CRIs and business.

Sources: www.morst.govt.nz, www.tec.govt.nz.

The particular make-up of New Zealand’s NIS emphasises the importance of the country’s agriculture-related research. Research “success stories” to date include Research Consortia such as Ovita (which owns a commercialisation subsidiary Covita), boasting “the world’s largest database of sheep pedigree and genetic history”, and “the largest ovine DNA library”. A spin-off from Ovita, Catapult, merged in 2006 with Catapult and Genetic Solutions of Australia to form Catapult Genetics, focusing on developing and commercialising livestock genetic diagnostics. Other agriculture-related Research Consortia include:

- *Pastoral Genomics* – venture involving the dairy, meat and deer industries to use modern biotechnology techniques for improved pasture performance and extended growing season; and
- *Pastoral Greenhouse Gas Consortium* – research into reducing greenhouse gas emissions from pastoral agriculture.

Table 2.6 overleaf provides an overview of New Zealand’s nine CRIs. AgResearch, Crop and Food Research, HortResearch and Scion Research, in particular, are directly relevant to the agricultural sub-sectors examined in this report. Almost all the remaining CRIs also undertake research with some impact on the agricultural sector.

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Table 2.6 – Overview of New Zealand’s Crown Research Institutes (CRIs)

Institute	Description
AgResearch	AgResearch’s mission is to create sustainable wealth in the pastoral and biotechnology sectors with science and technology. Its mission is to be achieved by its 2020 Science Strategy, in which it works closely with industry partners to double the value produced by the dairy, meat and textile industries while halving their costs and impacts on the environment.
Crop and Food Research	Provides scientific research to support the sustainable production of crops, food and new biomaterials. Its areas of expertise include: sustainable land and water use, high performance plants, personalised foods, high value marine products, and biomolecules and biomaterials.
Institute of Environmental Science & Research	ESR’s work underpins the health and justice systems in New Zealand. It provides a range of scientific services to government organisations and commercial companies in New Zealand and the Asia-Pacific region, focusing on the areas of forensics, communicable diseases, food safety, pharmaceuticals, population and environmental health, toxicology, systems thinking and social science, and water management.
GNS Science	An earth systems science enterprise whose focus includes geological hazards and tectonics, environment and land use, earth and ocean resources for economic growth, and protection of the society and economy from risk.
HortResearch	A world leader in integrated fruit research using unique resources in fruit, plants and sustainable production systems to provide novel technologies, and innovative fruit and food products with high consumer appeal.
Industrial Research	Undertakes science, development and technology commercialisation in areas of communication, information and electronic technologies; advanced materials and performance; intelligent devices and systems; pharmaceutical discovery and development; biochemical technologies; energy technologies; complex measurement and analysis.

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Table 2.6 (cont'd) – Overview of New Zealand’s Crown Research Institutes (CRIs)

Institute	Description
Landcare Research	Research focuses on conserving and restoring New Zealand’s biodiversity, reducing pest and disease impacts on ecosystems, mitigating and adapting to the impacts of climate change, sustaining the long-term health and viability of our rural and urban environments, businesses adopting environmentally sustainable and competitive practices, and people and communities caring for our land.
National Institute of Water and Atmospheric Research	Provides a scientific basis for the sustainable management and development of New Zealand’s atmospheric, marine and freshwater systems and associated resources.
Scion Research	Scion is committed to creating the next generation of new bio-based products and sustainable manufacturing processes. With 60 years experience in plantation forestry, wood and fibre, Scion offers a wide range of biomaterials research and development services. Its forestry research capabilities are delivered through Ensis, a joint venture with CSIRO Forestry and Forest Products.

Source: www.morst.govt.nz.

HortResearch has contributed to the successful development and commercialisation of new varieties of apple (Jazz™) and kiwifruit (ZESPRI™ Gold), benefiting New Zealand’s horticulture sector. AgResearch has developed a technology called Sniffertech™ that samples gases emitted by biological items in shipping containers as a means to detect foreign species that could harm New Zealand’s agriculture sector, thus contributing to enhanced biosecurity. These are but a few of the examples of how CRIs have been instrumental in developments benefiting the agriculture sector.⁴

Industry-based Research Associations with an agricultural sector focus include:

- Dexcel – dairy industry research;
- New Zealand Fertiliser Manufacturer’s Research Association; and
- New Zealand Plant Breeding and Research Association.

Other agricultural research ventures (i.e. those not falling within MoRST’s categories in which there is some measure of public funding) include those owned by or otherwise associated with the dairy industry, such as:

⁴ Case studies describing the successful commercialisation of CRI horticultural research can be found at www.growingfutures.com.

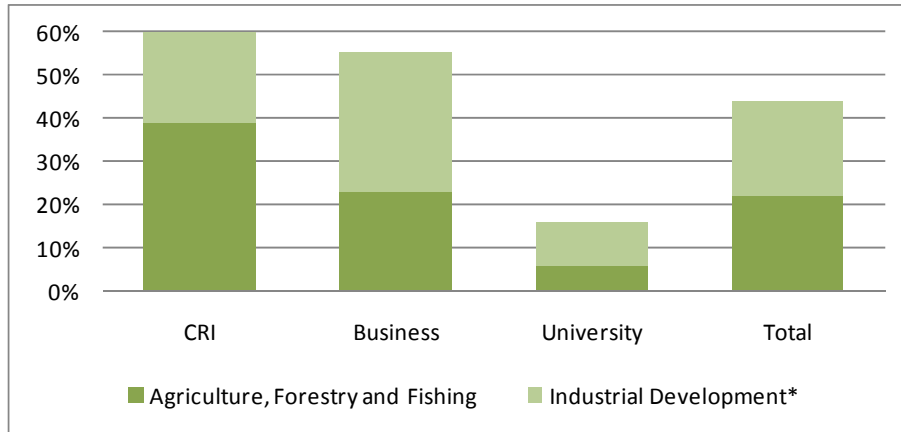
- *ViaLacta Biosciences* – a Fonterra subsidiary involved in the identification, discovery and commercialisation of methods of selection and genes important to the dairy industry, including those affecting pasture grasses, milk production and composition, and animal health;
- *Dairy InSight* – a farmer-owned organisation responsible for making investments into dairy industry research, development, extension and education projects and activities, fostering innovative technologies and smart business practices to drive on-farm productivity and profitability, and supporting industry imperatives such as biosecurity, sustainability and animal welfare;
- *Functional Nutraceuticals* – a company commercialising colostrum-based health products; and
- *BoviQuest* – a joint venture between ViaLacta Biosciences and Livestock Improvement Corporation (LIC) to create sustainable solutions for dairy farmers worldwide through bovine genomics, using research, data from alliances and publicly available sources, innovative technology and rapid gene dissemination (with a focus on improving the genetic gain of dairy cows).

For the remaining agricultural sub-sectors examined in this report other examples can be offered of such ventures – sometimes involving private funding and/or industry-levy funding:

- *Apples and pears* – e.g. Prevar, an international joint venture (between Pipfruit New Zealand, Australian Pipfruit Association, International Nursery Growers Association and HortResearch) to develop and commercialise new apple and pear varieties;
- *Kiwifruit* – e.g. Vital Food Processors, involving co-investments by Seeka Kiwifruit Industries and Australasian venture capital fund BioPacificVentures, to commercialise kiwifruit-based products for the relief of digestive disorders;
- *Meat* – e.g. Rissington Breedline, specialising in the science, production and development of sheep and beef cattle breeding programs;
- *Wine* – e.g. Marlborough Wine Research Centre, working with University of Auckland, Lincoln University, HortResearch and FoRST to conduct publicly and privately funded research, including New Zealand's first large-scale wine research project examining the source of Marlborough Sauvignon Blanc's distinctive flavour; and
- *Wool* – e.g. Keratec, a biotechnology company that designs and manufactures new materials utilizing keratins, and investigating cosmetics, medical materials, fine fibres for high value textiles and adhesives and resins.

Figure 2.2 summarises the relative emphasis placed by different parts of the New Zealand NIS on agricultural research. While 44% of total R&D funding was directed towards agriculture sector research, this figure rises to 60% of CRI funding, and 55% of business R&D funding.

Figure 2.2 – Agriculture Sector Share of 2004 R&D Funding by Source



Source: Data from MoRST (2006, p. 22).

Notes: * Includes meat and dairy processing; fruit, crop and beverage processing; wood and paper products.

While agriculture sector R&D, and government funding of R&D, feature prominently in the New Zealand NIS, overall R&D expenditure in New Zealand tends to lag that of the OECD. Based on data from MoRST (2006, p. 19) we can see that New Zealand R&D as a percentage of GDP ranks as shown in Table 2.7. While higher education expenditure on R&D compares favourably, both business and total R&D expenditure significantly lag the OECD average. However, this may be explicable in terms of New Zealand's industry mix and measurement of R&D as much as it is of R&D under-funding.

Table 2.7 – New Zealand R&D as a Percentage of GDP, versus OECD

R&D Expenditure Measure	New Zealand Rank	New Zealand Share	OECD Average
Gross	22 nd	1.25%	2.25%
Business	23 rd	0.50%	1.50%
Higher Education	19 th	0.35%	0.38%
Government	7 th	0.33%	0.29%

Source: Data from MoRST (2006, p. 19).

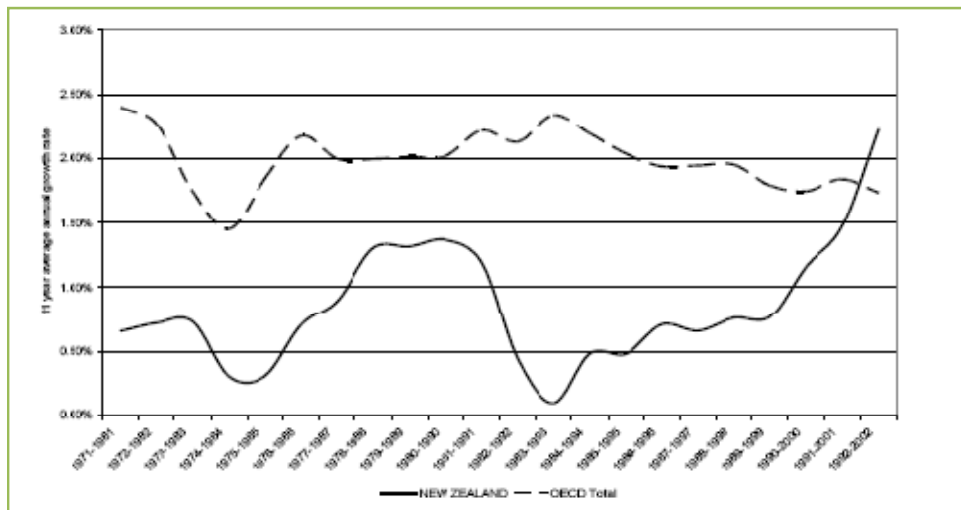
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2.3 New Zealand's Growth Performance

New Zealand's relative economic growth performance has long been a cause for some concern in policy circles. As shown in Figure 2.3, comparing growth in GDP per capita for New Zealand and the OECD, long-term average growth rates have only recently risen to OECD levels after decades of having substantially lagged behind them. Treasury (2004) attributes New Zealand's recent out-performance compared with the OECD to growth in the service sector and increases in labour utilisation. While New Zealand's economic reforms of the 1980s have contributed to this recent upturn, even the IMF has expressed puzzlement as to why New Zealand's performance should have been so poor for so long, given its adoption of a policy framework regarded as "international best practice" and the relatively very high overall quality of its domestic institutions.

Buckle et al. (2002) examine the New Zealand business cycle from 1983 to 2002 and conclude that internationally-sourced shocks tend to contribute more to underlying GDP fluctuations than domestic shocks. Climate was found to be an important contributor to the business cycle, being the dominant source of domestic shocks. Despite strong cyclical variation in the New Zealand dollar exchange rate, they find little impact of exchange rates on underlying GDP fluctuations.

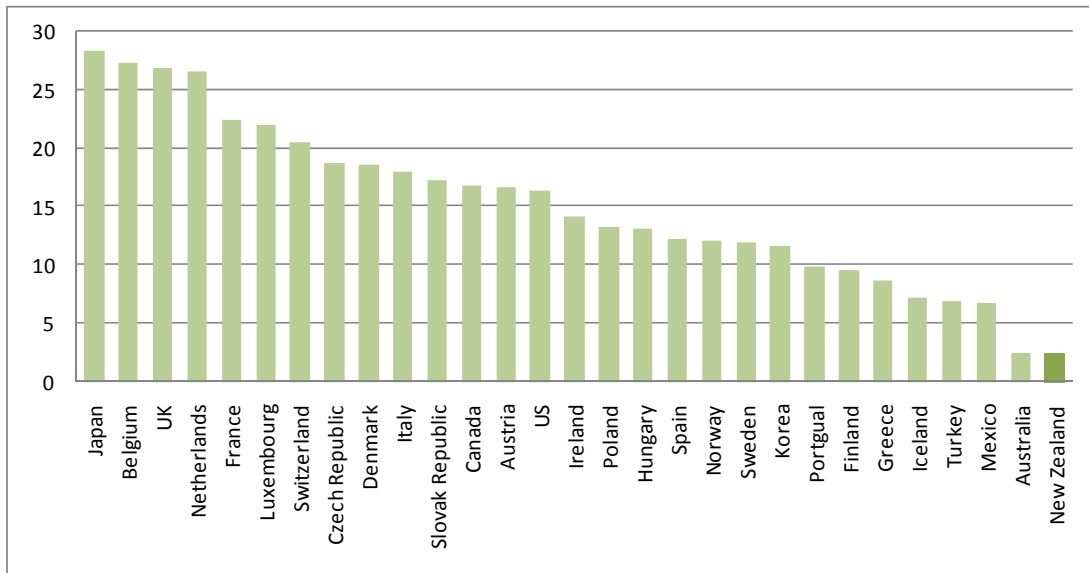
Figure 2.3 – New Zealand and OECD Average Growth Rates Compared 1971/81 – 1992/02



Source: Treasury (2004, p. 5).

One explanation for New Zealand's lagging growth performance is the effect of the country's distance from export markets, given the small domestic market. Drew (2007) notes New Zealand research indicating scale economies in local industries, emphasising the importance of accessing overseas markets to overcome the small local market size. However, distance from export markets remains a tax on growth. Figure 2.4 overleaf, based on gravity equation calculations produced by Evans and Hughes (2003), starkly demonstrates the issue for both New Zealand and Australia.

Figure 2.4 – Remoteness Index for OECD Countries



Source: Data from calculations by Evans and Hughes (2003).

Note: Smaller value indicated greater distance.

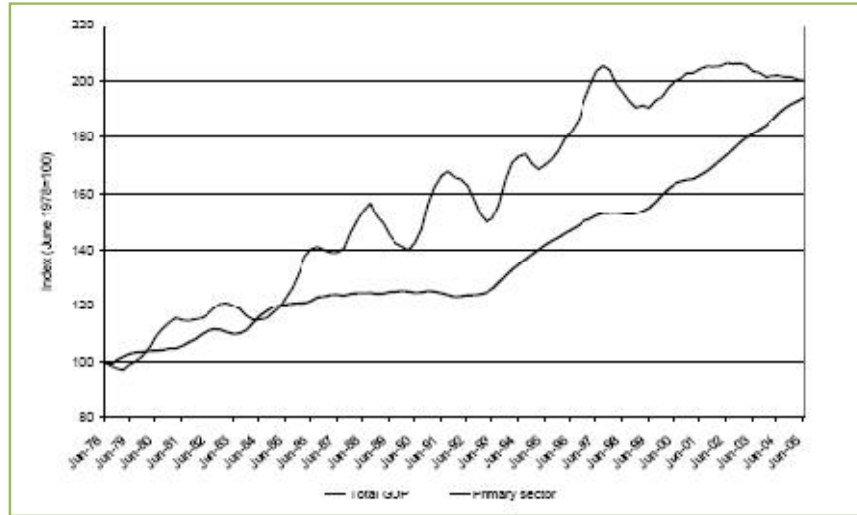
Research by IMF (2004) estimated that New Zealand's distance from markets reduces its GDP per capita growth rate by 0.5% p.a. relative to the OECD countries included in its sample. Similar research for Australia by Battersby (2006) estimates that distance from markets accounts for 45% of the gap in labour productivity between Australia and the US. However, Treasury (2004) cites evidence that New Zealand exports more than expected given its location, and that transportation costs and New Zealand's distance from economic activity (as opposed to countries per se) have both declined markedly over the past three decades. Hence, while location and scale will likely continue to play a role in New Zealand's growth performance, the extent of this role is not necessarily given.

However, research that questions the death of distance brought about by electronic technology may be of relevance to New Zealand. Citing others' research McCann (2007) argues that modern communication technology has lowered transactions costs within close-knit centres more than it has between them, and that the observed growth in international trade since the late 1990's (which New Zealand has not participated in) may be due to this. If so, this has far reaching consequences for New Zealand and for the multi-nation location of production, processing and marketing.

While the national economy has not fared relatively well until recently, Harrington (2005) documents the relative growth out-performance of the New Zealand agricultural sector. As shown in Figure 2.5 overleaf, real GDP has been more volatile but grown more strongly in the agriculture sector than for the wider economy for much of the period in question. The challenge for this report is to identify any existing impediments to institutional innovations, or changes in industry

structures, that might improve the future relative performance of New Zealand's agricultural sector. According to ABARE/MAF (2006), for the period 1977/78 – 2004/05 the New Zealand economy grew at an average annual rate of 2.5%, while agriculture grew at an average rate of 3.6%.

Figure 2.5 – Growth in Total and Primary Sector Real GDP 1978 - 2005



Source: Harrington (2005, p. 6).

2.4 Agriculture Sector Overview

2.4.1 Changing Land Use and Land Values

According to Statistics New Zealand (2006), 15.4 million hectares or 57% of New Zealand's 26.9 million hectare total area of is involved in agriculture and forestry. ABARE/MAF (2006) attributes around 77% of New Zealand's abstracted water to agriculture and forestry use.

Table 2.8 overleaf indicates which of the agriculture sub-sectors considered in this report involve the greatest area of land use. Note that the area attributed to wool production overlaps with that associated with sheep and combined sheep and beef farming.

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Table 2.8 – Land Use by Selected Agriculture Sub-Sectors

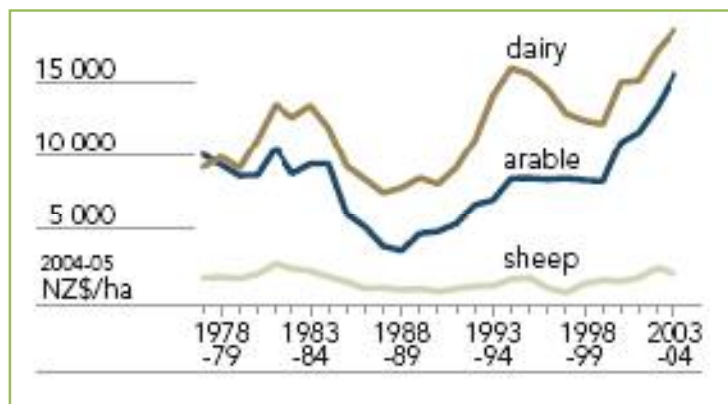
Sub-Sector	Share of Agriculture and Forestry Land Area	Share of Total New Zealand Land Area
Sheep and beef	67%	38%
Wool	53%	30%
Forestry	14%	8%
Dairy	13%	7%
Wine	c0.2%	c0.1%
Apples and pears	c0.1%	c0.04%
Kiwifruit	c0.1%	c0.04%

Source: Data from Table 1.1 and Statistics New Zealand (2006).

Clearly sheep and beef farming, and by association wool, are the dominant land use activity both within agriculture and nationally. Forestry and dairy are much smaller land users by comparison, but still account for a considerable share of overall land use – the lion’s share in the regions in which they tend to concentrate (i.e. Waikato for dairy, central North Island for forestry). Wine and horticulture account for very little land use overall, but can also be the dominant land use in the regions in which they are concentrated (e.g. wine in Marlborough).

Rural land values have undergone considerable change since the structural reforms of the 1980s, and the Asian Financial Crisis of 1998. As shown in Figure 2.6, strong dairy returns relative to returns from other land uses is reflected in higher average dairy land prices, while both arable and dairy land prices have recently been growing strongly. According to this data, land used in sheep farming has not enjoyed such rising land values.

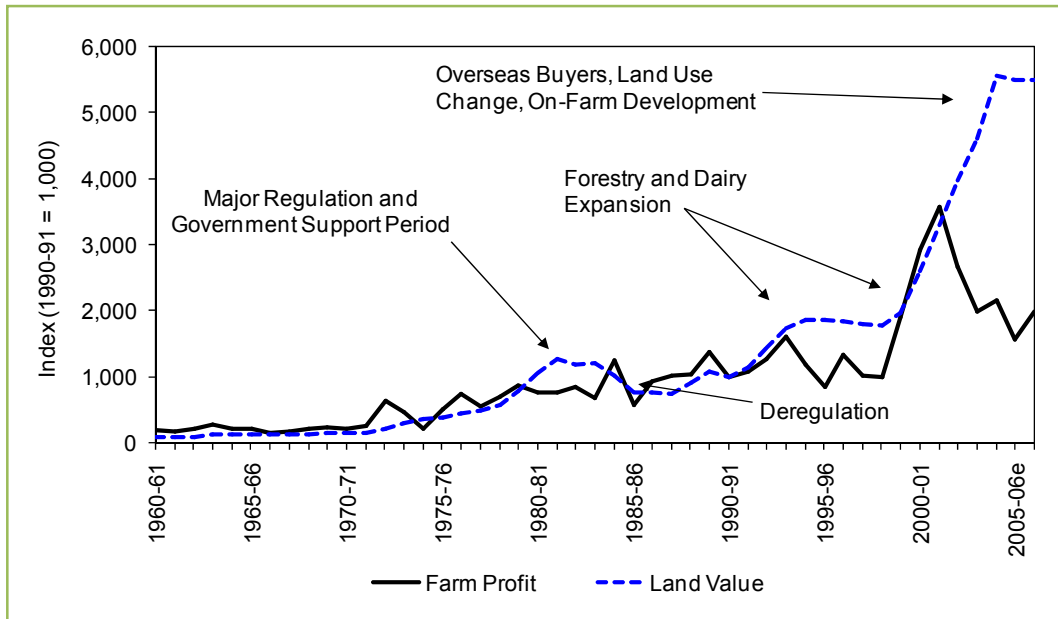
Figure 2.6 – Real Land Values, 1978/79 – 2003/04



Source: ABARE/MAF (2006, p. 71).

An increasing trend, however, has been for rural land prices to become uncoupled from underlying farm profitability. Meat & Wool New Zealand Economic Service explains this trend in terms of overseas demand for rural land, changing land use (from sheep and beef into e.g. dairy, forestry, viticulture, deer, lifestyle blocks), and on-farm development. Figure 2.7 illustrates the trend for sheep and beef farm land prices and profits.

Figure 2.7 – Sheep and Beef Land Values versus Farm Profitability 1960/61 – 2005/06



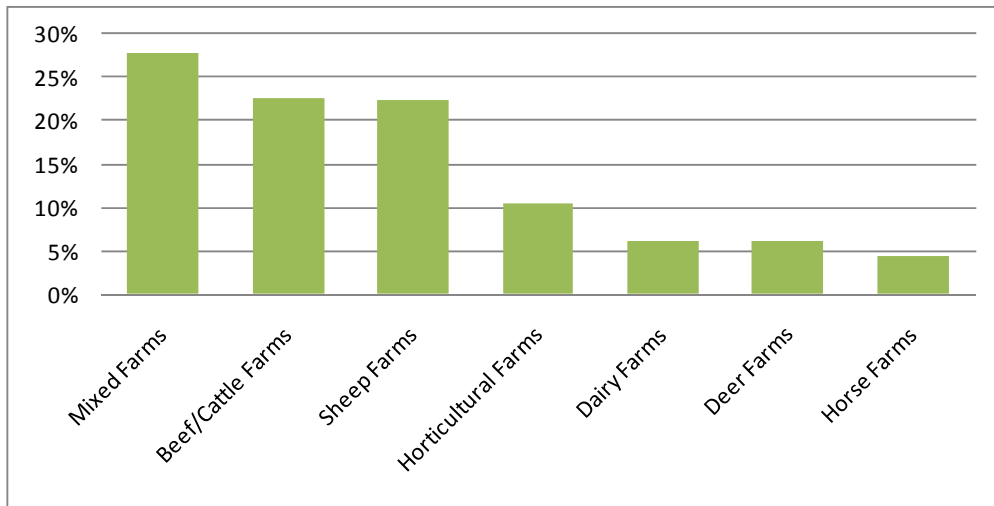
Source: Meat & Wool New Zealand Economic Service.

Aside from land use change into alternative forms of farming, since the agriculture sector reforms of the 1980s there has been an increasing diversification towards using farm land for recreational and tourism purposes alongside farming operations. Natural synergies clearly exist between winemaking and vineyard restaurants and tourism, but farmstays are increasingly popular across all farm types to varying degrees. New Zealand's largest farmstay company, Rural Tourism Holdings, has approximately 550 listings across all farm types, as illustrated in Figure 2.8 overleaf.

The relatively lower proportion of dairy farms involved in tourism has been found in overseas studies to reflect the greater labour intensity of dairy farming than other farm types (e.g. Jervell et al. (2005)). Armstrong (1990) found for New Zealand farms that the greater ability to manage peak demands for both tourism and farming favoured the use of larger pastoral farms for tourism.

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Figure 2.8 – Rural Tourism Holdings Farmstays by Farm Type



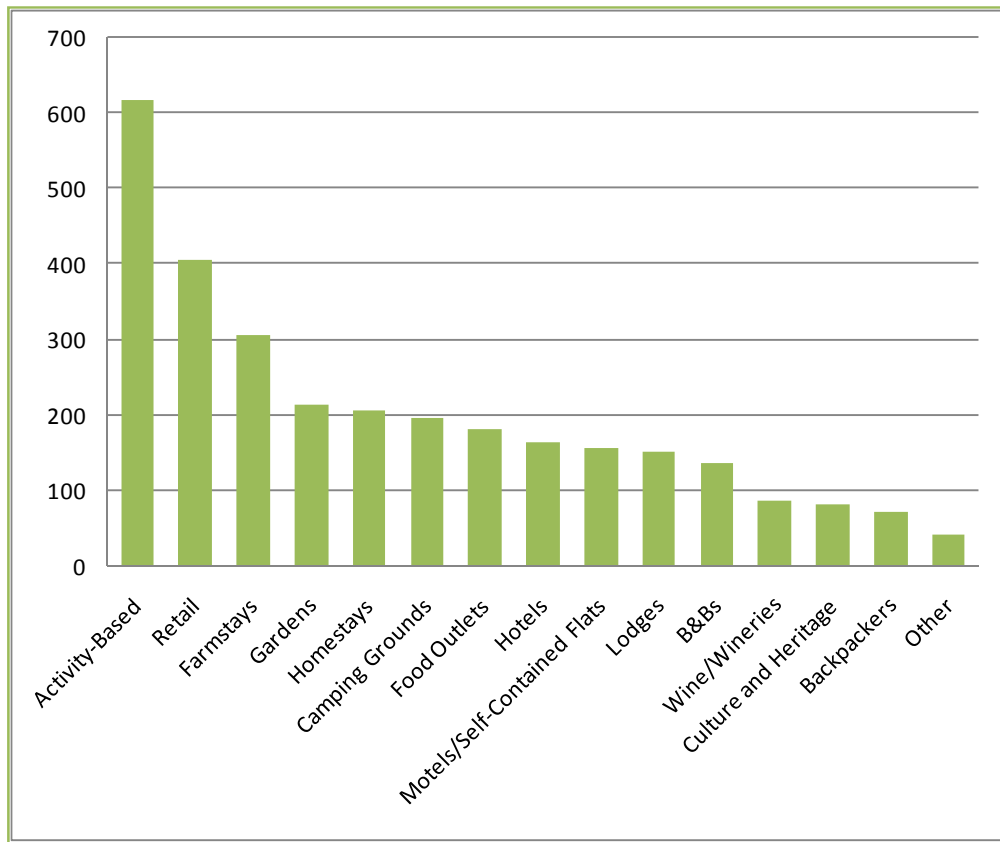
Source: Rural Tourism Holdings.

Warren and Taylor (1999) estimated that farmstays accounted for around 10% of rural tourism enterprises, suggesting that the total number of rural tourism enterprises in New Zealand could now be in the many thousands. This would be consistent with the observation in Sharpley and Vass (2005) that farm tourism is an international increasing phenomenon. However, survey evidence obtained by MAF (MRL (1993)) indicated that 84% of farmers also involved in tourism grossed under \$5,000 per annum from their tourism ventures. So while this trend may be becoming more widespread, its significance for farm incomes – at least to 1993 – may not yet be large.

Figure 2.9 overleaf summarises 1999 research into the different types of tourism and recreational activities then being operated in rural New Zealand.

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Figure 2.9 – Number of Rural Tourism Enterprises in New Zealand 1999



Source: Warren and Taylor (1999)

While the large high country stations in the South Island have traditionally been used for recreation purposes, Kearsley and Croy (2000) argue that this can be expected to increase as a consequence of the ongoing tenure review process. As discussed further in Section 4.3.1, this process involves negotiations between the Crown and holders of perpetually renewable Crown Pastoral Leases to convert parts of the leasehold land into freehold with the remnant (e.g. mountains and other high conservation value areas) being transferred into the conservation estate managed by DoC. By enlarging the amount of conservation estate that can be used for recreation purposes, and by removing restrictions on alternative commercial uses of leasehold land under existing lease terms, increased commercial recreation activities can be expected, although leaseholders indicate a range of possible conflicts between farming and recreational use (e.g. stock disturbance). The tenure review process is also enabling the conversion of parts of high country farms into lifestyle blocks.

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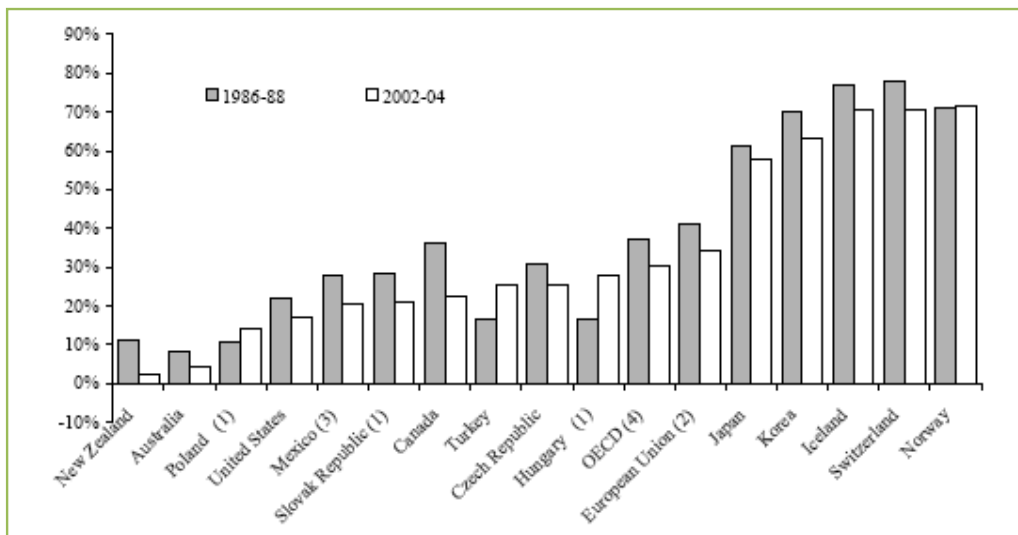
2.4.2 Structural Changes and Productivity Gains

Particularly since the dramatic agricultural sector reforms of the 1980s (e.g. see Gouin (2006)), the agriculture sector has enjoyed considerable productivity gains associated with significant changes in land use, and also changes in average farm size. According to ABARE/MAF (2006) the total number of farms actually grew in New Zealand following the removal of subsidies. Pastoral farms increased in size, while many farms diversifying away from traditional sectors such as sheep farming into deer and horticulture decreased in size. Since 1987 land used for both agriculture generally and pastoral farming in particular have been falling, and a greater share of pastoral land has shifted into dairy farming. Over that period dairy stock units rose 65% while beef fell 2%, and sheep fell 43%.

The agricultural labour force shrank from its 1982/83 peak of 127,000 full-time equivalents to 102,000 in 2003/04, with an associated doubling of labour productivity. Land productivity increased by 85% since 1983/84. Total sheep numbers fell dramatically with the removal of subsidies, but productivity increases meant the change in meat production did not fall commensurately. Between 1982/83 and 2003/04 lambing rates rose 18%, and lamb weights rose 18% on average. Since 1990/91 breeding ewe productivity has risen 60%, while dairy production has also experienced significant productivity gains, with milk solids produced per dairy cow rising over 30%.

Figure 2.10 demonstrates that among OECD countries New Zealand has experienced the largest proportionate decline in total support for agriculture as a percentage of farm incomes between 1986-88 and 2002-04.

Figure 2.10 – OECD Producer Support as Percentage of Gross Farm Receipts



Source: OECD (2005, p. 19).

Even in 1986 when state support for New Zealand farmers was being dismantled, the total level of state support was a relatively low proportion of farm incomes as compared with other OECD countries. The sector is now the least supported of all farming sectors among these developed countries. OECD (2005) data indicates that despite this ranking, New Zealand is second only to Australia in terms of the level of general support offered to farmers (as opposed to direct income support), at 38% of total support. This includes marketing and promotion support, public stockholding of agricultural products, infrastructure, R&D and education, and inspection services. Such support does not directly affect farm incomes (and hence is considered less distorting), although it can contribute to longer-term productivity and growth.

2.4.3 History of Major Innovations

Aside from major institutional reforms such as those occurring with the loss of traditional markets in the 1970s, and the structural reforms of the 1980s, productivity gains in the New Zealand agriculture sector have also often been associated with a number of major innovations over the past 100 or more years (e.g. See Harrington (2005)), including:

- Refrigerated shipping, allowing frozen meat to be exported to Europe;
- Use of phosphate fertilisers to improve soil fertility, and also to address cobalt deficiency that had hampered farming in the central North Island;
- Development of aerial top-dressing following the Second world War;
- Milking machines and milk tankers for efficient and rapid milk collection and transportation; and
- Artificial insemination.

2.4.4 Ongoing Pressures for Innovation

The pressure for New Zealand agriculture to continue making such productivity gains and innovations remains greater than ever. According to Sherwin (2007) the sector confronts the following major challenges:

- *More discerning global consumers* – concerned about the health benefits, safety, animal welfare, and environmental sustainability of foods and their production;

- *New forms of trade protection* (over and above existing tariffs and quotas) – particularly technical barriers based on sanitary and phyto-sanitary (SPS) regulations permitted under the World Trade Organization (WTO), requiring New Zealand producers to pay greater attention to biosecurity;
- *Greater competition from low-cost producers* – particularly in South America and Asia, where labour and increasingly also land costs are much lower than in New Zealand;
- *Demographic changes* – with declining rural populations in New Zealand, increasing skills shortages, greater farming intensity (with associated strains on ecosystems), and competition for rural land between farmers and lifestylers; and
- *Increasing buyer power*, with ten supermarket chains now controlling 80 – 90% of world food and beverage trade, and increasingly setting standards for products and supply processes (including for climate change-related attributes such as “food miles” or “carbon footprints”).

Added to this list should be the rapid escalation in shipping costs faced by New Zealand agricultural exporters as a consequence of growing demand for shipping space to and from Asia. For example, shipping rates faced by timber exporters are reported to have more than tripled in five years.⁵ Increases such as these exacerbate the difficulties of distance and scale faced by all exporters of bulk product from New Zealand.

These challenges mean New Zealand producers face pressures to improve their farming sustainability, to ensure product traceability from farm to plate, and to increasingly differentiate what have historically been commodities into value-added products according to the attributes demanded by consumers. They must pay increasing attention to questions of biosecurity. Cost competition requires them to re-evaluate the basis of their comparative advantage (i.e. shifting from competing on cost to quality and supply security, and from exporting raw commodities to exporting value-added products and/or farming and processing technologies themselves). To redress buyer market power and buyers' increased control of product specifications and supply requirements they must also improve coordination of every aspect of the supply process, paying greater regard to demand considerations as much as supply considerations. This also increases their need for industry structures and practices that support any investments required to produce increasingly specialised and differentiated products to meet these tighter product and production process specifications.

⁵ “Shipping Sinks Logs”, *The Dominion Post*, 16 June 2007.

The pressure for productivity increases in primary industries that use land will depend to an extent on the dependence of New Zealand on these industries for its export earnings (as opposed to some other activities). The evolution of other activities will provide domestic competition, whereas if New Zealand relies on agriculturally based export income, the real exchange rate and New Zealand's real income will (ultimately) depend upon the productivity of these industries.

2.4.5 Climate Change and Water Supply/Quality Issues

An increasing focus on agricultural sustainability also highlights two particular issues for New Zealand agricultural producers:

- The climate change implications of New Zealand agriculture (which accounts for around 50% of New Zealand's total Greenhouse Gas (GHG) emissions, mostly in the form of methane emissions from pastoral farming); and
- The impact of intensive farming practices and fertiliser use on water quality.

Increasing land use intensity, particularly for dairy farming and wine growing in their respective areas of geographic concentration, are straining available natural water resources, and also having detrimental impacts on water quality (in the case of farming). European consumers in particular are increasingly concerned about the GHGs associated with shipping produce from distant countries like New Zealand to their home markets, aided by moves by local producers to encourage consumption of locally-made produce ("buy local").

European supermarket chains are responding to such concerns, such as with "food miles" labelling, although they acknowledge that more comprehensive "carbon footprint" labelling that accounts for carbon used in the entire food supply chain would give a more accurate assessment of agricultural carbon intensity. This raises important measurement issues which New Zealand producers should expect to resolve if they are to maintain market position by effectively addressing consumer concerns about climate change impacts from food supply.

Finally, as well as mitigating adverse environmental impacts from farming, New Zealand producers also need to be mindful of adapting to any changes in New Zealand's climate as a consequence of GHG emissions (or otherwise). In this respect, however, the news is not all bad, as farmers have an ability to change land use in response to climatic changes, enabling them to take advantage of favourable changes and mitigating the effects of adverse changes.

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2.4.6 Industry Structures, Issues and Trends

Table 2.9, spanning the closing pages of this section, offers a high-level overview of the industry structures of the seven agriculture sub-sectors considered in this report. It focuses on questions of industry composition and ownership (including extent of foreign ownership), vertical and horizontal integration, exporting arrangements, market access restrictions, capital access and constraints, and each sub-sector's main competitor nations. It also sets out high-level issues and trends in each sub-sector.

In terms of issues and trends some common themes emerge:

- Rapidly rising shipping costs and consumer concerns about “food miles” (i.e. CO₂ emissions from transporting goods around the world), combined with rising “buy local” campaigns in the UK especially, are a shared problem across sub-sectors.
- Apples and pears, and kiwifruit producers face increasing competitive pressure from low-cost producers like Chile, particularly as quality of Chilean fruit improves, and also a loss of seasonal supply advantage (which is shared with Southern Hemisphere competitors like Chile) due to improved storage technologies extending the year-round supply of European fruit, exacerbated by the uncoordinated marketing of Southern Hemisphere fruit in Europe.
- New Zealand horticulture growers also face seasonal labour supply shortages affecting fruit picking, in part because of competition for low/medium skill labour from other sectors such as construction.
- These horticultural producers are increasingly relying on IP-protected variety innovations to give them a competitive edge over producers of non-protected traditional varieties, but their ability to control such IP at a national level is diminished when they undertake the necessary R&D via joint ventures with competitor nations.
- Winemakers continue to face a related challenge – how best to preserve market position in the face of an international wine glut, which includes defending New Zealand winemakers' position as high-quality niche players against other New World producers such as Chile, Argentina and the US – and to countervail against supermarket buying power where producers are not already part of multinational beverage concerns.
- Horticulture, winemaking and dairy all face regional constraints on water access, and dairy in particular is facing increasing pressures to decrease adverse impacts of farming on water quality.

- Both wool and wine face the challenge of consumer preferences shifting towards alternative products (i.e. synthetic fibres, and other beverages, respectively).
- All sub-sectors must adapt to growing supermarket buyer power, and the associated increasing product differentiation in relation to food safety, food health attributes, food-chain traceability, good agricultural practices and animal welfare, environmental sustainability, and year-round supply security.
- Across the horticulture, dairy, and sheep and beef sub-sectors there is an emerging trend towards New Zealand processors and marketer/exporters – whether producer/grower controlled or not – increasingly sourcing supplies of raw products from competitor nations, sometimes involving IP-protected new varieties under licence, and deriving returns in a greater measure by exporting farming and processing/exporting know-how and relationships.

Additionally, almost all of these sub-sectors have experienced long-term declines in real commodity prices. While the forestry sector has enjoyed a recent upturn in log prices, in part due to Russian export taxes being levied on exports of Russian logs to encourage greater domestic processing, much of these gains have been eroded by a high exchange rate and rapidly rising shipping costs. Dairy prices are the main exception at present, with strong growth in world demand for dairy products, particularly from the strongly growing Asian economies. However, both dairy and beef prices are enjoying strong prices due to developments in bioethanol markets, particularly in the US. As corn production is being diverted toward subsidised bioethanol manufacturing, the cost of feed for non-pastoral dairy and beef producers is rising. It remains to be seen whether this particular shift will persist.

Each sub-sector clearly has its own particular challenges and trends as well. In forestry, for example, infrastructure issues (e.g. roading constraints) and obstacles to new processing development (e.g. RMA consent problems) potentially impede investments in processing capacity. To make matter worse, distance from markets combined with rising shipping costs require new investments to be large enough to provide competitive scale economies (e.g. compared with Chile, for example). Having said this, with shipping costs for logs proportionately higher than container shipping costs, Asian log buyers who traditionally prefer to purchase logs on competitive world spot markets are now contemplating processing investments in New Zealand supported by long-term supply contracts.⁶

Meat processors also face RMA challenges in building new capacity, for example in regions affected by rising competition for water supplies. Meat and apple exporters have suffered from a

⁶ “Asia Logs Interest in New Zealand Sawmills”, *The Dominion Post*, 23 June 2007.

lack of export marketing coordination but are increasingly cooperating to resolve this (e.g. joint apples branding, and joint lamb marketing in the US, respectively).

The final theme suggested above – towards increasing procurement of offshore supply – deserves further mention. It takes various forms, such as cross-border investment in farms and/or processing, contracting of foreign supply using licensed varieties or New Zealand farming practice technologies, and joint ventures and alliances with foreign suppliers or processor/marketers. Fonterra is a leading example of such strategies, but in recent years a pattern of outbound foreign direct investment (ODI) by local operators has emerged across almost all of the sub-sectors we are considering. In short – like a number of the country’s non-food industrial companies – New Zealand agriculture is increasingly conducted by multinational enterprises (MNEs), whether locally or foreign owned and controlled. Among other things, the advantages of this change include:

- Bypassing delays in WTO reforms (enabling local producers to jump tariff barriers and access foreign subsidised product);
- Coat-tailing off other countries’ FTAs where New Zealand is yet to secure such agreements;
- Bypassing (or at least diversifying) New Zealand dollar exchange rate risks;
- Reducing “food miles” and shipping costs by securing product closer to market; and
- Becoming “local” suppliers in foreign markets (thus side-stepping problems from “buy local” campaigns and country of origin rules).

This is an important theme to which we shall return in Section 4.

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Table 2.9 – Overview of Industry Structures, Issues and Trends for Selected Agriculture Sub-Sectors

Dimension	Apples and Pears	Dairy	Forestry	Kiwifruit	Sheep and Beef	Wine	Wool
Composition	920 orchards. 32 coolstores. 85 packhouses. Turners & Growers dominant (owns ENZA) – like other large players increasingly vertically integrated.	12,000 herds. Fonterra dominant in processing and marketing (95% market share).	Numerous small farm-foresters as well as concentrated large-scale owners. Some Maori corporate foresters. Concentrated processing, with multiple smaller operators.	2,760 growers. Concentration in processing, packing and coolstores: e.g. Seeka, Satara, G6 Kiwi, with backward integration into growing.	15,000 farms. Four dominant (PPCS, Alliance AFFCO, ANZCO) and multiple specialised processors. Landcorp Farming largest corporate farmer in New Zealand. Maori corporate farming significant.	516 wineries. Contract as well as integrated grape supplies. Six winery groups dominant and mostly foreign owned (e.g. Allied Domecq, LMVH, Fosters), but multiple niche operators.	13,900 farms, mainly in meat production with wool as by-product. Smaller number of high-value merino farmers (5% of production). Multiple other downstream operators (auctioneers/brokers, scourers, etc).
Ownership	Mostly independent growers. Turners & Growers listed.	Independent farms, often with share milking and contract milking. Cooperatives dominate downstream.	Larger forests increasingly owned by TIMOs. Land beneath CFLs returning to Maori under Treaty settlements process.	Independent and integrated growers. Cooperative and JV downstream.	Independent farms, sometimes corporate. PPCS and Alliance cooperatives. AFFCO listed. ANZCO foreign owned.	Predominantly foreign corporate beverage company ownership. Some listed wineries (e.g. Delectat), and many independents.	Farming as for sheep and beef. Private and/or listed auctioneers/brokers and scourers. Private and/or foreign exporters. Limited/niche private domestic processing.

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Table 2.9 (cont'd) – Overview of Industry Structures, Issues and Trends for Selected Agriculture Sub-Sectors

Dimension	Apples and Pears	Dairy	Forestry	Kiwifruit	Sheep and Beef	Wine	Wool
Vertical and Horizontal Integration	Trend to economies of scope through increasing product range marketed, and of scale (e.g. variety specialisation). Trend to integrated supply chain through alliances and backward integration.	Backward integration not a feature, but increased contracting and pricing to elicit differentiated milk supply. Fonterra uses alliances and JVs to procure foreign supply and downstream value-added.	Trend to de-integration of supply and processing, and downstream integration of processing into export markets.	Downstream operators already back-integrated, and increasingly so (e.g. through leases). Growers integrating downstream also (e.g. into packing). ZESPRI pricing policies to improve supply features.	Significant farmer ownership of processing via PPCS and Alliance. No significant back integration by processing. Increasing use of contracts for differentiated supply. Farmer ownership of niche processors on investor basis.	Among larger winery groups trend is to complete vertical integration, squeezing out contract grape suppliers. Other groups increasingly cooperating on marketing.	Limited, except for niche operators (e.g. merino clothing designers, producers and marketers such as Icebreaker). Merino industry uses contracting to procure required volumes and specifications.
Concentration	Consolidation on buying side reflected in increasing supply concentration.	Consolidation on supply side, with increasing corporate farm ownership.	Decreasing on supply side as integrated foresters divest estates to TIMOs.	Five companies supply 50% of trays.	Four processors dominant.	High on distribution and buying side. Increasing on supply side.	High in exporting. China a major buyer at auctions.
Cooperation	Marketing collaboration via The Market Panel (90% of exports).	Strong, via Fonterra. DairyInsight coordinates industry good activities such as R&D.	Weak, with diverse owner types and interests.	Export marketing coordinated via ZESPRI and HEA.	Increased through PPCS acquisitions, and possible merger with Alliance. Joint US lamb marketing.	Marketing coalition "The Twelve – New Zealand's Wine Family".	Attempts at cooperative marketing in the past. New Zealand Merino Company actively markets merino.
Exporting	90 exporters, with two largest ENZA (35%) and Mr Apple.	Fonterra dominant, but Tatura and Westland also significant. Niche exporters.	Largely uncoordinated.	ZESPRI is single point of entry for all markets except Australia.	EU and US quotas administered by New Zealand Meat Board. EU uncoordinated, but some US coordination.	Mostly integrated multinational beverage companies. Some independent or cooperative. 46 registered exporters.	220 registered exporters but only 25 active. Top 5 account for 80% of exports.

... cont'd

Table 2.9 (cont'd) – Overview of Industry Structures, Issues and Trends for Selected Agriculture Sub-Sectors

Dimension	Apples and Pears	Dairy	Forestry	Kiwifruit	Sheep and Beef	Wine	Wool
Foreign Ownership	Increasing in downstream.	Negligible.	High.	Low.	Relatively low (e.g. ANZCO) given cooperative dominance.	High. Over 50% of domestic sales and exports by foreign owned wine groups.	Low in production, auctions/broking and scouring. Significant in exporting.
Access to Capital	Unconstrained. Some listed.	Cooperative structures needing to innovate to relieve capital constraint. Financial innovations (Dairy Equity, Dairy Investment Fund).	Unconstrained.	Some listed. ZESPRI constrained by grower control.	PPCS highly geared and capital constrained. Other processors unconstrained.	Unconstrained, except perhaps for some Maori corporate farmers.	Unconstrained, except perhaps for some Maori corporate farmers.
Market Access	SPS issues in Australia	Tariffs/Quotas to US, EU and Japan.	Tariffs into Korea, US, China, Japan.	45% tariff in South Korea.	EU and US quotas.	Technical/labelling and/or other non-tariff barriers significant.	China wool quota.
Innovation	Prevar JV for new varieties development.	Largest private R&D investor in New Zealand. LIC.	ENSIS JV between CRI Scion and Australian CSIRO.	Red Kiwifruit development. Process innovations.	Selective breeding and genetics to improve yields and attributes.	New Zealand wines regarded as high-quality, niche, "New World".	Canesis and Wool Equities active in new product development. Merino and keratin-based products. Flexible fabric switching (Softswitch). AgResearch flame and stab-proof woollen fabric (Natural Easy Care).
Main Competitors	Chile, South Africa, Italy.	EU, Australia.	Russia, US, Canada, EU, Chile.	Chile, Italy.	Australia for lamb. Brazil and Australia for beef.	Australia, Chile, France.	Australia.

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Table 2.9 (cont'd) – Overview of Industry Structures, Issues and Trends for Selected Agriculture Sub-Sectors

Dimension	Apples and Pears	Dairy	Forestry	Kiwifruit	Sheep and Beef	Wine	Wool
Issues	Tough global market, though less for new varieties. Concern about losing IP in new varieties. Need for marketing cooperation. Shipping costs. Food miles. Labour shortages.	Increasing low-cost supply from competitors. Fonterra capital restructuring. Sustainability and water access issues. Market access and EU/US subsidies. Food miles. Shipping costs.	Scale economies and cost pressures in processing. Climate change policy uncertainty reflected in historically low new planting and net deforestation. Low prices and tough export markets. Shipping costs.	Tough global market, though less for new varieties. Need for tighter supply chain management. Shipping costs. Food miles. Labour shortages.	Financial state of PPCS. Ongoing procurement challenges for processors. Labour cost pressures under Holidays and Employment Relations Acts. Growing low-cost competition. Food miles. Shipping costs. UK "buy local".	International wine glut. Buy-side concentration. Competition for water. Need for non-integrated exporters to co-market wine with other beverages.	Declining wool demand in favour of synthetic fibres. Low wool prices and high shearing costs biasing sheep farming towards meat focus. Lower potential for productivity gains than in meat. Multiple overlapping industry bodies. Excess scouring capacity.

... cont'd

Table 2.9 (cont'd) – Overview of Industry Structures, Issues and Trends for Selected Agriculture Sub-Sectors

Dimension	Apples and Pears	Dairy	Forestry	Kiwifruit	Sheep and Beef	Wine	Wool
Trends	ENZA sourcing Italian supply of Jazz™ under licence.	Fontterra sourcing supply from China, Latin America, US and Australia. Exporting technology and know-how. Increasing investor-involvement (domestic and foreign) in sector. Talley's-controlled AFFCO diversifying into dairy via Dairy Trust.	Conversion of forests into dairy land. Forestry as diversification strategy for offshore investment funds.	ZESPRI™ Gold increasingly sourced from Italy, France, Chile, Korea and Japan under licence.	Rissington Breedline securing UK supply using licensed genetics to ensure consistent and year-round supply to Marks & Spencer. New Zealand Farming Systems Uruguay buying cheap land in Uruguay and applying New Zealand know-how to lift dairy and beef productivity. Talley's-controlled AFFCO diversifying into dairy via Dairy Trust.	Increasing ownership by foreign beverage companies, consolidation, backward and forward vertical integration. Increasing export marketing cooperation by non-integrated wine producers.	Focus on R&D to develop specialised uses for wool. Treating wool as a marginally economic by-product of higher-value meat production for the majority of farmers other than merino producers. Australia examining adoption of New Zealand merino industry's structure.

Notes: IP = intellectual property. JV = joint venture. TIMO = Timberland Investment Management Organisations. CFLs = Crown Forest Licences.

3. Theoretical and Empirical Literature

“Commerce and manufactures can seldom flourish long in any state which does not enjoy a regular administration of justice, in which the people do not feel themselves secure in the possession of their property, in which the faith of contracts is not supported by law, and in which the authority of the state is not supposed to be regularly employed in enforcing the payment of debts from all those who are able to pay. Commerce and manufactures, in short, can seldom flourish in any state in which there is not a certain degree of confidence in the justice of government.” From Adam Smith’s *Wealth of Nations*, quoted in Rodrik et al. (2002, p. 2).

Given the broad scope of our inquiry, our challenge is to keep this section’s review of the relevant theoretical and empirical literatures at a manageable scale while also doing justice to the important details. Since our aim is to inform the policy-oriented discussion of industry structures and institutions affecting growth and innovation in our selected New Zealand agricultural sub-sectors, the greater focus in this section will be on the empirical findings from the international and New Zealand literature.

Moreover, our institutional focus means that we will only quickly traverse non-institutional factors considered in the growth and innovation literatures. This also means we will not delve into the more proximate causes of growth – namely influences directly affecting factor accumulation – but rather focus on the fundamental causes of growth (i.e. the influences affecting factor accumulation at a more basis level). Also, wherever possible we include studies with a particular agriculture focus in our review. In these ways our review extends those provided by others on the general determinants of growth (e.g. Galt (2000), Treasury (2004)), providing a greater institutional focus, and also examining the influence of institutions on growth via their influence on innovation.

With these considerations in mind, Section 3 is structured as follows:

- Sections 3.1 and 3.2 provide a high level and brief summary of leading growth theories, and leading innovation theories, respectively;
- Section 3.3.1 provides a high level and brief summary of the evidence on general factors affecting growth, really just to identify the relevant control variables that any studies involving institutional variables should also look to consider;
- Sections 3.3.2 through 3.3.4, comprising the bulk of Section 3, provide more comprehensive surveys of the empirical findings on the linkages between institutions and growth, between institutions and innovation, and between innovation and growth; and
- Section 3.3 distils these empirical lessons into key overall findings from the literature.

Finally, before proceeding further it is worth emphasising that blithely translating foreign or international lessons into the New Zealand context would be unwise. Hence any results from our literature review should be interpreted as pointers for further inquiry, and any such inquiry should fully take into account New Zealand's particular circumstances and issues.

3.1 Growth Theory

Only a brief overview of the theories of growth is provided in this section. Fuller overviews can be found in Barro and Sala-i-Martin (2004), Aghion and Durlauf (2005), and Galt (2000), among many others.

3.1.1 Neoclassical Growth Theory

Neoclassical growth models trace their lineage to the model first developed by Solow (1956) and Swan (1956). A key feature of their model is its neoclassical production function, assuming competitive markets, constant returns to scale, and diminishing returns to each input (commonly, land and capital). That production function is commonly assumed to take the Cobb-Douglas form:

$$Y = AK^\alpha L^{1-\alpha}$$

Where Y is output, K and L are capital and labour inputs, α is the capital share of factor inputs, and A represents the level of technology. Many variations abound, such as those that include natural resources as an explicit input factor (e.g. Gylfason and Zoega (2006)), or those which deconstruct the technology term into R&D and other (e.g. efficiency) effects (e.g. Johnson et al. (2005)).

Features of this model include that increasing factor inputs should increase output, but not long-run output growth (only short-term growth increases as output moves to its new equilibrium level). Increased domestic savings – and hence increased investment – is predicted to increase the level of output, but not the permanent level of output growth. Given diminishing returns to capital, the model predicts that per capita growth must eventually cease, absent continuing improvements in technology. Furthermore, it predicts that the lower a country's starting output per capita, relative to the steady-state level, the higher should be that country's growth rate (so-called "conditional convergence"). Finally, the model treats technological change as determined independently, and hence cannot explain a common empirical finding (see Section 3.3) that much output growth is not related to factor accumulation, and hence can be attributed to the residual "A" term. The long-term output growth rate is tied to the rate of technical progress, which is determined outside of the model.

3.1.2 Endogenous Growth Theory

Endogenous growth models attempt to overcome the limitation of the neoclassical model by explaining the process of technological change, and in so doing present a better explanation for explaining the growth in output as opposed to its level. They commonly require departure from the assumption of competitive markets, since technological progress requires the creation of new ideas which can have public good attributes (e.g. there can be spill-overs of new ideas across firms), and also lead to increasing returns to scale. The competitive assumptions also fail where new ideas do not perfectly diffuse to all producers, and importantly, where costly innovation requires compensation to innovators in the form of positive economic rents (as in Schumpeterian models of innovation – see Section 3.2.1).

Grossman and Helpman (1994) emphasise the need in such models for imperfect competition to be assumed. This ensures firms can charge more than marginal production costs for goods or services embodying new ideas, which in turn provides the reward necessary to incur the up-front costs of innovation. A consequence of such models is that output can continue to grow even with static input supplies, as ongoing technological progress results in increasing factor productivity.

Consequences of such models include that the resulting rate of output growth need not be socially optimal, with innovation driven by private innovation returns which may not coincide with social returns. Either over- or under-investment in innovation can arise. Government actions are also predicted to affect long-term growth rates, including taxation, maintenance of law and order, provision of infrastructure, protection of intellectual property rights, and market regulation.

3.1.3 Other Growth Theories

As will be apparent from the survey of empirical growth literature in Section 3.3, a great many other explanations for growth have been developed. These include models:

- Suggesting that institutions such as impartial contract enforcement and secure private property rights, as well as macroeconomic stability, contribute to economic growth by ensuring private investors can appropriate the rewards from their endeavour;
- Relating growth to investments in human capital in the form of health and education, which improves labour productivity and increases lifetime productive potential;
- Arguing that the scale and nature of direct government involvement in the economy can have either a positive (e.g. infrastructure, health and education expenditure) or negative (e.g. income taxation, wealth transfers) impact on growth, crowding out private endeavour and/or distorting the incentives for private investments;

- Suggesting that openness to trade can improve growth, for example by increasing competition and increasing technology spill-overs;
- Emphasising the importance of scale economies in production to ensure export competitiveness, and also the distance from markets (or the degree of inter-connectedness of producers) which can affect both cost competitiveness as well as technology diffusion; and
- Arguing that the greater the proportion of output derived from natural resources the lower the expected growth rate, e.g. because of adverse incentives to make investments in other productive factors, or to attempt to capture the returns from natural resources rather than to make more productive investments, and because commodity price rises can result in high real exchange rates which hinder the development of non-commodity based exporting industries.

3.2 Innovation Theory

As for the growth theory discussion above, only a brief overview of the theories of innovation is provided in this section. Fuller overviews can be found in OECD (2005), Smith (2006), Baumol (2002), and CRA (2002), among many others.

3.2.1 Schumpeterian Competition

The work of Austrian economist Joseph Schumpeter has been influential in the development of theories about the nature and origins of innovation in market economies. Neoclassical economics emphasises competition *within* markets based on price competition, characterised in the ideal of perfect competition by multiple price-taking firms with identical production technologies and hence cost structures, and zero supernormal profits. By contrast, Schumpeterian economics emphasises competition *for* markets with competition in both price and technology, in which firms invest in innovation to enable them to displace competitors. This type of competition occurs sometimes in the ICT sector, for example, where successful innovators create the standard for new products or services (e.g. Microsoft's Windows operating system), with the result that other innovators are thwarted. As summarised in OECD (2005), Schumpeter proposed five types of innovation:

- The introduction of new products;
- The introduction of new production methods;
- The opening of new markets;
- The development of new sources of supply for raw materials or other inputs; and
- The creation of new market structures.

Schumpeter argued that innovation gives rise to “creative destruction”, or the replacement of older technologies by newer ones. “Radical” innovations can give rise to major disruptive changes, whereas “incremental” innovations give rise to continuous change. For Schumpeter innovation is more concerned with the former – resulting in major structural changes. Such thinking has been influential in many OECD countries where new “carrier” or “enabling” technologies such as ICT, biotechnology and nanotechnology are seen as being keys to driving other growth-enhancing innovations.

The neoclassical ideal of perfect competition is unlikely to support such investments in innovation. As discussed in Section 3.1.2, the benefits of innovations are generally not fully appropriable by those making the investments required to generate them. Nor do innovations fully diffuse from their originators to impersonators. Furthermore, innovative investments can involve initial costs which are not compensated in perfectly competitive markets where prices are driven to marginal cost. These considerations suggest that innovators can be expected to enjoy some measure of market power because of their innovations, and also that institutions such as IPRs conveying market power to innovators can be necessary to induce innovative investments. Either way, the innovative process is expected to be characterised by less than perfect competition, or in other words, to be imperfectly competitive.

As a consequence, the classic tension between static and dynamic efficiency is expected to arise in innovative markets. Under perfect competition static efficiency is predicted, with prices equalling marginal costs, but with the consequence that firms lack the incentive to make innovative investments. Conversely, welfare-enhancing and dynamically efficient investments can be supported in imperfectly competitive markets, but at the expense of static efficiency, since prices in such markets should be expected to exceed marginal costs in order for the costs of innovative investments to be recovered.

3.2.2 Systems Innovation Theory

Systems innovation theory (e.g. Lundvall (1992)) extends the ideas of Schumpeter beyond consideration of innovation by individual firms to include the systemic interactions that support and produce innovation. Innovation is seen as the product of complex interactions between firms and their customers and suppliers, and at the wider institutional (i.e. social, cultural, infrastructural) level. Whereas Schumpeter emphasised innovation as an instrument of competition between firms, under innovation systems models innovation often arises as a consequence of cooperation and coordination among different actors. Important among such actors are institutions involved in searching and learning, such as universities, technological institutes and R&D departments.

Also important to innovation systems are physical and knowledge infrastructures. The former include transport, energy and communications networks, all of which tend to play at least a general role in facilitating new discoveries. The latter – knowledge infrastructures – include core technologies such as the internet, microelectronics and biotechnology which play a major role in the development of advanced economies. Empirically many such technologies evolve from initial work undertaken in governmental or other public agencies, such as military R&D programmes, universities, and government-owned laboratories.

Systems innovation theory posits that differences in countries' macroeconomic performance can be traced to differences in the ways that these actors interrelate within each country and across countries, as well as to underlying differences in social and economic structures.

3.2.3 Other Theories of Innovation

OECD (2005) briefly summarises other innovations theories. In addition to the Schumpeterian and systems innovations views, other theories include:

- *Evolutionary economics* – linked to the Schumpeterian and systems innovation approaches, variety creation (i.e. innovation) arises as a consequence of interactions between multiple actors and factors, including selection via markets, and results in path-dependent development;
- *Competitive positioning models* – akin to Schumpeterian competition, but recognising that firms can innovate to retain their existing competitive position as well as to secure new ones;
- *Organisational innovation* – sees different types of organisational structure as more suitable to innovation than others, for example with greater organisational flexibility and autonomy seen as conducive to more radical innovation, while organisations that are more integrated and coordinate with others are more suitable for more incremental innovation;
- *Marketing theories* – argue that product differentiation through innovation is important to capture the demand of heterogeneous consumers; and
- *Technology gap models* – posit that countries lagging technological leaders catch up to those leaders through imitating and importing their technology, often with explicit government support to do so (e.g. as occurred in certain South-East Asian economies in the late twentieth century, but also in Nordic countries in the nineteenth).

3.3 Evidence

3.3.1 General Evidence on Growth

As discussed in the introduction to Section 3, the main focus of our literature review will be on the empirical lessons regarding the role of institutions on growth and innovation. A full survey of the literature on the general determinants of growth is therefore beyond the scope of our report, and for overviews the interested reader is referred to texts such as Barro and Sala-i-Martin (2004), studies such as Bassanini and Scarpetta (2001a), Bosworth and Collins (2003) and Rodrik (2005), or to surveys such as Temple (1999), Ahn and Hemmings (2000), Galt (2000) and Treasury (2004). Here we present only a very general overview of the factors found in previous studies to play a potential role in explaining growth, in the main to provide context to the institutional literature surveys.

Stylised Facts

Easterly and Levine (2001) present five “stylised facts” of economic growth they glean from the burgeoning growth literature. They start by observing that (p. 1) “The central problem in understanding economic development and growth is *not* to understand the process by which an economy raises its savings rate and increases the rate of physical capital accumulation” [original emphasis]. They argue that factor accumulation is not unimportant for growth, but rather that the majority of cross-country differences in both income levels and growth rates are accounted for by something other than factor accumulation – in other words, Solow’s “residual” or “technical progress”, otherwise known as total factor productivity (TFP). This is their first stylised fact. Various theories of what determines TFP are mentioned, but the authors conclude that economists are yet to disentangle precisely what it is that drives this residual.

Their other stylised facts are:

- There are huge and growing differences in per capita GDP across the world – not the conditional convergence suggested by neoclassical growth theories;
- Growth is not persistent – while some countries experience steady growth others experience none, others experience surges and troughs, and changes in factor accumulation do not correlate well with changes in growth;
- Economic activity tends to be highly concentrated, with factors of production flowing to the same places, suggesting important externalities; and

- National policies influence long-run growth, particularly where they increase the efficiency of capital and labour, or change the rate of technological change that boosts productivity growth and hence long-run economic growth.

Easterly and Levine’s “big picture” conclusion from their review of the literature on growth is that (pp 4-5) “creating the incentives for productive factor accumulation is more important for growth than factor accumulation per se.”

Empirical Regularities

Barro and Sala-i-Martin (2004) argue that the evidence on growth indicates that observed differences in per capita growth rates across countries are large and can be explained in terms of a set of quantifiable variables. One element is a convergence term, implying a positive growth effect when initial real GDP per capita is low relative to initial human capital (measured as educational attainment and life expectancy), as well as variables measuring policies and national characteristics.

Their second group of explanatory variables, taking GDP per capita and human capital as given, is summarised in Table 3.1.

Table 3.1 – Barro and Sala-i-Martin (2004) Additional Growth Factors

Positive Growth Factors	Negative Growth Factors
Rule of law	Ratio of government consumption to GDP
International openness	Increases in fertility rate
Positive changes in terms of trade	
Investment ratio (weak effect)	

Source: Barro and Sala-i-Martin (2004).

Illustrative Variables List

Numerous studies have highlighted factors beyond those included in Barro and Sala-i-Martin as playing a role in growth. Setting aside institutional explanations to the discussions that follow, examples include:

- The negative impact of natural resource abundance on growth – e.g. Sachs and Warner’s (2001) “curse of natural resources”, and Gylfason and Zoega (2006) evidence suggesting good growth performance is incompatible with a share of natural resources in excess of

15% of national wealth (New Zealand is included among a group of developing countries, with a share of between 15-20%);

- Geography and demography – e.g. Bloom and Sachs (1998) highlight what they describe as disastrous geography lying at the heart of Africa’s poor economic performance (echoing generally poorer economic performance in the tropics relative to temperate zones), involving high disease burdens, low agricultural productivity, and low international trade concentrated in a few primary commodities;
- The importance of price and macroeconomic stability, and well-developed financial markets – e.g. Bassanini and Scarpetta (2001a);
- The positive influence of trade – e.g. WTO (1998, Ch. 4), Frankel and Romer (1999); and
- The importance of agricultural growth for economic performance – e.g. Johnson (1997).

Table 3.2 summarises a “representative” sample of variables commonly used in growth regressions to control for common growth factors.

Table 3.2 – IMF (2003) Variables used for Growth Modelling

Class of Variables	Measures Used
Institutions	<ul style="list-style-type: none"> • Governance index – aggregating measures of voice and accountability, political stability and absence of violence, government effectiveness, regulatory burden, rule of law, and freedom from graft; • Property rights protection; • Constraint on the executive.
Policies	<ul style="list-style-type: none"> • Inflation – price stability; • Exchange rate overvaluation – macroeconomic imbalance; • Trade openness – goods market integration; • Government size – fiscal prudence; • Financial development – depth of financial markets; • Capital account openness – financial market integration.
Other variables	<ul style="list-style-type: none"> • Latitude – distance from equator/tropics; • Landlocked – access to large markets; • Settler mortality – disease environment; • Ethnolinguistic diversity – social cohesion; • European languages – English and others; • Legal origins – British, French or German.

Source: IMF (2003).

Policy Guidance

Kenny and Williams (2001) conclude that the empirical evidence on growth does not unanimously support any particular view of the growth process, or the efficacy of any particular policy prescriptions for growth. Indeed, they conclude from a survey of the econometric studies of growth that the key conclusion would be that difference policies work for different countries at different times. This echoes the conclusion of Hausmann et al. (2005), who argue that most instances of economic reform do not result in growth accelerations.

3.3.2 Evidence on Institutions and Growth

There is now considerable cross-country and case study evidence for a strong relationship between institutions, variously defined, and either economic growth, or income levels. Useful surveys are provided in IMF (2003), Galt (2000), Treasury (2004), and Ahn and Hemings (2000), to name a few. Indeed, Acemoglu et al. (2005, p. 402) go further than confirming a mere association, and attribute causation: “We now argue that there is convincing empirical support for the hypothesis that differences in economic institutions, rather than geography or culture, *cause* differences in incomes per-capita.” [original emphasis] They further suggest that this result is robust to different measures of institutions.

Authors such as Jameson (2006) and Rodrik (2006) take such evidence as sufficient to conclude that institutionalism has won the development debate, in particular supplanting the so-called “Washington Consensus” of development policies based on “market fundamentalism”. Instead of merely displacing the Washington Consensus, however, institutionalism is seen as extending the Consensus, by the inclusion of factors such as those in the second column of Table 3.3.

Table 3.3 – The Institutions-Augmented Washington Consensus

Original Washington Consensus	“Augmented” Washington Consensus – the previous 10 items, plus:
1. Fiscal discipline	11. Corporate governance
2. Reorientation of public expenditures	12. Anti-corruption
3. Tax Reform	13. Flexible labour markets
4. Financial liberalisation	14. WTO agreements
5. Unified and competitive exchange rates	15. Financial codes and standards
6. Trade liberalisation	16. “Prudent” capital-account opening
7. Openness to FDI	17. Non-intermediate exchange rate regimes
8. Privatisation	18. Independent central banks/inflation targeting
9. Deregulation	19. Social safety nets
10. Secure property rights	20. Targeted poverty reduction

Source: Rodrik (2006, p. 978).

Conversely, Glaeser et al. (2004) critically appraise the empirical literature suggesting political institutions cause growth. They identify conceptual flaws in the way that institutions are measured, and econometric limitations in existing studies, concluding that the link is yet to be established. Indeed, they find instead that much evidence points to human capital as being the main predictor of both growth and improving political institutions (i.e. democratisation). They emphasise that the importance of institutions is not in question, but that establishing their importance for growth requires attention to better institutional measures. Similarly, Temple (1999) highlights a number of methodological pitfalls faced by growth studies generally, including those examining the link between institutions and growth.

Recent research argues that high-level or “first order” institutions such as property rights, rule of law, etc, are the underlying drivers of growth, and not lower-level institutions such as policies. For example, Rodrik (2005) notes that various Asian economies have prospered despite not following Washington Consensus-like prescriptions, whereas Latin American countries have suffered stagnant growth despite more closely aligning domestic policies with those of the Consensus. This causes Rodrik to conclude that there is no unique mapping from good institutions to good policies, and suggests the policy-maker must instead resort to pragmatism and first principles in designing domestic policies. In a related vein, Easterly (2005) finds that once extreme policies are excluded, policies have no effect on growth, and only institutions retain any explanatory power for growth. Similarly, Temple (1999) observes that post-war growth rates in OECD countries have not shown any persistent upwards trend despite significant policy changes such as trade liberalisation, increasing years of schooling, and increases in both investment and R&D. He does however find that infrastructure investments by government, such as in roading and telecommunications, are robustly found to be associated with growth.

Aghion and Howitt (2005) argue that growth policies remain relevant if Schumpeterian growth theory is adopted in place of the more common neoclassical growth paradigm. They survey empirical evidence strongly supporting the main Schumpeterian predictions, namely that competitive entry is important for growth in countries already close to their technological frontier, and that firm exit can improve productivity growth by replacing less efficient firms with more efficient ones. Furthermore, under their approach a higher human capital stock should foster growth by enabling countries to catch up with the technology frontier. Higher education should thus make a bigger difference for countries close to the technology frontier, while primary and secondary education should be of greater benefit to less advanced economies: predictions supported by the evidence they surveyed.

Finally, their Schumpeterian approach sheds light on the importance of macro-stability for growth. Macroeconomic instability will hinder innovation if firms lack access to sufficient capital to reorganise their activities in response to economic shocks, meaning that in countries with lower financial development recessions should discourage R&D investments. In support of this they cite

OECD evidence showing that counter-cyclical budget deficits can be growth enhancing in countries with low financial development, particularly where public investments are involved (as opposed to government consumption), and particularly also where there are high levels of product and labour market liberalisation. They conclude that appropriate growth policies will therefore vary along with a country's institutions, rather than be dominated by those institutions.

IMF (2003) and Gradstein (2004) argue for mutual reinforcement between institutions and policies. On the one hand institutions such as sound property rights are found to be important for growth, but consistent with Glaeser et al (2004) above, social and economic development are also seen as important for sound institutions. Given our growth context this lends weight to the argument of Davis (2005) that growth is less a function of static institutions as it is to political and legal flexibility. As we suggested in Section 1.3.1, the ability of institutions to adapt to changing imperatives in efficient ways lies at the heart of their appropriateness. Indeed, Kuran (2004) attributes much of the relative decline of Islamic states – which were technologically and economically advanced compared to the West a millennium ago – to what he calls “evolutionary bottlenecks” arising from institutional rigidities rooted in Islam.

With this snapshot of some of the variety of issues arising in the literature regarding the evidence on the impact of institutions on growth, the following sections summarise some of the major contributions. We consider institutions categorised under the following headings:

- Property rights, and Intellectual Property Rights (IPRs);
- Social infrastructure;
- Colonial origins;
- Economic freedom and other broad institutional measures;
- Size of government, and structure of government revenues and expenditures;
- Finance;
- Regulation, and competition policy;
- Electoral systems;
- Trade; and
- Industrial policy and export promotion agencies.

The key lessons of this literature are summarised in Section 3.4.

Property Rights, and Intellectual Property Rights (IPRs)

Knack and Keefer (1995) provide early evidence on the relationship between institutions and growth. They use cross-country data for 1974 – 1989 to examine the role of institutions in explaining economic growth and investment. Table 3.4 overleaf summarises the institutional

variables they combine to form two institutions indexes – an ICRG (International Country Risk Guide) Index and a BERI (Business Environmental Risk Intelligence) Index.

Table 3.4 – Knack and Keefer (1995) Institutional Index Variables

ICRG Index Variables	BERI Index Variables
Expropriation Risk	Contract Enforcement
Rule of Law	Infrastructure Quality*
Repudiation of Contracts by Government	Nationalization Potential
Corruption in Government	Bureaucratic Delays
Quality of Bureaucracy	

Source: Knack and Keefer (1995).

Notes: * Measure of efficiency with which governments allocate public goods.

These authors find that institutions protective of property rights are crucial to both growth in GDP per capita, and private investment as a proportion of GDP, rivalling the importance of education, and affecting both the magnitude and efficiency of investment.

Vijayaraghavan and Ward (2001) examine the relationship between institutional infrastructure and growth rates in real output per worker across 43 countries (all but nine of which are developing countries) over 1975-90. Institutions are measured using variables relating to security of property rights, quality of governance, political freedom and size of government. They find that the security of property rights and size of government are the most significant institutions that explain observed variations in economic growth rates.

Finally, Johnson et al. (2002) use 1997 survey data from small manufacturing firms in five post-communist transition economies to disentangle the relative importance for investment of access to external finance and security of property rights. In particular, they ask whether secure property rights are sufficient for investment, or merely necessary, given that investment may not arise even with secure property rights if external financing is not available. They find that weak property rights discourage firms from reinvesting profits, even when external finance is available, while firms reinvest profits when property rights are strong.

On the more particular question of how IPRs affect growth, Falvey et al. (2006) survey the existing literature and further investigate the impact of IPR protection on economic growth. They argue that a role for IPR protection arises because intellectual property shares some of the characteristics of public goods. It can be non-rival, and also non-excludable, with the result that underinvestment in intellectual property can result without protection of IPRs. Not only does such protection reward innovation (by enabling the right-holder to better profit from their innovation), but it also stimulates the acquisition and dissemination of knowledge since the information in patents is available to

other potential inventors. While one earlier study found a significant positive relationship between IPR protection and growth in a sample of 95 countries over 1960-88, others produced more equivocal results.

Since innovative activity and capability is distributed unevenly across countries, the authors posit that IPRs might have differential effects on the growth in such countries, Consistent with this view, they find in a panel of 79 countries over 1975-94 that IPR protection is significantly and positively related to growth in high- and low-income countries, but not for middle-income countries. They interpret this to mean that IPR protection encourages innovation in high-income countries, and technology diffusion to low-income countries, but middle-income countries may have offsetting losses from reduced imitation opportunities.

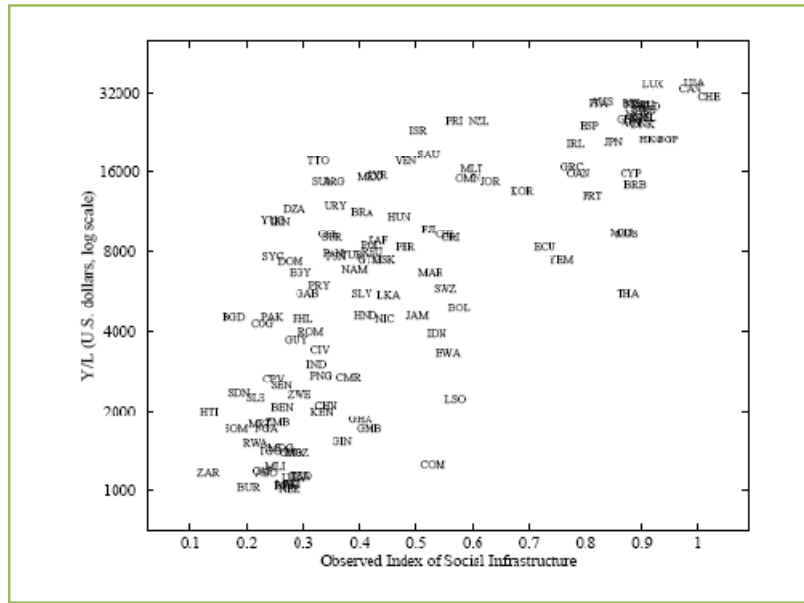
Social Infrastructure

Another early contribution to the institutions and growth literature was the study by Hall and Jones (1999). These authors seek to explain why some countries produce vastly more output per worker (as opposed to higher economic growth) than other countries, more so than can be explained by differences in capital intensity and human capital per worker. They hypothesise that differences in capital accumulation, productivity and therefore output per worker are fundamentally related to differences in social infrastructure, by which they mean the (p. 2) “institutions and government policies that determine the economic environment within which individuals accumulate skills, and firms accumulate capital and produce output”. They argue that a social infrastructure conducive to high output per worker is one in which individuals capture the social returns to their actions as private returns. Such an infrastructure must protect the output of productive units from *private diversion* (e.g. theft, extortion) but also *public diversion* (e.g. expropriation, confiscatory taxation, and corruption).

Hall and Jones measure social infrastructure by combining Political Risk Service’s index of government anti-diversion policies (GADP) with an index of openness to international trade. Using 1988 data for 127 countries they find a (p. 2) “powerful and close association between output per worker and measures of social infrastructure. Countries with long-standing policies favourable to productive activities – rather than diversion – produce much more output per worker.” Their results suggest that a 0.01 difference in social infrastructure is associated with a difference in output per worker of just over 5 percent.

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Figure 3.1 – Hall and Jones (1999) Social Infrastructure and Output per Worker



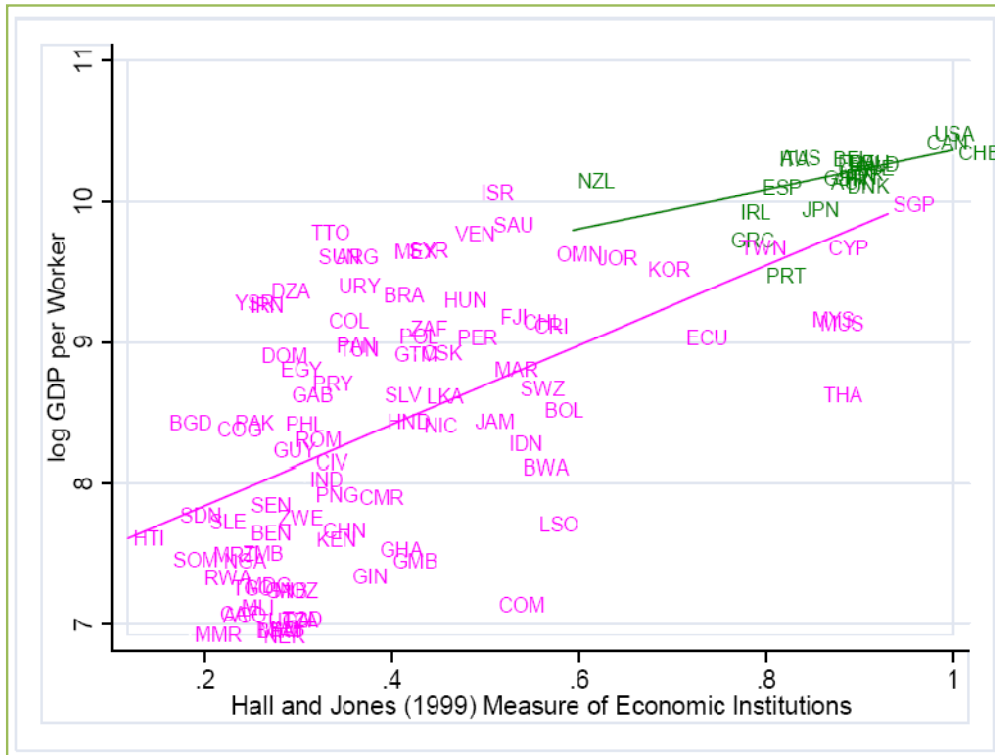
Source: Hall and Jones (1999). New Zealand highlighted.

Eicher and Leukert (2006) extend Hall and Jones by exploring whether the use of global or developing nations data can be relied upon to make inferences about the relationship between institutions and growth in developed countries. They further examine whether the institutions identified in such studies are important for developed countries, or whether different institutions matter for developed countries.

These authors develop a new set of institutional variables, following a “hierarchy of institutions approach” under which constitutional institutions and political rules set the stage for economic institutions that in turn affect economic performance. Specifically, they augment the “social infrastructure” index of Hall and Jones (1999) by measures of political institutions from the Polity IV database, World Bank, and Country Risk Guide. Adding the political instruments reduces the Hall and Jones dataset from 127 to 114 countries.

Using this data Eicher and Leukert find that popular instruments used in developing country studies – such as distance from equator and European influence (proxied by use of European languages) – are relevant for explaining income per worker differences only in those countries. They argue this is to be expected, since European countries will obviously be European influenced, and because European settlers would naturally have inclined towards familiar climates when colonising other countries. They show that the effect of Hall and Jones’ “social infrastructure” variables is three times as strong for non-OECD countries as it is for OECD countries. By contrast, using political institutions as instruments for economic institutions can explain income differences among OECD countries.

Figure 3.2 – Eicher and Leukert (2006) Distinction between OECD and Other Countries



Source: Eicher and Leukert (2006). New Zealand highlighted.

Colonial Origins

In an ingenious way to address endogeneity problems in studies examining the link between institutions and growth – i.e. the problem that institutions might be affected by the same things that affect growth – various authors have analysed the impact of countries’ colonial origins on their contemporary growth. Since the institutions established when those countries were first colonised some centuries ago are unlikely to be caused by other factors driving contemporary economic performance, this provides the researchers with a source of exogenous institutional variation with which to more robustly examine the empirical linkages.

Acemoglu et al. (2001) examine the link between institutions and income per capita using cross-country data. They highlight the differing experiences of North and South Korea, as well as East and West Germany, to demonstrate that at some level it has to be obvious that institutions matter. To establish such a role they develop a theory relating countries’ European colonial origins and the development of modern institutions.

Using data from 64 former colonies, they find that settler mortality rates provide the required exogenous instrument for current institutions in each country, accounting for over 25% of the variation in current institutions as measured by the average of Political Risk Services’ “risk of

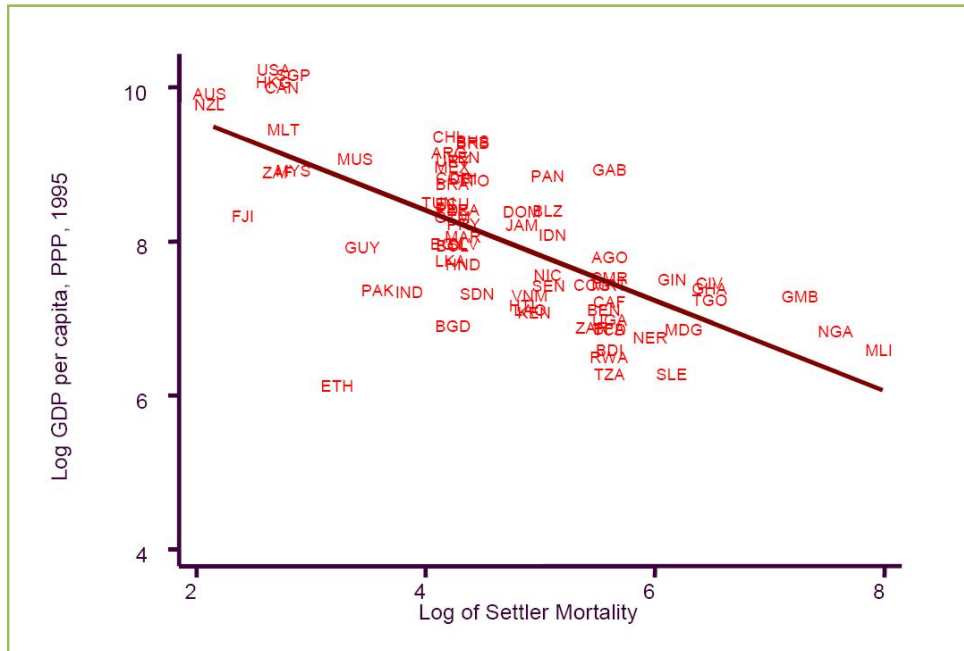
expropriation” index for 1985-95. Figures 3.3 and 3.4 illustrate the associations uncovered from their sample.

Figure 3.3 – Acemoglu et al. (2001) Expropriation Risk vs. Settler Mortality



Source: Acemoglu et al. (2001). New Zealand highlighted.

Figure 3.4 – Acemoglu et al. (2001) GDP Per Capita vs. Settler Mortality



Source: Acemoglu et al. (2001). New Zealand highlighted.

These authors estimate large effects of institutions on 1995 per capita income. For example, if the risk of expropriation in Nigeria improved to equal that of Chile, their model predicts a sevenfold increase in per capita income (in fact Chile is 11 times as wealthy). This result is found to be robust against the inclusion of other possible determinants of income, such as legal origin, climate, religion, geography, natural resources, soil quality, ethnolinguistic fragmentation and current disease environment. They are also robust to the exclusion of the US, Canada, Australia and New Zealand. Notably, once institutions are controlled for, the common finding that distance from the equator predicts higher income is no longer significant.

Their model posits that different colonisation policies have resulted in differing modern institutions in former European colonies. At one extreme were the extractive states set up in the Belgian Congo which were not protective of private property and involved little protection against state expropriation. At the other are “Neo-Europes” created by Europeans migrating and settling in countries like Australia, New Zealand, Canada and the US, in which strong property rights and protections against expropriation were developed. The authors argue that the colonial model adopted depended on how amenable countries were to settlement, with less hospitable environments (e.g. those with higher settler mortality, such as from malaria and yellow fever) more likely to suffer extractive institutions.

In a related vein Bertocchi and Canova (1996) observe that many of today’s “growth losers” also happen to be former colonies, many of which were in Africa. Focusing on the impact of colonisation on 1960-88 growth of income per capita in former African colonies, they find a negative impact on average. Specifically, dependencies tended to fare better than colonies, and British and French colonies did better than Portuguese and Italian ones. Their variables capturing colonial heritage account for the differential and negative growth performance of Africa relative to other continents.

Finally, Banerjee and Iyer (2002) demonstrate persistent effects of different colonial land tenure systems on economic performance in India. Specifically, they explore differences in post-colonial agricultural investment and productivity arising from the establishment of different types of property rights institutions created as land revenue collection mechanisms under British rule. Even though these institutions no longer exist, they find that areas that were formerly controlled by landlords exhibit lower investments in irrigation, lower fertiliser use, and lower adoption of high-yielding crops than areas where rights had been given to cultivators. They explain these differences in terms of the incentive problems commonly found to arise when farmers cultivate land owned by others, as well as property rights insecurity experienced by tenant farmers where landlords were given authority to extract as much as they could from tenants.

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Economic Freedom and Other Broad Institutional Measures

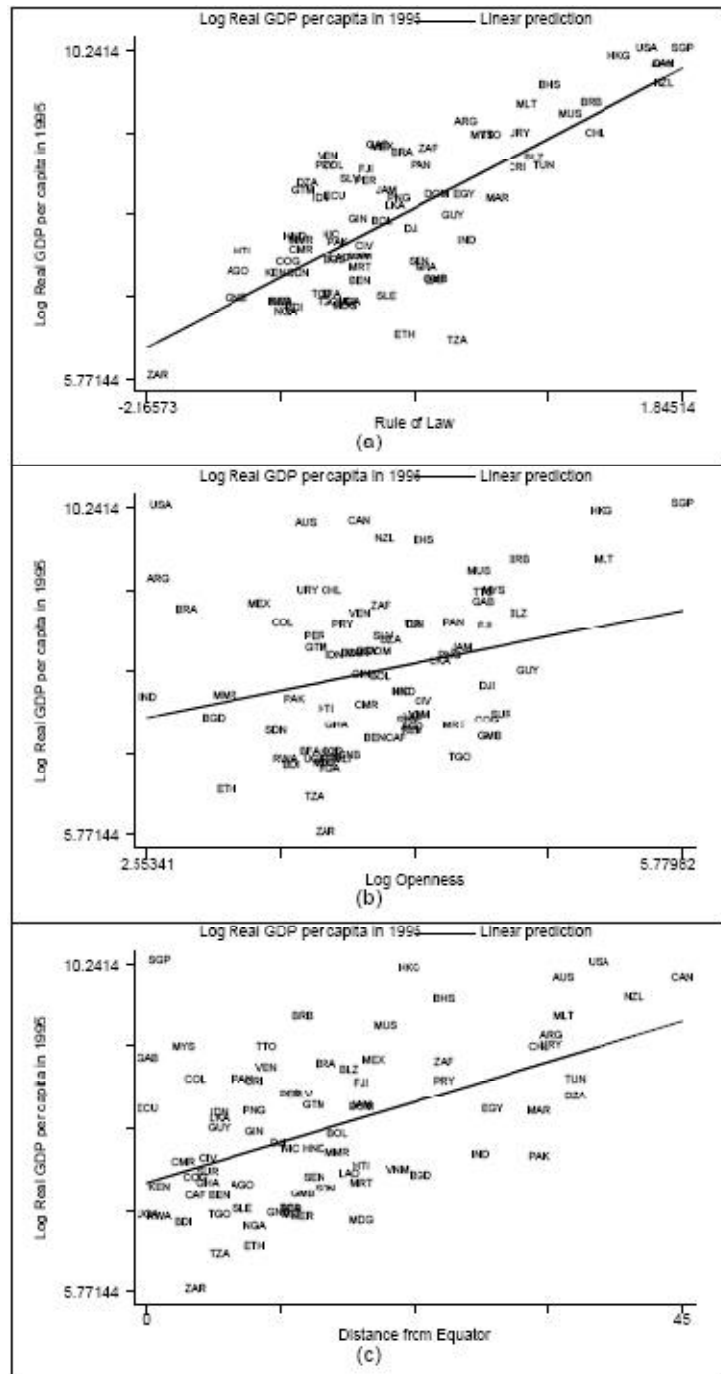
As introduced in Section 2.1.1, The Fraser Institute and Heritage Foundation both produce indices of what they call “economic freedom”. Full descriptions of their index components are contained in the Appendices to this report. Bates (2001) shows that these two indices are highly correlated, but the Fraser Institute index is the one commonly used in institutions and growth investigations. Haan et al. (2006) critically and comprehensively survey the burgeoning empirical literature relating economic growth to the Fraser Institute’s Economic Freedom index. Many of the index’s components correlate well with key elements of the Washington Consensus. Its publication has therefore paved the way for the growth effects of market-oriented policies such as those of the Consensus to be contrasted with those of more planned economies.

The authors explain why economic freedom might correlate with economic growth. Economic freedom is associated with greater competition, which is widely believed to contribute to growth, since firms that fail to cater to consumer demands will be displaced by those that do. Liberal economies are also thought to foster innovation, enabling entrepreneurs to try new things, and to better facilitate the flow of private capital towards the highest returns. Consistent with the broad consensus in the literature, secure property rights are crucial for growth, both supporting investment and also the transfer of resources to their highest use. Similarly, there is much consensus that less regulation in general is beneficial for growth, although the consensus is less clear regarding different components of regulation. The authors express doubt, however, about the relationship between some other aspects of the Economic Freedom index and growth. For example, government size can be argued to either hinder or enhance growth over various ranges. Furthermore, while trade liberalisation should increase market size, the potential gains from trade, and technology diffusion, the authors cite equivocal findings on this point.

Despite serious drawbacks in many of the studies they survey, the authors argue that the positive association between Economic Freedom and growth is a strong and reliable result. Certainly none of the studies reviewed suggested a negative relationship, and while more careful studies find a weaker relationship, the positive relationship remains. They thus conclude that liberalisation should boost economic growth. Also, evidence exists for political liberalisation enhancing economic liberalisation, and that economic crises also enhance Economic Freedom. Finally, like Rodrik (2005) they caution that institutions do not uniquely map to economic outcomes, and that they must be considered in their historical and social context when assessing their impact on growth.

Related research by Rodrik et al. (2002) examines the respective contributions of institutions, geography and economic integration in determining income levels using 1995 data from 80 countries. Graphs illustrating some of the relevant correlations are reproduced in Figure 3.5 overleaf.

Figure 3.5 – Rodrik et al. (2002) Correlations between Income and Rule of Law, Openness and Distance from Equator



Source: Rodrik et al. (2002, p. 26). New Zealand highlighted.

These authors highlight an important issue for institutions-based studies, namely that of reverse causality: is higher income caused by better institutions, or vice versa? The challenge, therefore, is to identify sources of exogenous variation in institutional quality that are uncorrelated with other

plausible explanations of income. They measure institutions using a composite indicator of factors capturing the protection of property rights, as well as the strength of the rule of law. Following studies demonstrating that distance from the equator is a strong predictor of higher income levels, geography is measured accordingly. Integration is measured as total trade to GDP. Figure 3.5 illustrates the correlations between income and their three main measures under investigation.

Rodrik et al. find that the contribution of institutions to income levels dominates those of geography and integration. In fact, once institutional differences are controlled for, the other two variables have only weak or insignificant effects on income (and for trade with a negative rather than positive sign), although they both in turn have positive effects on institutional quality.

Finally, Acemoglu et al. (2005) observe that traditional neoclassical growth models explain differences in per capita income in terms of different paths of factor accumulation, in turn driven by savings rates, preferences or other exogenous variables such as total factor productivity. Subsequent growth models emphasised that externalities from physical and human capital, or dedicating resources to innovation, could induce sustained, steady-state growth, yet still ultimately explained growth differences in terms of preferences and endowments. But factor accumulation and growth are merely proximate causes of growth, so they ask what are the fundamental causes? The authors argue that institutions matter for economic growth because they shape the incentives of key economic actors in society, and hence investments in physical and human capital and technology, and the organisation of production.

Referring to partial correlations between income per capita and variables such as protection against expropriation (such as are used in Knack and Keefer (1995), and Hall and Jones (1999), the authors provide the standard cautions against inferring causation from one to the other. For starters causation could run in the reverse direction – perhaps only rich countries can afford property rights protections? Alternatively, perhaps truly causal variables are omitted – maybe geography explains why countries are both poor and have insecure property rights? Hence to establish a causative relationship between institutions and income per capita, resort is needed to a source of variation in economic institutions that should have no effect on economic outcomes, or to a natural experiment. As to the latter, they suggest the division of Korea into communist North and capitalist South, and the process of European colonisation, provide useful examples.

The case of Korea is relatively clear. The two countries share a similar culture, geography and resource endowment (indeed, North Korea enjoys some advantages in resources). Following the countries' partition in 1950, however, each followed strongly divergent paths in terms of institutions. The difference in growth path experienced by each, while being a sample size of only one, presents a reasonably compelling illustration of how these institutional differences could be said to have caused differing growth experiences.

Size of Government, and Structure of Government Revenues and Expenditures

Bates (2001), Vijayaraghavan and Ward (2001) and others argue for a detrimental effect of large government, often measured as total government expenditure as a percentage of GDP, on economic growth. However, other studies emphasise that the composition of government expenditures and revenues are the more important influence.

Nijkamp and Poot (2003) provide a meta-analysis of 93 studies published between 1983 and 1998 examining the impact of fiscal policies on long-run growth. Specifically, they examine the growth impact of general government consumption, tax rates, defence, education expenditures and public infrastructure. The authors find that the evidence for commonly predicted impacts is weak, although the positive impact of education and infrastructure expenditure is confirmed (which, they noted, offers little guidance for policy in these areas). Cross-section studies were more likely to find a negative impact of general government consumption than studies using panel data.

Studies using later data include Kneller et al. (1999), and Grimes (2003). Table 3.5 summarises the classifications used by Kneller et al. to distinguish distortionary and non-distortionary taxation, and productive and unproductive government expenditures.

Table 3.5 – Kneller et al. (1999) Classifications of Taxation and Expenditure

Theoretical Classification	Functional Classification
Distortionary taxation	<ul style="list-style-type: none">• Taxation on income and profit• Social security contributions• Taxation on payroll and manpower• Taxation on property
Non-distortionary taxation	<ul style="list-style-type: none">• Taxation on domestic goods and services
Other revenues	<ul style="list-style-type: none">• Taxation on international trade
Productive expenditures	<ul style="list-style-type: none">• General public services expenditure• Defence expenditure• Educational expenditure• Health expenditure• Housing expenditure• Transport and communications expenditure
Unproductive expenditures	<ul style="list-style-type: none">• Social security and welfare expenditure• Expenditure on recreation• Expenditure on economic services
Other expenditures	<ul style="list-style-type: none">• Other expenditures (unclassified)

Source: Kneller et al. (1999, p. 177).

Using a panel of 22 OECD countries for 1970-95 these authors find that distortionary taxation reduces growth, while non-distortionary taxation does not, and productive government expenditure enhances growth, while non-productive expenditure does not.

Looking at New Zealand in particular, Grimes (2003) re-examines evidence presented by Gwartney et al. (1998) of a negative association between size of government and growth based on a sample of 23 OECD countries. Using their data and those of others Grimes finds that New Zealand has a relatively small government sector, with both government revenues and expenditures representing around 35% of GDP as compared with an OECD average closer to 40%. However, he finds that the structure of government expenditure in New Zealand warrants examination. Distortionary taxes are higher than the OECD average, and the taxation of overseas transactions is the second highest of any country. On the government expenditure front outlays for each of economic affairs, health, education – all of which are commonly regarded as productive expenditures – are lower than their respective OECD average. He concludes that these structural differences in New Zealand government revenue and expenditure may be detrimental for growth despite the country's low overall size of government.

Finally, looking at agricultural sector growth in particular, Allcott et al. (2006) examine the effects of the size and composition of rural expenditures on agricultural GDP for 15 Latin American countries between 1985 and 2001. They decompose government expenditures into two classes – “non-social subsidies” or private goods, and more traditional public good expenditures satisfying the non-excludability and non-rivalry criteria, as well as those mitigating market failures (such as in R&D investment, plant and animal disease control, and environmental protection). “Non-social subsidies” include expenditures such as export subsidies, internal commercialisation, forestry subsidies, and targeted rural production subsidies.

They hypothesise that while public good expenditures should improve agricultural GDP, the reverse may be true where government makes expenditures that could be provided privately. Their cross-country growth regressions indeed show that keeping total expenditures constant, governments can boost agricultural GDP by decreasing the share of their expenditures devoted to non-social subsidies, and increasing the proportion made to rural public goods and social services. The authors caution that further research is required to extend these findings beyond Latin America and the Caribbean.

Finance

Levine (2004) surveys and critiques the theoretical and empirical literature examining the link between financial system operation and economic growth. He concludes that a growing body of studies demonstrate a strong positive link between the functioning of the financial system and

growth. Both financial intermediaries and markets matter for growth, implicating both the size of the banking system and liquidity of equity markets as being important. Better developed financial systems are seen as easing firms' external financing constraints, offering one pathway through which financing affects growth.

Paralleling the arguments of IMF (2003) and Gradstein (2004), Allen et al. (2006) suggest that there may in fact be mutual reinforcement between economic structure and financial structure. While Levine concludes that the evidence suggests financial development does not simply respond to economic development, using panel data from 93 countries Allen et al. find that economies dominated by physical assets-intensive firms tend to have a bank-based financial system. Conversely, those with knowledge-based industries and intangible assets-intensive firms tend to have market-based financial systems. They thus conclude that financial structures develop in response to firms' financial needs, and hence to the characteristics of the real economy.

La Porta et al. (1997, 1999, 2006) in turn suggest that greater investor protection should lead to stronger financial development. Echoing the findings of Acemoglu et al. (2001), countries' legal origins (like their colonial origins) appear to play a role in determining the quality of financial markets institutions such as investor protection rights, which then underpin financial development. Contrary views abound on this, however, such as those in Rajan and Zingales (2003).

Castro et al. (2004) directly test the link between investor protection and economic growth. Using data for 43 countries over 1967-96, as well as studies of the growth experiences of South Korea and India, they conclude that there is indeed a positive linkage, and that it is stronger for countries with less restrictions on capital mobility.

Finally, Bekaert et al. (2005) use cross-country data to examine the link between financial market liberalisation and economic growth. They show that equity market liberalisations on average contribute 1% per annum to growth, with the largest growth response occurring in countries with high quality institutions.

Regulation, and Competition Policy

A number of studies examine the impact of regulation on investment, a proximate source of growth, and on growth more generally. Alesina et al. (2002), for example, find strong evidence in a sample of OECD countries for a negative association between tight product market regulation (particularly entry barriers) and investment. In an argument echoing that of Aghion and Hewitt (2005), they conclude that regulatory reforms that liberalise entry should spur investment. Similarly, Loayza et al. (2004) survey studies identifying the negative impact of regulation on proximate determinants of economic growth, namely investment, productivity and employment.

They form an index of regulation comprising measures of entry, labour regulation, fiscal burden, trade barriers, financial markets regulation, contract enforcement and bankruptcy regulation. Using 1990s data for a large sample of countries they find that a heavier regulatory burden reduces growth and increases volatility, although the effects are smaller the higher is the quality of the overall institutional framework.

Djankov et al. 2005 make use of the World Bank's Ease of Doing business Index mentioned in Section 2.1.1 (see Appendix A.1 for a description of the indexes components). These authors form an index using seven regulatory measures included in the ease of doing business index: starting a business, hiring and firing workers, registering property, getting bank credit, protecting equity investors, enforcing contracts in the courts, and closing a business. According to their index New Zealand ranks alongside the US, Singapore, Hong Kong, Australia and Norway as the most business-friendly countries in their 135 country sample. They find that countries with higher index values also enjoy higher growth rates, with a 2.3% per annum improvement in growth achievable by moving from the worst quartile to the best, all other things being equal.

Nicoletti and Scarpetta (2003) explain the recent relatively poor productivity performance of European countries relative to the US in terms of strict product market regulations and lack of regulatory reforms. While OECD countries on average have adopted less restrictive regulatory policies since the 1980s, they find that the dispersion of regulatory restrictiveness across this sample has increased. Using an index of regulatory restrictiveness for a sample of 18 OECD countries (excluding New Zealand) over 1984-98, these authors find that reforms promoting private governance and competition tend to boost productivity, with greater gains particularly in manufacturing industries that are far from the technology frontier. They interpret this evidence as suggesting that regulation that limits competitive entry may hinder the adoption of existing technologies, possibly by reducing competitive pressures, technology spillovers, or the entry of high-tech firms.

Ahn and Hemmings' (2000) survey of policy influences on growth in OECD countries supports the above findings that there is a consistent negative correlation between regulation and growth. Pro-competitive policies, including product market liberalisations, are found to be positively associated with higher growth.

Finally, Voigt (2006) uses survey evidence from 57 of the 90 states that currently have competition laws and four cross-country indicators of competition policy to estimate their effect on economic growth over 1990-2000. His four indicators are: the formal basis of competition laws (i.e. constitutional or otherwise), the extent to which an economic or legalistic approach is taken to competition law, the de jure independence of competition agencies, and the de facto independence of such agencies. His results suggest that all four variables contribute to explaining differences in total factor productivity, with de facto independence of competition agencies being

the most significant and positive explanatory variable. However, his results are not robust to the inclusion of indicators of general institutional quality.

Electoral Systems

Some research suggests that proportional representation systems of government result in poorer quality regulatory institutions, and also favour workers over investors. In either case this could have negative consequences for investment as a proximate cause of growth. Bertelli and Whitford (2005), for example, cite a number of studies linking investment and regulatory quality, and argue that perceptions of regulatory quality are dependent on the vertical separation of powers among domestic political institutions. They find evidence for regulatory independence being associated with perceptions of higher regulatory quality in presidential systems of government. However, systems with proportional representation and federal systems are found to exhibit uniformly lower perceptions of regulatory quality.

Pagano and Volpin (2005) present evidence supporting a model they develop of the political economy of investor and employment protections. Proportional electoral systems are found to be less protective of investors and more protective of employees than majoritarian systems. This is consistent with their argument that proportional voting – rewarding the party with the most votes – favours entrepreneurs and employees, whose respective interests are relatively homogeneous. By contrast, majoritarian systems reward the party winning the most districts, preferring marginal electorates which tend to be less ideologically inclined (and which, under proportional systems, therefore tend to be neglected).

Trade

Borrmann et al. (2006) observe that while theoretical models predict trade will improve productivity and income levels, the evidence is mixed. They posit that while trade improves welfare by increasing specialisation and fostering productivity growth, this process cannot work if factor movement is restricted or the structure of economic activity is otherwise rigid. They examine the link between income per capita and explanatory variables including institutional quality, trade, distance from the equator, and market size among others. Institutional quality is measured by combining good governance indicators with the World Bank's ten "ease of doing business" indicators. The good governance indicators in turn comprise measures of voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption.

Using data for 142 countries they find that institutional quality affects the relationship between trade and growth, with trade enhancing income per capita for countries with good institutions, but

reducing it where institutions are restrictive. Foremost they found that labour market flexibility, ease of market entry, and tax level/efficiency are closely related to gains from trade. Other institutional factors found to play a role were regulations affecting trade across borders, contract enforcement, and the ease of closing down businesses. While good institutions are found to be an important pre-requisite for gains from trade, the authors caution that their results do not offer guidance for institutional reform. Large-scale reform is typically found to not be a pre-requisite for boosting growth, and good institutions are more likely to sustain growth than to promote it.

Berkowitz et al. (2006) examine the linkages between trade, law and product complexity. Using data for 55 countries over 1982-92 they find that countries with good institutions tend to export more complex products and import more simple products. They take this as support for their argument that contracting problems that arise in respect of trade involving more complex products require impartial dispute resolution processes, typically in the products' country of origin. However, they also find that international institutions can substitute for domestic ones in this respect, in that domestic institutions are less important for promoting exports from countries that have signed the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards.

Industrial Policy and Export Promotion Agencies

Pack (2000) explores the debate about industrial policy following the East Asian financial crisis beginning in South Korea 1997, and the weak growth in Japan over much of the 1990s. These two countries pursued sectoral selectivity most intensively, so if their approach was successful then this might offer lessons for other countries still in the early stages of industrialisation. If not, more conventional policies would be suggested.

He notes that by the 1970s import-substituting industrialisation was widely viewed as a failure, with a large body of empirical research showing that it led to labour and capital misallocation across industries, and did not improve long-run growth in total factor productivity. While the proponents of industrial policy had seen it as a way to encourage newer and more modern sectors, the evidence suggests the approach did not deliver as expected. Japan and South Korea adopted industry policies that bettered those of other countries in that they went beyond just industry intervention to also include promoting education, building a large and efficient social infrastructure, encouraging international technology transfers, and fostering research and development. They also adopted growth-supporting macroeconomic policies including the encouragement of private saving, the maintenance of stable real exchange rates and constraints on financial speculation, as well as fiscal and monetary policies to limit inflation.

Pack examines the source of the South Korean and Japanese growth stories, and attributes their success relative to other states which intervened in industry to policies that induced significant

competition. Japan's use of industry "contests", and Korea's linking of preferential interest rates and tariffs on imported goods to success in export markets, provided firms with incentives to improve productivity. This stands in contrast to countries using domestic market protections such as tariffs to protect local industries, which reduce rather than induce such competition, and provide weak incentives for learning. He suggests that countries wishing to mimic successful elements in the Japanese and Korean experiences require not just an exceptionally capable bureaucracy, but also the political ability to withdraw support for non-performing firms, both of which are difficult to ensure in practice. However, his estimates indicate that industry policy might have contributed to increasing Japan and Korea's growth rates by around 1% per annum, which he describes as a "minor growth hormone" at best. He thus concludes that (p. 64) "in view of the minor benefits and the potentially adverse effects on the financial sector and the neglected industrial sectors, countries should be exceptionally cautious before embarking on such policies." Kasper (2002) echoes such caution in respect of New Zealand.

Finally, Lederman et al. (2006) use data from 104 countries to examine the features of export promotion agencies that are found to be effective. They find that such agencies on average have a positive effect on exports, with every dollar of export promotion translating into an extra \$300 of exports for the median agency. However, the effect is in fact negative for countries with low GDP per capita, and while positive for higher income countries, the result is not significant. Moreover, they find that the agencies with greater impact were those with a large share of private sector governance but government sector funding. A focus on non-traditional exports or broad sectors, and on large firms that are not already exporters, was also found to be important for success.

3.3.3 Evidence on Institutions and Innovation

Ruttan (2002) observes that prior to the twentieth century almost all increases in crop and animal production resulted from increases in the area of land being farmed, whereas by the end of that century almost all increases came from improved land productivity. This shift from a resource-based to science-based system of agricultural production underscores the importance of innovation for agriculture in particular, let alone for the economy more widely. He records that institutional arrangements for the support of agricultural research began in the mid-nineteenth century, with a private English research station established in 1843, and publicly-funded German research station in 1852 (the German public research model later being adopted in the US). International institutions such as the United Nations Food and Agricultural Organization (FAO) are now operating in this area.

Ruttan suggests that it will be hard for agricultural countries already operating at the technological frontier to sustain the high agricultural growth rates enjoyed in the past half century. He further expresses doubt that new genetics technologies will overcome the long-term prospect of

diminishing returns to research on agricultural productivity. In contrast, Smith (2006) observes that traditional or “low-tech” industries (which include agriculture) continue to contribute a significant part of GDP in even advanced economies, whereas “high-tech” industries such as ICT, biotechnology and nanotechnology typically account for less than 3% of GDP. Hence continuing innovation in traditional or “low-tech” sectors, as well as in now dominant service sectors, should remain the focus of ongoing innovative activity. Thus an exploration of the institutional factors affecting innovation is pertinent for countries like New Zealand where agriculture is an important component of economic activity.

There is now a considerable literature examining the institutional factors influencing innovation. We defer consideration of research on the link between innovation and growth to Section 3.3.3, and instead here consider this more preliminary literature on the causes of innovation under the following headings:

- Empirical regularities regarding innovation and technology diffusion;
- R&D policy and funding;
- Competition;
- Regulation, and competition policy;
- Support measures;
- Finance; and
- Incentive arrangements and bankruptcy laws.

As for Sections 3.3.1 and 3.3.2, we provide a high-level summary of this literature in Section 3.4.

Empirical Regularities regarding Innovation and Technology Diffusion

Smith (2006) summarises well-established empirical results in growth theory relating to innovation:

- “Technical change” (i.e. new techniques, organisational change, and improvements in education and knowledge) explains the greater part of economic growth;
- Countries with higher levels of innovative activity (e.g. as measured by R&D expenditure or patenting) tend to have higher income per capita;
- Technology spillovers are important, with social returns to R&D exceeding private returns;
- There is a positive and significant correlation between R&D and productivity at both firm and industry levels;

- Within any given industry countries with higher levels of innovation also have higher shares of world trade;
- R&D is strongly correlated to growth, mainly through private R&D; and
- Public R&D is less directly associated with growth, but contributes to growth via its stimulation of private R&D (via contract research).

In terms of the factors affecting innovation research, Smith offers nine “core results” from the empirical literature on innovation:

- Innovation rarely follows a simple “linear” path from research, to discovery to commercialisation, with reverse drivers often involving market-lead problems giving rise to innovative activity where existing solutions are not suitable;
- Innovation arises where enterprises make investments in specialised knowledge and capabilities, though there is no general path to innovation success;
- Innovation occurs across all sectors, including traditional and “low-tech” sectors, not just in the usually economically less important “high-tech” sectors;
- Innovation activity is cumulative, building over time, but with possible path-dependence and associated lock-in potential (e.g. where adoption of radical new technologies requires departure from older technologies);
- Enterprises typically innovate by collaborating and cooperating with others, including with publicly-supported infrastructure such as universities and research institutes;
- Innovation has highly uncertain outcomes, which increases its riskiness and suggests possible public policy rationales for government intervention where the risks are too great for private entities to bear but the possible social returns are significant;
- Horizontal (across same business types) and vertical (across industry stages) clustering is important for innovation, building on regional and national patterns of industrial and technical specialisation, but with cross-border clustering also becoming important;
- Many inventions draw on science, and particularly on the science generated by public scientific research organisations, but less in the form of R&D commercialisation than through R&D offering problem-solving support to existing innovation projects; and

- Innovation does not occur simply at the organisational level but has systemic features based on interactions across the wider institutional framework, including regulation, infrastructure, and the processes for creating and disseminating knowledge.

Smith observes that these core results pose a challenge for innovation policy in many countries, where a “linear” model driven by R&D investments is a plank of policy, and where “high-tech” sectors receive the bulk of R&D funding despite the greater economic significance of traditional, “low-tech” (which does not equate to “low knowledge”) and services sectors. The systemic nature of innovation raises particular policy questions for smaller economies, where coordination can more easily be achieved, but where scale and depth issues can present obstacles to success.

While Smith (2006) focuses on innovation in general, Keller (2004) surveys what is known empirically about the extent of international technology diffusion and the channels through which technology is spread. He observes that technology is an important driver of productivity, yet for most countries, foreign sources of technology from a handful of rich countries account for 90% or more of domestic productivity growth. He concludes that the pattern of worldwide technical change is determined in large part by international technology diffusion. Some of the major channels of technology diffusion are foreign direct investment and international trade (particularly imports). While public R&D is substantial in many countries, most R&D is privately funded.

Two key features of technology are identified to be:

- It is non-rival (the marginal cost of technologies’ use by others is small); and
- Technology investment provides both private and public returns.

The first distinguishes technology from labour and capital. The second means that there are external effects or “spillovers” from technology investments, over and above those required to justify private technology investments. Moreover, since only a fraction of technology is codified – the remainder is “tacit” – technology diffusion will only ever be incomplete. The stock of technology will therefore vary across countries, and will also tend to be more geographically localised the less codified it is. International economic activities such as FDI should stimulate the diffusion of non-codified technology by increasing international contacts.

Technology is intangible and therefore hard to measure, with three widely used measures being:

- Inputs (i.e. R&D);
- Outputs (i.e. patents); and
- Technology effects (i.e. higher productivity).

Using R&D expenditures is problematic because technological developments bear a less than systematic relationship to R&D expenditures, and typically only business R&D is measured due to the commonly lower rate of return to public R&D. Patents too are problematic, since only a small

number of patents account for most of total patent value. Total factor productivity is a derived measure of technology, and can be confounded by other influences. While data on royalty payments can give an indication of cross-border technology flows, many economists believe that much technology diffusion occurs through spillovers, for which there is no direct data.

Table 3.6 summarises the key channels found to be important for international technology diffusion in Keller's empirical survey.

Table 3.6 – Keller (2004) Survey of Factors Affecting International Technology Diffusion

Factor	Discussion
Importing	Imports from high R&D countries, particularly of capital goods, play a significant role in international technology diffusion.
Exporting	While evidence exists that exporting firms tend to be more productive than non-exporters, conventional wisdom based on empirical studies is that there is no significant "learning-by-exporting" effect.
Foreign direct investment	Positive and sometimes economically large spillovers are associated with FDI.
Geographical considerations	Within-country diffusion is found to be stronger than diffusion across countries, though the degree of localisation is found to be decreasing over time (e.g. due to transport cost improvements, ICT innovations, and increased MNE activity).
Human capital and R&D	Countries differ markedly in their ability to adopt foreign technology, amplifying differences in world income levels. Both human capital and R&D expenditures stand out as influences of "absorptive capacity", or the ability to successfully adopt foreign technology. They each provide the skills necessary for technology adoption.
Domestic and foreign sources of productivity growth	Foreign R&D is much more important for smaller countries, in part because they are more open to trade.

Source: Keller (2004).

Keller draws the following policy implications:

- The evidence is not strong enough to support strong policy measures such as subsidies to encourage foreign direct investment to improve technology transfer;
- The importance of technology diffusion rises as the world becomes more integrated, so the performance advantage of outward oriented economies over inward-oriented ones should rise as this process continues;

- Well-functioning markets and an undistorted trade and foreign investment regime assist with spillovers, and specialising in producing high-tech goods does not appear to be a critical factor; and
- (p. 779) “technological knowledge spillovers appear to be resulting from a deliberate commitment to learning and matching international performance standards through ongoing interaction with foreigners.”

R&D Policy and Funding

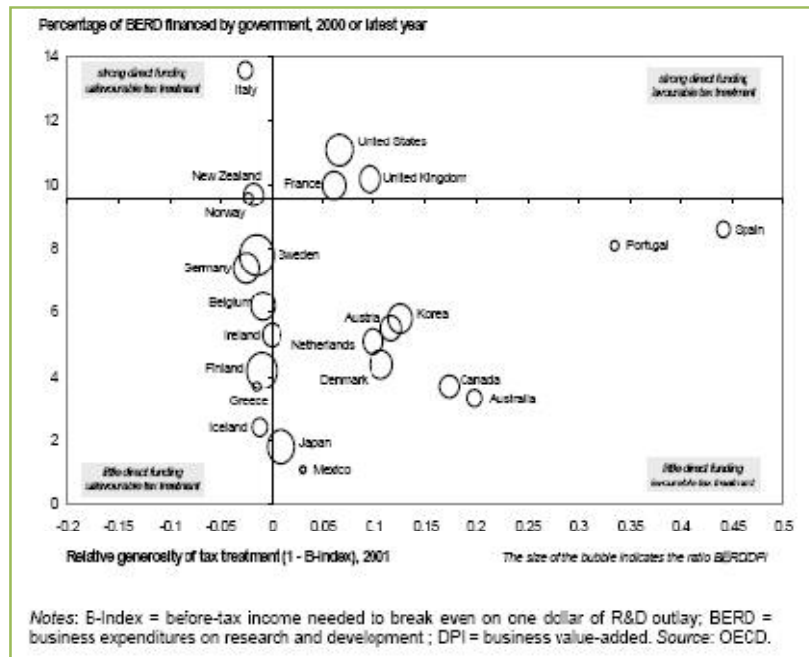
OECD (2003[b]) observes that a number of OECD governments are offering fiscal incentives to businesses to increase R&D spending, mainly because of a widespread acceptance that such R&D has positive externalities in terms of technical and economic spillovers, and because it is considered key to productivity and growth performance. The study compares design features of different schemes across OECD countries, for example noting that R&D tax breaks provide greater role for market-based selection of R&D projects than, for example, direct state subsidies for research (which often require research efforts to be directed towards efforts with greater possible social returns). Moreover, R&D tax breaks are commonly more accessible by smaller firms. Figure 3.6 overleaf illustrates the relative approaches to R&D incentives adopted across OECD countries.

This figure shows that New Zealand (before the R&D tax allowances announced in the May 2006 budget) had a relatively neutral tax treatment of R&D expenditures, and relatively strong direct funding by government of business R&D expenditures. With the R&D tax allowances now announced, all other things being equal this would shift where New Zealand plots to the right.

The study surveys empirical estimates of the effectiveness of R&D incentives in stimulating private research, concluding from a study involving nine OECD countries over 1979-97 that, on average, every dollar of foregone tax revenue due to such incentives gives rise to a dollar of additional private R&D expenditure. It notes that most incentives are taken up by large manufacturing firms in sectors such as electronics, telecommunications and chemicals. It also observes that countries with lower corporate tax rates may be less attractive to MNEs conducting research since they prefer to incur R&D costs where they receive larger tax breaks on such expenditures.

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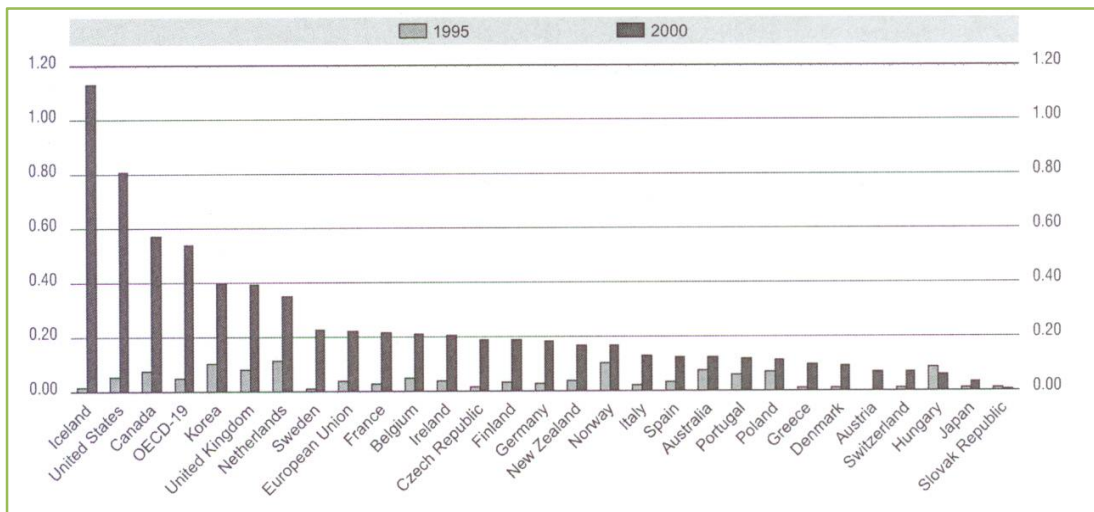
Figure 3.6 – Government Funding of Business R&D Across OECD Countries



Source: OECD (2003[b], p. 11).

OECD (2002b) is another study examining drivers of R&D expenditure in OECD countries. Among other things it observes the growing role of venture capital markets in providing financing to risky business ventures, such as those undertaking significant R&D. Figure 3.7 illustrates the growth in venture capital markets across OECD countries over 1995-2000, indicating that in 2000 New Zealand's venture capital market compared favourably with that in many other OECD countries.

Figure 3.7 – OECD Venture Capital Markets as Percentage of GDP 1995-2000



Source: OECD (2002b, p. 104).

The study argues that evidence is mounting for business strategies increasingly driving R&D investments, with firms actively seeking to demonstrate financial returns on R&D expenditure, and therefore choosing to pursue projects closely linked to new product development. It concludes however that governments will continue to have an important role in supporting business R&D, particularly in creating basic scientific and technical knowledge that firms then incorporate into products, processes and services.

Garcia-Quevedo (2004) takes a more agnostic stance on whether public subsidies complement rather than simply substitute for private R&D expenditures. He notes the standard rationale for public R&D funding, namely that the public benefits from R&D far outweigh the private benefits, meaning that private R&D expenditures are likely to fall well below the social optimum. Previous research is cited in which difficulties in establishing the sign and significance of the relationship between public R&D funding and private R&D expenditure are noted, yet the author on balance concludes that such expenditures are complementary. Garcia-Quevedo performs a meta analysis of 39 empirical studies on this question, and concludes that the resulting evidence is ambiguous, and hence that many countries' technology policy is (p. 96) "more a matter of faith than of understanding."

Falk (2006) surveys previous studies on the general determinants of business R&D expenditures. His tabulated results are reproduced in Table 3.7 overleaf, emphasising the positive impacts of previous R&D, direct R&D subsidies, real GDP levels, protection of IPRs, firm size, collaboration, and quality of research institutions. Human capital variables have had a more ambiguous influence.

Performing his own analysis of drivers of business sector R&D intensity (i.e. expenditure as a percentage of GDP) using data from a panel of OECD countries over 1975-2002, he finds R&D tax incentives have a significant positive impact. Moreover, university R&D expenditures are significantly and positively related to business R&D expenditures, indicating that public and private R&D expenditures are indeed complementary.

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Table 3.7 – Falk (2006) Summary of Empirical Studies on Determinants of R&D Intensity

Variable category	Specific variable	Expected sign	Empirical findings
Lagged R&D intensity	Log of R&D intensity	+	+ and high degree of persistence: Lederman and Maloney (2003)
	Log of business-funded and performed R&D	+	0 or low degree of persistence: Guellec and Pottelsberghe (2003)
Direct R&D subsidies	Government funded BERD, % GDP	Ambiguous	
	Government funded BERD, % total BERD	Ambiguous	+ (long term elasticity = 0.08 and marginal effect = 0.70) Guellec and Pottelsberghe (2003) 0 Bassanini and Ernst (2002)
R&D tax incentives	R&D user costs of capital	-	- Bloom <i>et al.</i> 2002.
Public sector R&D	B-index	-	- Guellec and Pottelsberghe (2003),
	HERD, % GDP	Ambiguous	0 Guellec and Pottelsberghe (2003),
Specialisation in high tech industries	GOVERD, % GDP	Ambiguous	- Guellec and Pottelsberghe (2003)
	High-tech export share		
GDP	Real GDP in constant ppp	+	+ Guellec and Pottelsberghe (2003), 0 Bebczuk (2002), 0 Lederman and Maloney (2003), 0 Kanwar and Evanson (2003), + Lederman and Maloney (2003)
	Real GDP growth rate		
Protection of property rights	GDP per capita in constant ppp	+	
	Ginarte-Park index of patent rights	Ambiguous	+ Varsakelis (2001), + Lederman and Maloney (2003), + Kanwar and Evanson (2003), + Bassanini and Ernst (2002), + Bebczuk (2002)
Human capital	Kaufmann <i>et al.</i> Rule of Law Index	Ambiguous	
	Average years of schooling in population over 15 years	+	0 Kanwar and Evanson (2003)
Openness	Total literacy rate in population over 15	+	+ Kanwar and Evanson (2003)
	Tertiary school enrolment	+	0 Bebczuk (2002)
Investment	Share of university graduates	+	
	Exports and imports as percentage of GDP	+/0	- Bebczuk (2002)
Firm size	Investment ratio	+	- Bebczuk (2002)
	Employment share of large firms	+	+ Bassanini and Ernst (2002)
Collaboration	Index of collaboration between enterprises and universities		+ Lederman and Maloney (2003)
Quality of research institutions	Index of quality of academic research institutions		+ Lederman and Maloney (2003)
	OECD Indicator	-	+ Bassanini and Ernst (2002)

Notes: The last columns summarise significant signs of the R&D determinants of a number of studies. Significant signs are identified by a plus or a minus, and a zero indicates an insignificant coefficient.

Source: Falk (2006, p. 536).

Sheehan and Wyckoff (2003) examine the increasing popularity among OECD countries of targeting R&D expenditures as a proportion of GDP, such as the EU's target of R&D spending at 3% of GDP by 2010. A growing R&D funding gap between the US and EU is identified, standing at 0.8 percentage points in 2000, mostly due to higher industry financed and business performed R&D in the US. One common feature of countries with higher R&D intensities is that industry accounts for a larger and growing share of their R&D than in other OECD countries. In such countries R&D also tends to be performed by larger firms. Industry structure also appears to play a role in such countries' R&D, which have a high share of their business R&D and a significant part of their economic output in high-tech sectors. Finally, many of the countries with high R&D intensity also tend to have high levels of social protection (e.g. Finland, Sweden). The authors argue that (p. 31) "social capital in the form of well-functioning institutions, a trusting environment

between businesses and governments and basic infrastructure such as communications and education are important elements in economic success. In this sense the optimal environment for innovation includes many quality-of-life factors that make a location appealing to a cadre of innovators who are highly mobile.”

Finally, Sheehan (2004) discusses trends and drivers relating to the globalisation of R&D. R&D business models are argued to be moving towards open innovation, characterised by R&D being linked to business strategy, external technology being acquired through licensing, venture capital, mergers and acquisitions and collaborative research, the externalisation of R&D results (e.g. through licensing and spin-offs), and increasing use of global talent pools. Factors influencing the location of R&D are argued to include proximity to a large market with lead customers, proximity to leading firms, universities and labs, access to skilled workers in flexible labour markets at reasonable cost, the ease of commercialising inventions and expanding business, an ability to protect inventions, and other factors such as infrastructure, tax concessions, and quality of life. His main policy implications from such trends and drivers are that to encourage R&D in a globalised R&D market governments should build an innovation-friendly environment, capitalise on fundamental research, and cultivate, attract and retain a highly skilled work force.

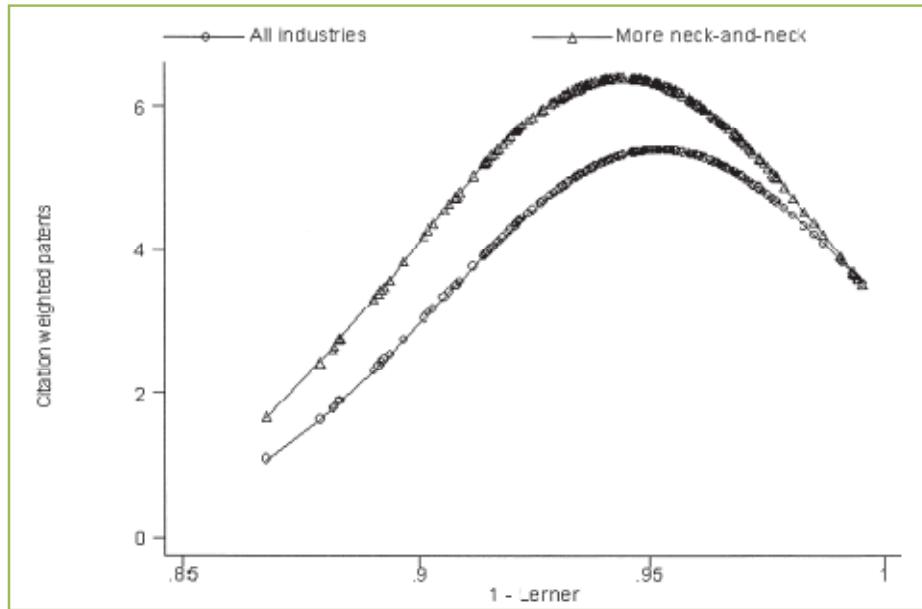
Competition

Aghion et al. (2005) note that empirical observations typically contradict common theoretical predictions that competition should be associated with lower levels of innovation. They predict that product market competition should encourage firms operating at similar technological levels (“neck-and-neck firms”) to innovate, but discourage technologically laggard firms from doing so. For neck-and-neck firms competition can reduce post-innovation rents by less than they reduce pre-innovation rents (i.e. on existing investments), offering positive incremental profits from innovating which encourage R&D investments intended to help them “escape competition”. On the other hand, technologically laggard firms already face low pre-innovation rents, so greater product market competition will primarily reduce post-innovation rents, giving rise to the standard “Schumpeterian effect” (i.e. that higher competition is associated with lower innovation).

They therefore posit an inverted u-shape relationship between competition and innovation. When competition is low, relatively more sectors in the economy will engage in neck-and-neck competition, so the escape competition effect should dominate the Schumpeterian effect. Conversely, when competition is high innovation will be performed by a larger share of laggard firms for which the Schumpeterian effect dominates.

Using panel data from 311 UK firms over 1973-94 they indeed find such an inverted u-shaped relationship between competition (as measured by the Lerner index) and innovation (as measured by citation-weighted patents). This relationship is shown in Figure 3.8.

Figure 3.8 – Aghion et al. (2005) Relationship between Innovation and Competition



Source: Aghion et al. (2005, p. 720).

Gopinath et al. (2003) establish a similar inverted u-shaped relationship between competition and innovation, but this time in respect of 36 US food processing industries over 1964 – 1992. Like Aghion et al. (2005), they test Schumpeter’s “creative destruction” hypothesis suggesting that competitive markets are appropriate for static resource allocation, but that the extra profits generated by a large firm in a concentrated market are required to fund output expansion over the long-run, providing the resources necessary for innovation.

Specifically they investigate whether growth in concentration indeed results in increased innovation, and if so, can the welfare gains from a higher innovation rate offset the deadweight loss from such increased concentration. As predicted they find an inverted u-shaped relationship between food processing industry concentration, and innovation (as measured by growth in total factor productivity). The optimal concentration ratio is found to be 18% higher than existing levels. At this concentration ratio the current deadweight loss could be reduced from US\$7.8 billion to around US\$2.8 billion. While consumers would still not achieve their ideal competitive welfare level at this level of industry concentration, their welfare still improves relative to existing concentration levels, with gains accruing from lower food prices. They conclude that growth in concentration is an important determinant of total factor productivity growth and vice versa.

Finally, Ahn (2002) reviews empirical literature examining the relationship between product market competition and “allocative efficiency”/“dynamic efficiency”, concluding:

- Competition has pervasive and long-term effects on economic performance by encouraging firms’ innovative activities and by selecting more efficient activities over less efficient ones, over time;
- In “high-tech” industries like ICT competition is increasingly for the market as opposed to in the market, with innovation directed towards establishing new market standards to displace old ones;
- Overall there is little empirical support for the standard Schumpeterian prediction that large firm size of high industry concentration is associated with higher levels of innovation;
- There is a robust positive relationship between product market competition and productivity growth, as well as welfare gains and long-run economic growth; and
- Dynamic efficiency gains from product market competition are supported where there are well-functioning factor markets.

Ahn observes that the first two of these pose challenges for competition policy. Given the long-term effects of competition, such policy cannot be judged simply in terms of its short-run static efficiency gains. Moreover, competition for the market indicates that concentrated rather than atomistic markets may well be a consequence of effective competition and innovation, complicating detection of market power abuse.

Regulation, and Competition Policy

Bassanini and Ernst (2002) examine the interplay between labour market institutions, product market regulation and innovation using data from 18 manufacturing industries in 18 OECD countries (excluding New Zealand) over 1993-97. They argue that sufficient empirical research exists to conclude that greater product market competition is positively associated with innovation, but that the link between labour market institutions and innovation is less established. They posit that such institutions should affect the returns to innovation – for example, where demand elasticity is low innovation should lead to greater employment downsizing, so labour market restraints will reduce the rents from innovation. Conversely, innovation requires readjustment of labour and capital types and mixes, requiring new labour from external sources or retraining of internal labour resources.

They find a negative association between R&D intensity and indicators of non-tariff barriers and inward-oriented economic regulation (i.e. stronger product market regulation), and a positive relationship between R&D intensity and stronger protection of IPRs. However, their findings regarding labour market institutions are more mixed:

- Labour market flexibility is associated with higher R&D intensity in all countries with decentralised wage-bargaining or little coordination;
- Only some aspects of labour market flexibility are associated with greater R&D intensity in “low-tech” industries; and
- A negative association arises in countries with coordinated industrial relations in industries having a more cumulative knowledge base.

Bassanini and Ernst explain the latter result in terms of the gains to be had in regimes where firms must resort to internal labour markets and cannot easily change their workforce in response to changing requirements arising from innovations. Such gains include the greater alignment of worker and firm incentives, higher levels of firm-sponsored training, and accumulation of firm-specific competencies.

Conway et al. (2006) examine a related but different question, namely how product market regulation affects the international diffusion of productivity shocks. In particular, they examine how product market regulation influences two channels of productivity shock diffusion: the adoption of ICT, and the location decisions of MNEs. Using data for 18 OECD countries (excluding New Zealand) over 1978-2003, they find that anti-competitive product market regulation has a significantly negative effect on each of these channels, and thus slows the process of adjustment through which best practice technologies diffuse internationally.

Griffith et al. (2006) examine the effect of the EU Single Market Programme (SMP) reforms on competition, innovation, and productivity growth. They note the usual theoretical prediction that competition can motivate firms to reduce slack, or to innovate in order to enhance or protect market position (i.e. to escape competition). Conversely it can also reduce the rents to innovation or competitive entry, thus reducing such activities. Using data for 12 manufacturing industries in eight European countries and the US over 1987-2000, they find the SMP reforms were associated with increased competition (i.e. reduced average firm profitability), as well as increased innovative activity and total factor productivity growth.

Finally, CRA (2002) observe that the Schumpeterian model of competition and innovation rests on innovating firms being able to capture the rents associated with their highly uncertain and risky innovation investment activities. If competition authorities should intervene to diminish such rents

simply because the successful innovator has subdued its competitors by better satisfying consumer preferences, then this would provide a chilling effect on firms' incentives to innovate. On the other hand, they argue that there is a clear role for competition authorities to ensure that markets remain open to competitive entry by firms making subsequent innovations, so an appropriate focus of regulatory scrutiny would include ensuring that incumbent firms do not use their existing market dominance to foreclose entry by others.

Support Measures

Finnish Ministry of Trade and Industry (2007) surveys support measures in Australia, Brazil, Finland, Hong Kong, Hungary, Italy, the Netherlands, Spain and the UK. The study aimed to distil policy recommendations for supporting entrepreneurial activity in high-growth SMEs. Its general policy lessons included a need for support programmes to have autonomy, flexibility and speed in assisting entrepreneurs who are disinclined to wait for bureaucratic processes to run their course. Furthermore, the needs of high-growth SME entrepreneurs are typically so varied that no one agency can support them, but it is possible to frame support programmes around groups of needs or business/sector types. Also, for government programmes to be effective they need to be not just independent and flexible, but also involve private sector partners, and already successful entrepreneurs, all of which are necessary to improve their image in the eyes of aspiring entrepreneurs.

Among the study's policy recommendations were a particular focus of organising support programmes around universities and other centres of higher learning, as well as for the rapid internationalisation of new ideas. The former stems from the fact that high-growth entrepreneurs tend to be more highly educated and also because higher educational institutes tend to be the centre of independent knowledge-based research. The need for rapid internationalisation extends beyond just more proactive, sustained, and hands-on support initiatives, and is suggested to also include policy initiatives for cross-border collaboration in high-growth entrepreneurship support.

Finance

Atanassov et al. (2005) explore whether firms' innovation activities affect their financing choices. Based on an agency-cost model of how managers determine their financing type, these authors hypothesise that established firms with innovative projects and technologies will make relatively greater use of public debt and equity (i.e. arms-length financing) while less innovative firms will rely more on bank borrowing (i.e. relational borrowing). This arises, for example, because bank borrowing is likely to involve greater decision rights being given by managers to their financiers, which will only be optimal for managers where lenders have better information than their own.

Since firms with more novel and innovative projects are likely to possess superior information to their lenders, this should favour their use of arms-length financing.

Using a large panel of US firms over 1974-2000 they find that firms with greater patenting activity indeed rely more on external financing than those with lower activity. Moreover, firms that issue public debt for the first time or issue seasoned equity show a significant increase in innovative activity two years after the issue.

Incentive Arrangements and Bankruptcy Laws

Manso (2006) provides a principally theoretical analysis of incentive arrangements that encourage innovative activity. In designing optimal incentive schemes the problem faced is that innovation usually requires the exploration of untested approaches that are likely to fail, and failure is normally associated with low wages and termination. He shows that optimal incentive schemes for motivating innovation will therefore fundamentally differ from standard pay-for-performance schemes. They can involve commonly contentious and unpopular elements such as golden parachutes, and should be tolerant of failure (and possibly even reward it). Even inefficient continuation of tenure can be optimal if the threat of termination causes agents to curtail their exploration of approaches that might fail.

As regards his predictions with a slightly greater empirical content, Manso argues that strict bankruptcy laws can be a disincentive to innovative activity, since the agent under such laws faces loss of personal assets if untested approaches prove to be unsuccessful. More lenient bankruptcy laws can then better facilitate innovative activity, by softening the adverse consequences of failure. In support of this argument he refers to survey evidence that Europeans are more averse to failure from start-up businesses than their US counterparts, and attributes this to European bankruptcy laws being tougher on creditors than US laws. Europeans fear losing their property and going bankrupt should a start-up fail, whereas Americans reported being more concerned about income uncertainty.

3.3.4 Evidence on Innovation and Growth

The literature on the effect of innovation on growth is more sparse than the literatures surveyed on the role of institutions in each of growth and innovation just surveyed. We consider this literature under the following headings:

- Importance of funding source for R&D growth effects;
- Impact of R&D on productivity and growth; and
- Impact of R&D on agriculture sector productivity growth.

As for Sections 3.3.1 – 3.3.3, a high level summary of this research is provided in Section 3.4.

Importance of Funding Source for R&D Growth Effects

Guellec and van Pottelsberghe (2003) examine the impact of institutional setting and source of R&D funding on the link between R&D and productivity growth. Using data from 16 OECD countries (excluding New Zealand) over 1980-98 they find that three sources of knowledge – R&D performed by businesses, governments and foreign firms – are all significant determinants of long-run productivity growth. Several factors are found to influence the extent to which each source of knowledge contributes to productivity growth, including absorptive capacity, the socio-economic objectives of government support for R&D (i.e. civilian or defence-related), and the type of public institutions that perform R&D.

Citing previous empirical studies, they conclude that earlier research supports the conclusion that R&D matters for growth, with output elasticities with respect to business R&D ranging from 10% to 30%. Furthermore, business R&D has been found to improve absorptive capacity, with one study suggesting average imitation costs are about 65% of the original imitation costs. Based on their own analysis they find the long-term elasticity of total factor productivity with respect to business R&D is 13%, while for foreign R&D it is 45%, implying that for any country, provided it has the necessary absorptive capacity, other countries' R&D matters more than domestic R&D for productivity growth. The elasticity with respect to public R&D (performed by universities and laboratories) is 17% – even higher than for business R&D – which the authors suggest is due to the greater emphasis of public research bodies on basic research which generates greater positive externalities than applied research. Among their other findings are increasing returns from investment in research, and the result that smaller countries benefit more from foreign R&D than larger ones. Significant interactions are also identified;

- A negative effect of increasing government R&D funding share on the elasticity of TFP with respect to business R&D (although the effect is positive if only civilian R&D is considered), and of defence-related R&D on TFP;
- A positive impact of domestic R&D on absorptive capacity, with domestic R&D intensity positively related to the elasticity of TFP with respect to foreign R&D;
- A positive impact of business R&D on the elasticity of TFP with respect to public R&D, indicating the importance of the business sector being able to capitalise on public research; and
- The impact of public R&D increases with the share of public funding going to universities rather than laboratories, which the authors suggest reflects more productivity-oriented research at universities, or universities' greater use of project-based rather than institutional funding.

Curiously, Guellec and van Pottelsberghe find that university research funded by business has a lesser impact on productivity growth, perhaps because it has a more applied focus which has a lower potential than basic research (or in respect of which universities have less comparative advantage). Combining their findings they suggest that the best funding for public research is:

- More competitive than institutional; and
- More public than private.

Bassanini and Scarpetta (2001a) similarly find differential effects of R&D on growth depending on the source of R&D funding. Using data from 14-17 OECD countries over 1981-98 they find that a 0.1 percentage point increase in R&D intensity would have a long-run effect of about 1.2% higher GDP per capita. However, they find that business R&D intensity is the driver of this effect, with public R&D apparently making a negative contribution to growth. They caution that this does not necessarily imply public R&D crowds out private R&D, although evidence exists that this is the case in respect of defence research. Instead they conjecture that business R&D is likely to generate more short-term returns that show up in income, whereas public research such as energy, health and university R&D may generate more basic knowledge with consequently greater spillovers in the long run.

Impact of R&D on Productivity and Growth

Using data on 3,000 New Zealand firms Fabling and Grimes (2006) find that internally conducted and externally commissioned R&D are associated with higher relative profitability, higher relative productivity, and higher market share. Industry structure is also found to be important, with firms operating in an oligopolistic setting or not perceiving competition as a barrier to innovation tend to perform well on these three dimensions.

Williams (2004) surveys international evidence on the role of R&D on economic growth. In addition to the results of Fabling and Grimes (2006), Guellec and van Pottelsberghe (2003) and Bassanini and Scarpetta (2001a) summarised above, he cites evidence from other studies indicating:

- R&D is an important source of growth, but its true size does not show up in econometric studies because of data and attribution problems;
- Across developed countries the stock of accumulated R&D investments accounts for 10-15% of economic growth;
- Productivity is affected by factors such as R&D; and
- Direct returns from business R&D are in the order of 20-30%, while indirect or spillover returns are around 50%.

Williams observes that the results of Guellec and van Pottelsberghe (2003) – that foreign R&D has a stronger impact on productivity than domestic R&D, but domestic R&D improves absorptive capacity – has important implications for smaller countries like New Zealand. The evidence of Hall and Scobie (2006) discussed below confirms this observation for New Zealand agriculture in particular.

Congressional Budget Office (2005) provides a comprehensive survey of the empirical literature on the rates of return to business R&D, concluding that an estimate of 20% to 30% would be reasonable.⁷ The report also notes that social rates of return to R&D should exceed private rates of return, given the non-rivalness and non-excludability of knowledge, indicating that spillover effects should be anticipated from R&D. Some evidence is found in support of such spillovers, although it is less reliable than the research for private R&D returns. R&D spending is found to have made a small, steady contribution to post-war US economic growth, but does not explain major observed swings in productivity. Citing previous research by the Congressional Budget Office, little evidence is found for public (i.e. federal) R&D spending directly affecting private productivity growth, although there is evidence that private R&D benefits from the basic science research performed by government employees that is publicly available. Overall the study concludes that if R&D is defined broadly to include the invention of new products, the discovery of new ideas and the improvement of business processes, then (p. 30) “there is little doubt that research and development ... is the root of all increases in productivity.”

Lederman and Maloney (2003) examine the relationship between R&D and development, observing that developed countries tend to also spend more on R&D as a proportion of GDP than developing countries. Perversely such developed countries enjoy greater growth in TFP in manufacturing and agriculture than developing countries which in principle should simply be able to adopt new technologies, highlighting the importance of absorptive capacity for technology diffusion. They survey studies of the social rates of return to R&D, ranging from 68% to 123% for G7 countries, and from 15% to 85% for the remaining 15 OECD countries.

Research by these authors using a global dataset (including New Zealand) finds that R&D effort rises with development, and at an increasing rate. The main factors identified as underlying this relationship are financial depth, protection of IPRs, ability to mobilise government resources, and research institution quality.

... *cont'd*

⁷ Summary tables from this survey are reproduced in Appendix B.

Impact of R&D on Agriculture Sector Productivity Growth

Hall and Scobie (2006) examine the impact of R&D on productivity growth in New Zealand agriculture sector over 1927 to 2001. They cite previous New Zealand research using data from 1968 to 1999/2002 finding that private R&D had a significant impact on agriculture sector productivity, and a return of 69%. Conversely government R&D expenditure was found to *reduce* TFP in agriculture, and had a return of -7%. Perversely, instead of leading to beneficial spillovers, higher Australian business R&D (which is likely a poor proxy for the world stock of knowledge) was associated with *reduced* TFP in New Zealand agriculture.

These authors observe that public R&D intensities in agriculture over 1975 – 2003 averaged near 4% in Australia, but only around 1.3% in New Zealand. However, the New Zealand agriculture sector has enjoyed strong productivity growth rates, even more so following the country's structural reforms in the 1980s. Consistent with findings in other studies for small countries, the authors find using their own long-term data that foreign knowledge is consistently an important factor in explaining New Zealand agriculture sector productivity. Domestic R&D has a less clear effect, though they estimate that the return to such domestic R&D amounts to 17% per annum.

Gutierrez and Gutierrez (2003) use a sample of 47 countries (including New Zealand) over 1970-92 to examine the impact of international R&D spillovers on agriculture sector productivity growth. They find that agriculture sector productivity is positively affected by both the domestic R&D stocks and that of a country's trading partners. However, modern agriculture technology has tended to be developed in temperate countries, and they find that technology spillovers occur more in temperate zones than in the tropics. As a result temperate countries need not make as large investments in technology capability as tropical countries in order to enjoy agriculture sector productivity growth. Finally, the US exerts the greatest impact on the international transfer of agricultural R&D.

3.4 Summary

So what can we learn from this review of the empirical literature on the role of institutions in growth and productivity? First we should be aware that there are often methodological limitations in studies of this type, and also often quite divergent findings depending on the countries and period involved. This can be important for developed countries, when attempting to infer prescriptions from studies that include developing countries as well. And aside from these pitfalls there is the general caveat that institutional findings tend not to map into unique policy prescriptions, with successful growth sometimes occurring despite the predictions rather than consistent with them. All in all a case by case analysis is warranted when attempting to derive a package of policy prescriptions for growth.

Bearing these caveats in mind, what are the general themes emerging from our review? The first is that growth is driven more by total factor productivity (TFP) – Solow’s “residual” – than it is by factor accumulation per se. Policies affecting the accumulation of high quality labour and capital are likely to be more easily devised and implemented than those to dramatically improve the institutional environment, yet the latter may be more important for growth in the long run. Factor accumulation clearly plays a role in growth, but untangling the influences on TFP – whether they are institutions-related or otherwise – remains unfinished business.

Institutions and Growth

So do institutions drive TFP? The answer appears to be “yes”, though the precise mechanism by which they do so remains unclear. Certainly none of the studies surveyed find institutions to be unimportant for growth, although institutions may be more important for sustaining growth than causing it. Moreover, institutions are found to dominate certain other explanations for growth, such as geography and economic integration. They are sometimes found to either reduce or eliminate the explanatory power of certain policies for growth, but in other cases good institutions can reinforce the growth effect of such policies (e.g. trade).

Secure property rights emerge as a constant factor underpinning growth. So too does good governance in forms such as political stability and absence of violence, government effectiveness, rule of law, and freedom from graft. Note, however, that this is not a universal prescription for democracy per se, as Asian growth miracles can attest. However, the evidence confirms the importance of “economic freedom”, broadly measured, for growth. In turn, good institutions appear to reflect countries’ origins, particularly their legal origins and history of colonisation. However, the importance of institutions for growth can be considerably greater for developing countries than for developed ones. New Zealand’s institutions rate well internationally, though as we will explore further in Section 4, there are particular dimensions of New Zealand’s high-level institutions that rate well below the country’s overall strong ranking.

Evidence on the *size* of government is less conclusive. Some studies reveal a negative impact of the size of government on growth, but closer examination reveals that it is rather certain “distortionary” types of government revenue and expenditure that are negative for growth. These include income taxes, and expenditures on welfare, among others. Conversely, taxation on goods and services, and expenditure on education and infrastructure are found to be positive for growth. While New Zealand has a relatively small level of government compared to OECD averages, the country compares unfavourably in terms of a relatively high distortionary tax burden, and relatively low non-distortionary government expenditure. On the other hand, its agriculture sector expenditures are predominantly of the public good type, rather than comprising non-social subsidies, which bodes well for agriculture sector growth.

Financial development also plays a significant role in underpinning growth. However, absolute measures of capital market development, such as share market capitalisation to GDP, are likely to give a misleading impression without further considering the structure of the economy. New Zealand's emphasis on asset-based industries (e.g. agriculture) rather than knowledge-based industries suggests it should rely more on bank funding than equity, so its relatively small equity market – belying its strong investor protections – need not represent a constraint on growth.

Regulation is consistently found to have a constraining effect on growth, particularly where it impedes competition, the destruction of failing firms, and factor market flexibility. It also amplifies income volatility, although both effects are smaller where countries have better institutions overall. The gains from trade are also found to be dependent on institutional flexibility, particularly in labour markets, and also in terms of market entry and exit. Competition policy can also have important positive or negative effects for growth, with de facto independence of competition authorities found to make the most important contribution. Interestingly, proportional representation-based systems of government are found to be a negative for the quality of regulatory institutions, all other things being equal.

Institutions and Innovation

Accepting that institutions can affect growth at a very high level, what does the literature tell us about their impact on innovation, and thereby growth? Certain empirical regularities about the nature of innovation and systems to support it emerge. Firstly, innovation is found to drive productivity growth, and hence ultimately income growth. Private returns to R&D are found to be significant, with social returns higher still (i.e. through spillovers). Innovation occurs across the economy, not just in “high tech” sectors which tend to contribute little to overall GDP. Increasingly innovation is driven by firms seeking or undertaking research to address existing or perceived market needs, rather than as a consequence of R&D “supply push”. The factors found to positively influence business R&D are found to include previous R&D, direct R&D subsidies and tax incentives, real GDP levels, protection of IPRs, firm size, collaboration, and quality of research institutions.

While much of the growth contribution of R&D can be attributed to business R&D, public R&D plays an important underpinning role. Both contribute to a nation's absorptive capacity, encouraging diffusion of technologies developed overseas, which for smaller countries tends to be the dominant source of innovation. International trade and FDI are also important channels of such diffusion.

The public role in R&D is emphasised by the systemic nature of innovative activity. Increasingly innovation occurs on an open basis, involving importing or exporting of technology across firms,

and is driven by collaboration among firms and even across borders. Underlying such activities are coordinated research efforts among universities and other higher centres of learning (which are found to be more important for countries operating close to their technology frontier). The importance of social and technological infrastructures, allied with access to markets for innovative outputs, and quality-of-life factors for internationally mobile high-skilled workers, are also emphasised.

The effect of competition on innovation proves to be more nuanced than simple theories of innovation might at first suggest. Competitive entry is important for growth in countries already close to their technological frontier. The limited evidence available suggests that competition is generally conducive to innovation, though there appears to be a non-linear relationship between the two. Across economies and sectors there is likely to be a level of competition (or industry concentration) at which innovative activity is optimised. This optimum is unlikely to occur at the textbook ideal level of atomistic competition, implying welfare tradeoffs for consumers, who face higher prices from concentration, but lower prices from innovation. Competition laws and their enforcement can therefore serve to support or hinder innovative activity depending on how they traverse such complexities.

Unlike for growth in general, the role of regulation on innovation is not as clear. Certainly product market competition is associated with productivity growth, and flexibility to adopt and adapt to new technologies is also important. However, the role of labour market flexibility is more nuanced, though it is positive for R&D intensity where labour markets are decentralised.

Access to external finance is also important for innovation, as are incentive arrangements conducive to the exploration of risky research. The strictness or leniency of bankruptcy laws may play a role in either supporting or dampening innovative activity.

In respect of agricultural R&D and growth, New Zealand research confirms the importance of international technology spillovers. Similar cross-country research finds the same, though it reveals that spillovers occur more easily for countries in temperate climates, reducing the need for such countries to make their own investments to boost productivity in agriculture.

With these empirical lessons in mind, we now turn to an assessment of New Zealand's institutions as they affect growth and innovation in our selected sub-sectors, identifying where further research is warranted to determine if institutional innovations are warranted, and if so, what if anything is impeding those innovations from occurring.

4. Assessment of New Zealand's Institutions

Given the scene-setting in Section 2, and review of the relevant literatures in Section 3, this section now turns to identifying where New Zealand's institutions might be improved in order to encourage innovation and growth in our selected agriculture sub-sectors. As cautioned in the introduction, the breadth of our inquiry has not permitted detailed analyses of each of the particular institutions discussed, so we restrict ourselves to suggesting areas for further inquiry rather than making firm recommendations. In any case, if institutional improvements present themselves, one must always ask why they have not already occurred before assuming there is an automatic public policy rationale for intervention.

We begin the section with an analysis of New Zealand's institutions in general, followed by an assessment of its institutions as they relate to innovation. Institutions affecting the main productive factors – land, labour and capital, as well as water – are then examined. Climate change policy is given particular mention, given its possibly wide-ranging impacts on agriculture. Other institutions affecting our selected agriculture sub-sectors are then discussed. A summary is provided in the final part of this section. Given the breadth of possible issues that might be traversed in a study such as this, at best we would claim to have provided a sampling of the relevant issues. Doubtless other relevant issues might be identified and analysed, which we leave to future research. Suggestions for further inquiry are underlined for ease of reference, with priority areas also italicised.

4.1 New Zealand Institutions in General

4.1.1 Deconstructing Composite Measures of Institutions

Table 2.1 suggests New Zealand has little room to improve on its existing high-level institutions, given its high international rankings according to various international indexes of institutions. However, institutions across the world should expect change with time, so current rankings are no reason for a country to rest on its laurels. Moreover, closer examination of the indexes contained in that table reveals areas for improvement, as summarised in Table 4.1 overleaf.

Size and Structure of Government

One consistent theme emerging from Table 4.1 overleaf is that aspects of government involvement in New Zealand is unproductively high – whether measured in terms of unproductive expenditures, or in terms of distortionary taxation. This accords with the evidence of Grimes (2003) for New Zealand, and of Nijkamp and Poot (2003) and Kneller et al. (1999) from cross-country

studies. It raises the apparently conflicting benefits of a shift towards lower and/or less income-based taxation, and for improved infrastructure expenditure. As suggested by Kasper (2002), this could be resolved by consideration of greater involvement of the private sector in infrastructure investments, such as through public-private partnerships (PPPs).

Table 4.1 – Areas for Possible Improvement in High-Level Institutions

Institutions Index	Components with Relatively Low Rankings
World Bank – Ease of Doing Business Index	<ul style="list-style-type: none"> • 21st in bankruptcy recovery rates; • 18th in construction industry licensing complexity; • 15th in the efficacy of resolving commercial disputes; • 12th in exporting and importing compliance; • 10th in each of tax burden and compliance; and • 10th in hiring and firing of workers.
Fraser Institute – Economic Freedom of the World Index	<ul style="list-style-type: none"> • 39th for size of government; • 32nd for labour market regulations; • 24th for access to sound money (inflation record and monetary growth relative to GDP growth); and • 16th for freedom to trade internationally.
Heritage Foundation – Index of Economic Freedom	<p>Out of top 10 countries:</p> <ul style="list-style-type: none"> • 10th for fiscal freedom (tax burden); • 9th for trade freedom (tariff and non-tariff barriers); • 7th for freedom from government (government expenditures); and • 7th for investment freedom (capital flows).
World Economic Forum – Global Competitiveness Index	<ul style="list-style-type: none"> • 27th for infrastructure; • 26th for business sophistication; • 25th for macroeconomy indicators; • 25th for innovation; • 23rd for technological readiness; and • 22nd for higher education and training.

Source: www.doingbusiness.org, www.visionofhumanity.com, www.fraserinstitute.ca, www.heritage.org, www.weforum.org.

Note: Descriptions of the relevant sub-components of each index are provided in Appendix A.

Openness to Trade

Another, perhaps more surprising theme, is that New Zealand is not apparently as open to trade as is commonly thought. Figure 3.5, from Rodrik et al. (2002), illustrates that on the dimension of openness New Zealand does not rate as well as many other countries, consistent with the above rankings. Further inquiry is warranted as to the source of this relatively poor ranking, to identify

possible room for improvement. This finding also suggests the importance of New Zealand continuing to seek reform of international trade barriers through multilateral institutions such as the WTO, and bilateral and regional trade agreements either in lieu of achieving such reform, or to support it. In doing so, however, it will be important not to undermine the strategies emerging across the agriculture sub-sectors to overcome trade barriers in other ways (e.g. see Section 2.4.6) where those alternatives are superior to trade liberalisation per se.

The Hall and Jones (1999) “social infrastructure” measure – combining indices of government anti-diversion policies and openness to international trade – possibly measures the same effect. As shown in Figure 3.2, Eicher and Leukert’s (2006) reworking of the Hall and Jones dataset reveals that New Zealand’s index of social infrastructure compares at the least favourable end of the spectrum for developed countries. Regardless of whether the poor ranking results from poor government anti-diversion policies or lack of openness to international trade, it would be instructive to determine why New Zealand fares relatively so poorly on this measure.

Security of Property Rights

A curiosity of the above rankings is that New Zealand scores relatively well in respect of property rights variables. The World Bank index refers to ease of registering property, the Fraser Institute index to judicial independence, impartiality and integrity, protection of IPRs, and military involvement in the rule of law and political process. The Heritage Foundation index refers to the ability to accumulate assets secured by clear laws enforced by the state, while the World Economic Forum index relies on respect for property rights. None of these are likely to capture the absence of a clear constitutional protection of property rights in New Zealand, enforceable against the state, despite many other developed countries having such a protection. Even jurisdictions lacking such a constitutional protection will have other measures (such as licensing in the UK) to enhance the state’s ability to make credible commitments to investors not to expropriate their wealth through direct or indirect means.

The ability of the state to make such credible commitments supports long-term investments being made by the private sector (such as in PPPs). Certainly there is much discussion in New Zealand in the lead-up to the first Kyoto Protocol commitment period (CP1) about the role played by climate change policy uncertainty in the advent of net deforestation since 2005. Such uncertainty, revolving around the extent to which pre-1990 foresters will in future face new costs if they put their land to non-forestry uses, impacts on the value of long-term investment decisions made now. Ironically, while institutional flexibility is generally an efficiency-enhancing characteristic, this issue is one in which institutional inflexibility – an inability for the state to expropriate investors – should enhance efficiency. More will be said about climate change policy in Section 4.4.

While the New Zealand courts adhere to the principle that private property should not be taken by the state without compensation except in extreme circumstances, the courts have limited ability to challenge any such takings once an intention to legislate them is announced. Hence, despite New Zealand's apparent high rankings in respect of property rights protections, we feel further research is required on the particular question of whether enforceable constraints should be imposed on the ability of the state to expropriate private property in New Zealand. Alternatively, exploration of other credible commitment devices to protect private investors against expropriation by the state could be undertaken. Given the acute importance of property rights for growth identified in the empirical literature these questions, in our view, deserve ongoing assessment.

4.1.2 Regulation

Over the past decade New Zealand has shifted from primarily light-handed regulation based on information disclosures to more industry-specific regulation. At the same time, it has shifted towards a greater codification of regulatory and other governance arrangements both across and within industries. It has done so without constitutional protections of property rights that would entitle investors to compensation where regulatory changes unduly undermine the value of their investments, and also without adopting the rigorous cost-benefit analysis apparatus (which extends beyond New Zealand's "regulatory impact statements") commonly employed in other jurisdictions when assessing regulatory changes. Accordingly, this shift in regulatory approach has not been subject to the same level of discipline as it might have been in other jurisdictions.

In addition, New Zealand's change from a first-past-the-post to mixed-member proportional representation system of government has implications for the quality of the country's regulatory institutions. The evidence of Bertelli and Whitford (2005), and of Pagano and Volpin (2005), suggests that proportional representation systems are associated with poorer regulatory institutions. It is unlikely that New Zealand's parliamentary system will be returned to first-past-the-post in the foreseeable future, so we instead suggest that inquiry is warranted into institutions for improving the quality of regulation-making and enforcement in New Zealand, such as:

- More formal cost-benefit analysis procedures;
- Merit reviews of regulatory decisions;
- Long-term licensing, regulatory institutions placed at arms length from government, or other commitment devices to mitigate regulatory uncertainty for long-lived investments;
- Both formal and effective independence of regulatory institutions; and
- Sunset clauses on regulations, and/or clear criteria for their review.

The government's current Quality Regulation Review process does not address these particular issues, except peripherally in terms of one of its stated objectives, namely improving risk analysis when developing and enforcing laws. Accordingly these suggestions remain relevant.

4.1.3 Competition Laws

Given the recurring emphasis in the empirical literature on the importance of competition for innovation, consideration is required of the suitability of New Zealand's competition law institutions. This is particularly so with the increasingly multinational nature of agriculture sector activities, involving vertical and horizontal integration across borders. It is also required given the increasing vertical and horizontal integration – both within and across sectors – arising in agriculture.

Rise of the "Hybrid" Form

As Menard and Valceschini (2005, p. 423) put it, "Comparative advantages can no longer be understood solely in terms of factor endowments, nor purely in terms of technological development: they also depend significantly on how transactions, including trade activities, are organised and supported, and how institutional changes transform initial endowments." They note that new "hybrid" forms of organisation are emerging in agricultural sectors internationally as transaction-cost minimising forms of institution (Fonterra is an obvious example). Such organisation often involves inter-firm contractual agreements, usually among several parties, in which resources are pooled while keeping property and decision rights distinct. Competition remains both among parties involved in the hybrid, as well with other types of organisation. Such arrangements require competition policies to be revisited where they simply regard such hybrids as anti-competitive coalitions.

Regulating MNEs

Indeed, Calzolari (2001) highlights the increasing challenges faced by competition law agencies when dealing with organisations or hybrid groups of organisations operating in multiple jurisdictions. Not only do the inevitable inconsistencies in competition rules across jurisdictions create problems both for regulators and such companies. So too do problems in enforcing rules on organisations that can play agencies in different countries off against one another. Moreover, enforcement in one jurisdiction can create externalities (positive or negative) for enforcement agencies in another. While recognising that there are benefits from regulatory institution competition, greater cross-border rules harmonisation, information sharing and enforcement

coordination between competition agencies may become necessary when regulating increasingly multi-national agri-food concerns.

Competition Law Flexibility and Focus

Institutional flexibility and pragmatism has already been demonstrated in respect of dairy industry restructuring in New Zealand, although the efficacy of the resulting arrangements deserves monitoring. It would be instructive to see if a similar approach would be taken to a meat processing industry “mega-merger”, for example, or to cross-border cooperation between dairy, apple, kiwifruit, forestry or other agriculture sector producers and processors. Questions of appropriate market definition and net benefit tests under the Commerce Act will increasingly arise as agricultural producers seek better ways to coordinate the international agri-food supply chain, and gain economies of scale and scope, to countervail against increasing buyer market power in the form of international supermarket chains and buying groups.

Additionally, the increasing importance of competition *for* markets as opposed to competition *in* markets, particularly where technological innovation is an important part of competition, highlights the need for competition law tests to focus on dynamic efficiency rather than just static allocative efficiency. This will possibly become more important in agriculture, where greater reliance on genetic selection and new varieties (e.g. of apples or kiwifruit), sometimes with licensing arrangements, is emerging. Achieving dominance in such products is already an important competitive tool for (e.g.) ZESPRI, ENZA and Rissington Breedlines, and with the discovery of a “trim milk” gene in cows, possibly for Fonterra as well. It will be interesting to see how any structural realignment in sectors such as these fare under existing competition rules.

These are perhaps matters more for ongoing monitoring than for review, but indicate that institutional flexibility in the area of competition law may be increasingly important in the light of emerging global and domestic changes in agricultural sector organisation and strategy.

4.2 Institutions affecting Innovation

4.2.1 Rationale for Government Involvement

General Issues

Williams (2005) presents the case for government intervention in research, science and technology (RS&T) in New Zealand. It hinges in part on conventional arguments of market failure – in particular the private underinvestment (from society’s perspective) in RS&T said to arise

because of positive externalities from investments in knowledge. Additionally there can be “public good” aspects of RS&T involving non-excludability and non-appropriability by private parties, which is conventionally taken to predict socially sub-optimal private investments.⁸

Intervention also hinges, however, on arguments of coordination failures – that from a systems perspective innovation requires coordination and interactions which too will arise at less than a socially optimal rate if left only to private agents. Certainly this is the main emphasis in the public policy framework discussion for New Zealand’s national innovation system provided in Smith (2006). He argues that coordination failures – unlike conventional market failures – arise at an institutional level preceding the operation of markets, or where markets cannot operate, thus requiring non-market or administrative coordination. State support for RS&T investments is also often argued to be necessary due to their long-term and highly risky nature, which can make them unattractive for private investors, though this argument is weaker where capital markets are developed, and where property rights are well-defined and secure.

Issues Particular to New Zealand

The argument for intervention in New Zealand also relates to the historical and assumed ongoing role of public research in supporting innovations in the country’s economically important agriculture sector, and to the country’s low rate of business R&D spending (in part related to poor RS&T capacity within most New Zealand firms). Consistent with the evidence discussed in Section 3.3.4 (e.g. Guellec and van Pottelsberghe (2003)), increasing domestic R&D is indeed particularly important for increasing small countries’ absorptive capacity. In New Zealand this argument is taken further, that because of low RS&T capabilities within local firms publicly-funded research organisations need to make investments beyond just basic research – which is likely to involve the greater public good, positive externalities and long-term high-risk attributes normally used to justify intervention – extending into activities such as commercialisation which conventionally are regarded as the responsibility of private parties.

One of the more compelling arguments offered by Williams (2005) is that public-funding is required for R&D directed at maintaining environmental quality. As discussed further in Section 4.5, New Zealand is like most other countries in lacking comprehensive market-based arrangements or property rights for the multiple positive and negative externalities involved in resource use. Until such multiple externalities are “owned” and “priced” – as they are now starting to be in terms of carbon and nitrate emissions – private parties will likely lack the incentives and appropriability of

⁸ Though even non-appropriable and non-excludable goods and services can be privately provided so long as private parties can raise sufficient revenues from them to justify their provision – e.g. free-to-air broadcasting funded by advertising. For a critique of the public good justification for state intervention, in this case regarding electricity supply security, see Meade (2005).

returns (or costs) to manage environmental quality to socially desirable levels, and to invest in socially-desired environmental innovations.

Testing the Rationale for Intervention

As with any arguments of market failure, it is important that public intervention rationales are tested and reviewed on an ongoing basis to determine their ongoing justification. If New Zealand firms genuinely do under-invest in R&D, then public intervention may remedy this (particularly if lack of scale remains an ongoing issue), or simply crowd out the emergence of private research (e.g. if scale issues diminish). Most New Zealand firms likely lack the scale, resources and incentives to undertake basic research, suggesting a possible role for public funding in this area. On the other hand, internationally only a handful of countries undertake most research (so New Zealand's situation is far from unique), and Galt (2000) presents evidence showing that New Zealand ranks favourably among OECD countries in terms of patent registrations per capita, and research productivity.

Ongoing questions to be addressed therefore include exactly how far government's role should extend beyond supporting or providing basic research, and to what extent government support and coordination activities should be directive (i.e. toward particular objectives or sectors)? Additionally, as Smith (2006) suggests, the identification of coordination failures and design of policy instruments to overcome them are also an appropriate focus of policy.

In our discussion of CRI arrangements below we test the proposition that ongoing public funding or provision of research remains necessary or desirable for agriculture sector innovation in all instances.

4.2.2 Research Funding Level and Mix

Low R&D Intensity Perhaps Justified?

It is clear that New Zealand's research intensity is at a *level* lower than that of other countries, with both business R&D and government R&D funding low compared to OECD averages (according to FoRST (2005), 0.49% versus 1.51%, and 0.52% versus 0.68% respectively). New Zealand research is also clearly dominated by agriculture sector research. As to whether or not the level of funding is a problem is not self-evident. Perhaps New Zealand can perform agriculture R&D more efficiently than other countries? Also, the evidence of Guitierrez and Guitierrez (2003) is that temperate climate countries like New Zealand are better placed to absorb innovations from other countries, hence lower investments to ensure absorptive capacity and to generate domestic

innovations may be justified. Finally, New Zealand's low R&D intensity may reflect the simple fact that it has much smaller "high tech" industries than many comparator countries, which Sheehan and Wyckoff (2003) observe tend to be more prominent in high R&D intensive countries.

Measurement Issues

Another possible explanation for New Zealand's relatively low rate of business R&D intensity is that its business R&D is simply not being measured appropriately, or that it is possibly overstated in comparator countries. In the May 2007 budget announcements were made for R&D tax credits for research undertaken in New Zealand according to various criteria. Until this announcement New Zealand businesses faced no particular incentive to categorise their business expenses as R&D or otherwise – unlike businesses in many other countries where such tax credits or other incentives have been available for some years (e.g. see OECD (2003[b])). With the announcement of tax credits in New Zealand it should be expected that the rate of reported business R&D will increase, even if this involves no net increase in R&D outlays.

New Zealand's Relative Support Mix

As shown in Figure 3.6, New Zealand compared reasonably well with other developed countries for its *mix* of R&D support in 2000, mainly because of relatively strong direct public funding support. With the R&D tax credits scheme in place this should improve New Zealand's ranking, although only if other countries have not also improved their R&D support regimes. Another possibility is to consider the approach taken in Australia where government provides matching funding for research funding provided by industry. This approach would have the merit of encouraging industry to self-select investments it thought would have the best commercial potential, thus reducing the risk of government funding priorities not aligning well with such investments.

Ongoing appraisal of the appropriate target level and mix of R&D support in New Zealand is therefore warranted, particularly if it turns out that previous business R&D in New Zealand has simply been under-reported. Changes in how public funding is targeted are also worth examining.

4.2.3 Research Focus

MoRST (2006) forcefully argues that New Zealand's RS&T policy should take its own course, given the particular attributes of the New Zealand economy. Agriculture makes a relatively large contribution to both GDP and GDP growth in New Zealand, while "high tech" sectors make even a

smaller contribution than they do in countries where they are prominent. Innovation in agriculture is therefore likely to play a greater role in New Zealand's economic growth than innovation in such other sectors. Williams (2005) makes the case for investments by New Zealand in "enabling technologies" such as biotechnology, nanotechnology and ICT.

However, this argument carries more weight in New Zealand where those technologies can be said to underpin innovation in those sectors important for the economy and in which the country has a comparative advantage. Certainly it is unclear that New Zealand has any significant comparative advantage in these areas already, except perhaps in relation to aspects of biotechnology in the context of a temperate climate and a geographically isolated economy.

Accordingly, the ongoing testing of public research funding priorities – ideally with formal ex post and ex ante cost-benefit analyses – will be important to ensure the public funding is usefully targeted from an economic growth perspective.

4.2.4 CRI Arrangements

MoRST/CCMAU (2003) provides an appraisal of New Zealand's nine CRIs. Among other things it identifies issues in relation to setting and meeting CRI objectives, and in respect of funding insecurity arising from FoRST's short-term contestable funding of research projects. Each is discussed below, as is the ownership of CRIs.

CRI Objectives

As to objectives, section 4 (purpose) and section 5 (principles of operation) of the Crown Research Institutes Act create multiple and potentially conflicting objectives. While CRIs are to undertake research, and to do so for the benefit of New Zealand, they are also to be good employers and to exhibit a sense of social responsibility by having regard to the interests of the communities in which they operate. At the same time they are required to operate in a financially responsible manner in order to maintain their financial viability.

These objectives and principles are clearly open to wide interpretation, leaving only financial viability as the clear constraint on performance. However, given CRIs' other purposes and principles of operation, they are not clearly commercial entities either, and so cannot be expected to have objectives that align closely with possible industry research partners or customers. It is no surprise that governance conflicts and performance issues might arise under such circumstances.

A review of the Crown Research Institutes Act to ensure sufficient clarity of objectives would appear to be worthwhile.

CRI Funding

As to funding, it is also unsurprising that FoRST's traditional reliance on short-term contestable funding has led to difficulties in CRI business planning. Ironically, the research areas most naturally the focus of government bodies – namely basic, high-risk and long-term research – has since 1992 been funded with primarily short-term and insecure funding. This funding approach has also complicated the recruitment and retention of skilled staff, who operate in an increasingly global labour market, and for whom lifestyle factors including security of tenure can significantly influence their job location choices.

FoRST (2005) identifies that a change in funding balance was necessary to provide CRIs with greater funding certainty. This has been achieved by increasing the proportion of negotiated, long-term funding contracts allocated to CRIs, as opposed to short-term contestable contracts, along with devolving greater authority to CRIs to determine research priorities. Ironically, while this change should improve the ability of CRIs to build research capacity and make long-term investments in high-risk, basic research, this conflicts with the conclusions of Guellec and van Pottelsberghe (2003). They suggest that public R&D might make a greater contribution to productivity growth with less institutional funding and greater funding contestability. However, it is possible that the countries in their survey placed too great a reliance on institutional funding, on average, whereas New Zealand has perhaps placed too great a reliance on contestable funding. Ongoing evaluation of the balance between contestable and non-contestable CRI funding, and CRI funding arrangements in general, is warranted.

CRI Ownership

Finally, the ownership of CRIs merits consideration. At present all nine are state-owned, and themselves incapable of combining with other entities except via joint venture or other subsidiary alliances. As mentioned above, mixed and conflicting CRI objectives may reduce their attractiveness as JV partners, as may any ongoing issues with their public funding component (and lack of ability to raise their own equity capital). Certainly MoRST/CCMAU (2003) identifies business skill and board composition/stability issues for CRIs that affect their suitability as commercial partners for other parties seeking to invest in joint research or to commercialise CRI discoveries.

There may therefore be merit in at least some CRIs being owned by the industries which they contribute to most, or by institutions such as universities. Obvious candidates are AgResearch and HortResearch, and perhaps to a lesser extent Scion (although lack of industry cohesiveness may preclude this). For example, the beneficial nexus between research and graduate study combined with the entrepreneurialism of universities suggests that arrangements to achieve greater

cooperation between CRIs and universities concentrating in the relevant areas – or ownership of CRIs by such universities – deserve consideration.

Alternatively, given the importance of AgResearch's work to the pastoral sector, and of HortResearch's to the apple and kiwifruit industries in particular, there is a possible rationale for these sectors to each jointly own these CRIs. For the apple and kiwifruit sectors the rationale appears the strongest, with competitive positioning being increasingly driven by the development of new varieties delivering consumer-driven product attributes, and control over the worldwide production of those varieties through control of their associated IPRs. The same might be said of the wine sector, but its competitive positioning is also tied to its location/climate and production processes, and less over control of grape varieties (which conceivably might change in the future, though).

Scope for joint industry ownership of HortResearch by the apple and/or kiwifruit sectors, and perhaps AgResearch by the dairy and/or wider pastoral sectors, is enhanced by the already significant and otherwise increasing levels of industry cooperation on industry good activities in each of these sectors, including where funding can be secured through industry levies. The basic research activities of the CRIs could continue to be funded publicly, or possibly by mixed public-private funding (perhaps in combination with university graduate research funding where there are synergies). Industry ownership would facilitate improved commercial incentives, and could potentially offer more secure research funding, and a greater ability to participate in horizontal or vertical alliances with other domestic or international parties. Importantly, from industry's perspective, greater control over these CRIs' research agendas and outputs would provide them with both an enhanced ability to drive research in line with commercial strategies, and a reduced risk that IPRs created by these CRIs are shared with or end up controlled by competitors.

Hence we suggest that the objectives and operating principles for CRIs, and the funding of CRIs, be reviewed to identify undue conflicts, and to consider possible improvements. In any case we suggest it is worth considering whether HortResearch and AgResearch might be better owned by their respective New Zealand customers or by universities.

4.2.5 Intellectual Property and Bankruptcy Laws

With the growing internationalisation of innovative activity, and export focus of New Zealand's agricultural innovators, the security of IPRs – both of overseas owners coming to New Zealand, and of New Zealand owners going abroad – requires ongoing attention. This security relates not just to the specification of IPRs, but to the international detection and enforcement of IPR violations (as has occurred in the past in respect of apples in Chile, for example). It will become increasingly important for New Zealand agriculture sector operators wishing to augment their

comparative advantage in production and exporting by also exporting their production technologies and genetic varieties to countries with less developed sectors (which includes meat as well as apples and kiwifruit, and also dairy).

It is therefore useful to examine whether New Zealand's IPR laws are well-aligned with international rules such as TRIPS, and that cross-border cooperation on monitoring and enforcement of IPRs is ensured. It would also be instructive to examine whether the country's lack of "fair use" rules impede technology diffusion.

Finally, in light of the arguments presented in Manso (2006), there could be merit in examining whether New Zealand's bankruptcy laws are relatively harsh as compared with those in jurisdictions where innovation is more common. While the evidence presented in Table 4.1 suggests New Zealand rates somewhat poorly for its rate of bankruptcy recovery rates, this does not necessarily imply that its bankruptcy laws are not relatively creditor-friendly, or efficient. Social attitudes towards business failure are obviously also important in this regard, but Manso's argument that strict bankruptcy laws will also serve to discourage innovative activities where the returns are highly uncertain deserves further consideration.

4.2.6 Genetic Modification

Under the Hazardous Substances and New Organisms (HASNO) Act the Environmental Risk Management Authority (ERMA) is charged with regulating the introduction of new organisms (including genetically modified organisms, or GMOs) into New Zealand, or their development in New Zealand. With the lifting of the moratorium on field trials of GMOs in September 2001, New Zealand researchers are now able to proceed with GMO research, within the constraints of the HASNO legislation.

In performing its functions ERMA must weigh all the costs and benefits relevant to matters taken account of or given effect to in its legislation. In doing so it must adopt a precautionary approach where there is scientific and technical uncertainty about any adverse effects associated with a matter under examination. It must also take into account any distributional effects of costs and benefits over time, space, and groups in the community.

This is clearly a very highly centralised and administrative approach to weighing the pros and cons of GMO research. Given the relative novelty of the technologies involved, this is to be expected. The tests by ERMA are not couched in solely efficiency terms, so it is conceivable that conflicts between efficiency and distributional objectives will arise. It is also couched in terms of scientific and technical uncertainty regarding adverse effects, rather than the particular social or economic costs of such potential effects (although those costs may be reflected in ERMA's wider cost-benefit

analysis). Hence there is reason to suspect that the HASNO/ERMA apparatus may involve growth trade-offs favouring non-economic considerations. Whether or not these trade-offs are appropriately made should be considered on an ongoing basis, particularly as and when new tools for making these tradeoffs become available (e.g. using more market-based mechanisms).

Ironically, New Zealand's resort to an administrative decision-making approach to the release of GMOs potentially encourages greater GMO research than in a market-based model with liability devolved to those causing harm by their research. While a party harmed by GMO release could conceivably take legal action to recover damages from the party making that release, if the release was made with ERMA's blessing then the releasing party might rely on that fact in its defence.⁹

While New Zealand does not formally prohibit research involving GMOs, the subject remains socially and hence politically contentious, and ERMA's decision-making processes will be applied against such a back-drop. Ruttan (2002) expresses doubt that genetic engineering will deliver the same high level of agriculture productivity gains as enjoyed in the last half of the twentieth century, but it would take a brave person to rule out breakthrough technological advances in this area. Hence it is desirable that New Zealand permits GMO research, and takes into account any positive or negative externalities created by the introduction or release of GMOs, though periodic review of the efficacy of the HASNO/ERMA apparatus would be desirable.

It can be argued that New Zealand's GE-free status is a huge marketing advantage for its agricultural producers overseas, particularly in highly food-safety conscious markets such as the EU. However, this argument is debatable, and the status is not determined solely by institutions. One agricultural sub-sector (or one member of that sub-sector) might prefer that another does not introduce GMOs because doing so undermines any "GE-free" branding it relies on, especially where cross-contamination from GMOs is possible. However, if such cross-contamination can occur easily, and if a GE-free status does confer a substantial marketing advantage over competitors, then it would presumably take very little for that status to be sabotaged by a competitor taking steps to cause such contamination, despite the best vigilance of New Zealand's biosecurity agencies. Hence, either GMOs are potential doom for agricultural producers, in which case they should probably prepare for doom, or they are an opportunity for researchers to embrace, in which case New Zealand's institutions should, at the very least, not impede them from doing so.

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⁹ Note also that the duty under section 13 of the HASNO legislation – to avoid, remedy or mitigate any harm from GMOs – does not create an enforceable right.

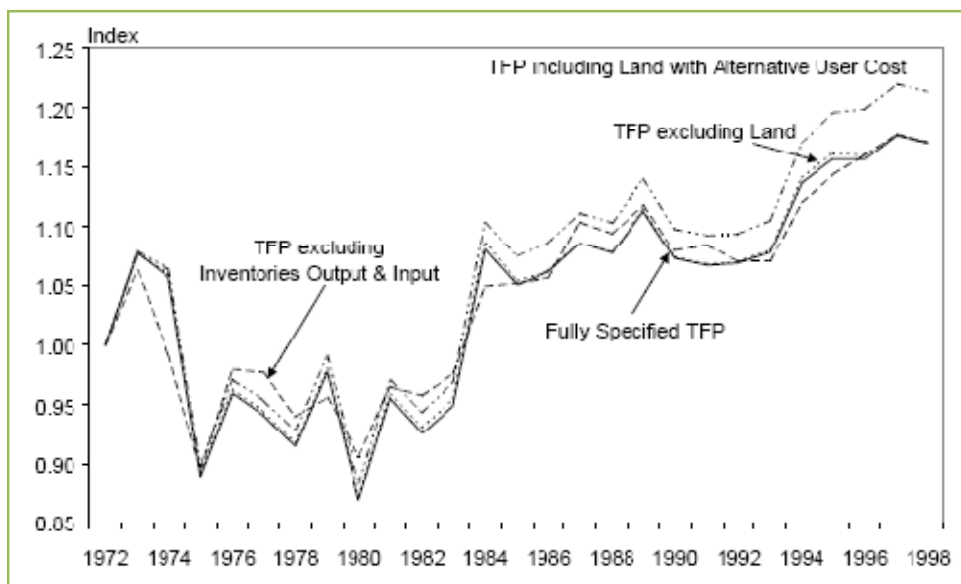
4.3 Institutions affecting Productive Factors

4.3.1 Land

Land as a Variable Factor of Production

It is conventional in economic growth models to ignore natural resources such as land, and focus on just labour and capital inputs. This is usually justified on the grounds that land is fixed in supply, and therefore will not independently affect economic output. As shown in Figure 4.1, it would indeed appear that including land in TFP calculations does little to change overall TFP.

Figure 4.1 – Effect of Land on TFP



Source: Lawrence and Diewert (1999, p. 22).

However, the total amount of land available for productive use in agriculture is clearly not fixed. Agricultural land users face choices not only about differing agricultural land uses, or multiple uses (such as farming and tourism), but also about whether that land can and should be used for agriculture at all. In this respect farmers face competition for rural land from local and foreign lifestylers, but also from the manager of New Zealand's conservation estate, the Department of Conservation (DoC), and conservation lobbies. In some parts of the country (e.g. the West Coast) this competition can be intense, and affects non-farming sectors as well as farming. In the South Island high country, the competition is played out deliberately in the form of the tenure review process pursuant to the Crown Pastoral Land Act.

Furthermore, the activities of the government’s land management agency – Land Information New Zealand (LINZ) – also affect the availability of land for use in agriculture. It makes surplus Crown land available to private owners, and also manages Crown land where it is not ready for sale or not available for sale.

Finally, aside from these considerations, land use decisions by farmers and other private landowners are also constrained by regional and local planning rules developed by regional and local authorities under the Resource Management Act, discussed further below.

Summaries of the roles of DoC and LINZ are presented in the following tables.

Table 4.2 – Role of the Department of Conservation (DoC)

Feature	Description
Position	The central government organisation charged with conserving the natural and historic heritage of New Zealand on behalf of and for the benefit of present and future New Zealanders.
Purpose	To conserve New Zealand's natural and historic heritage for all to enjoy now and in the future.
Key Legislation	<ul style="list-style-type: none"> • Conservation Act; • National Parks Act; and • Reserves Act.
Key Functions	<ul style="list-style-type: none"> • To manage land and other natural and historic resources; • To preserve as far as practicable all indigenous freshwater fisheries, protect recreational fisheries and freshwater habitats; • To advocate conservation of natural and historic resources; • To promote the benefits of conservation (including Antarctica and internationally); • To provide conservation information; and • To foster recreation and allow tourism, to the extent that use is not inconsistent with the conservation of any natural or historic resource.

Source: www.doc.govt.nz.

... cont'd

Table 4.3 – Role of Land Information New Zealand (LINZ)

Feature	Description
Purpose	To ensure: <ul style="list-style-type: none"> • Certainty of New Zealand property rights and interests; • Land information is available: <ul style="list-style-type: none"> ○ to enable New Zealand's economy to function effectively; and ○ for New Zealanders' safety and security; and • Crown assets are put to their best use.
Key Legislation	<ul style="list-style-type: none"> • Crown Grants Act; • Crown Pastoral Land Act; • Deeds Registration Act; • Land Act; • Land Transfer Act; • Public Works Act, Part II-IV, and Part VIII; • Rating Valuations Act; and • Reserves and Other Lands Disposal Acts.

Source: www.linz.govt.nz.

DoC also contributes to the conservation and sustainable management of natural and historic heritage in areas through its roles under other statutes including the Resource Management Act, the Fisheries Acts, the Biosecurity Act, the Forest and Rural Fires Act and the Crown Pastoral Land Act. Statistics New Zealand (2006) summarises DoC's conservation estate as comprising:

- National and Forest Parks;
- World Heritage Areas;
- Wilderness Areas;
- Marginal Strips around lakes and rivers; and
- More than 1,000 other reserves.

DoC's narrow focus on conservation, as opposed to the beneficial multiple use of land, deserves consideration, particularly since its advocacy and management roles are combined whenever it acquires land or has land assigned to it.

LINZ similarly has functions under other legislation, for example in relation to the disposal of former railways and state-owned enterprise land, and under Te Ture Whenua/Maori Land Act, and various Treaty of Waitangi Claims Settlement Acts. Statistics New Zealand (2006) described LINZ's role as being the administration of Crown land not otherwise administered by DoC or directly by service delivery Crown agencies (such as the Ministry of Education). This comprises around three million hectares of land, with major categories as in Table 4.4 overleaf.

Table 4.4 – Breakdown of Land administered by LINZ

Legislation	Property Details
Crown Pastoral Land Act	2.1 million hectares of South Island Crown Pastoral Leasehold land (304 properties).
Crown Forest Assets Act	490,000 hectares of land beneath Crown Forestry Licences (71 CFLs).
Public Works Act	Land no longer required by the Crown for the purpose for which it was acquired (127 properties).
Railways Corporation Restructuring Act	Land no longer required for railway operations (850 properties).

Source: Statistics New Zealand (2006), MAF (2006).

LINZ's role under the Crown Pastoral Land Act puts it directly at the interface between DoC and farmers holding the relevant leases. Under the tenure review process arising under that legislation the Crown negotiates with selected leaseholders for converting their renewable but restrictive leases into freehold title which can then be used for whatever broader purposes are permitted under local planning rules. In exchange leaseholders surrender areas of leased land with heritage or conservation values to the conservation estate managed by DoC, and receive additional compensation where the rights they surrender are not adequately compensated for by providing them with freeholded areas. The Tenure Review process is explored further below.

How the supply of land affects agriculture sector growth is therefore related in part to the institutions governing the boundaries between agricultural and non-agricultural land use, between conservation and non-conservation use, and between government and private land ownership. *We suggest that a periodic high-level review of how management of that interface affects agricultural land productivity could be useful for informing future policy decisions about that interface.*

Control of Land Use

The uses to which land can be put are generally governed by other sets of legislation. The Resource Management Act (RMA) in particular provides the main framework for land management, but other legislation such as the Crown Minerals Act also affects the economic returns that can be derived by landowners. The RMA involves a combination of administrative planning – generally decentralised to a regional level – and semi-tradable quasi property rights in the form of resource consents granted to landowners allowing them to put land, water or air resources to particular uses for certain periods, often with conditions. It also provides for central government guidance on matters of national importance through the issuance of national policy statements, and for consent decision processes to be “called in” for centralised determination.

Table 4.5 – Purpose of Resource Management Act (RMA)

Sections 5 and 6	
5. Purpose	
(1)	The purpose of this Act is to promote the sustainable management of natural and physical resources.
(2)	In this Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—
(a)	Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
(b)	Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
(c)	Avoiding, remedying, or mitigating any adverse effects of activities on the environment.
6. Matters of national importance	
	In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:
(a)	The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:
(b)	The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:
(c)	The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:
(d)	The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:
(e)	The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga:
(f)	The protection of historic heritage from inappropriate subdivision, use, and development:
(g)	The protection of recognised customary activities.

Source: www.legislation.govt.nz.

It should be noted that “the efficient use and development of natural and physical resources” is just one of the 11 other matters to which all persons exercising powers under the Act must have regard under section 7. Thus, while the RMA will impinge upon the economic use of land, efficiency of land use is not its primary concern, although many of the other requirements of the Act could, qualitatively, be cast under the rubric of economic efficiency. The Act is therefore an important institution affecting the productivity of land in general, and agricultural land in particular. Notable examples of its effects include the cap and trade rules imposed by Environment Waikato to control the leaching of nitrates into waterways in the Central North Island, and deforestation restrictions imposed by Horizon Regional Council for forests in hill country susceptible to soil slip erosion.

A review of the efficiency of the RMA and its affect on agriculture sector productivity is beyond the scope of this report. However, *we suggest that consideration is given to more generalised tradability and long-term security of resource consents issued under the RMA, and:*

- *Greater use of market-based instruments in managing environmental issues; and*
- *More formal cost-benefit analyses of environmental regulations made under the RMA.*

We note that DoC is not bound by the RMA in respect of any conservation area so long as that area is managed in accordance with a conservation management strategy, conservation management plan, or management plan established under the Conservation Act, and that management does not have a significant adverse effect beyond that area. Hence the RMA further, and arbitrarily, demarcates the governance of conservation and non-conservation land.

Thus the supply and usability of rural land for agricultural purposes is determined by not just the relative economics of alternative land uses (i.e. lifestyle blocks versus, e.g., sheep farming) but administrative decisions regarding the availability and usability of land administered by either DoC or LINZ, and decisions made under the RMA regarding permitted land uses.

The impacts of DoC land management decisions on agriculture land productivity deserve further discussion, particularly given its narrow objective function. For example, where DoC acquires land adjacent to waterways to preserve its conservation values, it diminishes the supply of land available for lifestyle landowners who want to live near water. This affects the price of other land adjacent to water, and potentially causes changes in land use where farmers owning such land determine that the returns they can make from farming it are not commensurate with those from converting it into lifestyle blocks.

DoC purchases of other types of land may have similar effects on adjacent rural land. Where DoC buys land from farmers with high conservation values (e.g. native scrub) it is likely such land was of lower average productivity in farming terms. By selling that land and retaining the more productive areas farmers should enjoy a measured increase in average productivity. Hence such activities by DoC might increase the value of rural land holdings without boosting the returns from farming per se, by causing rural land to shift out of farming into higher-valued non-farming uses. Economically speaking this is an efficient outcome, given DoC policies, and it creates added incentives for higher productivity on remaining farm land. There would therefore be merit in examining the impact of DoC land purchases on land productivity, to determine if purchases of certain classes of land, or certain types of purchases, are more beneficial than others for the productivity of both DoC and adjacent land.

Similarly, decisions by DoC to allow or not allow tourism activities on DoC land can have effects on tourism operators on adjacent farm land. In this case it is likely that there are significant complementarities between tourism on DoC land and tourism on adjacent farm land. It could be worthwhile examining the extent of any such complementarities – or of any direct competition – between such tourism activities, to determine whether DoC's tourism concession policies might be refined to enhance rural tourism opportunities without compromising DoCs conservation objectives.

Institutions Affecting Productivity of Maori-Owned Land

The productivity of land is also affected by institutions affecting the ownership of land. Most private land in New Zealand is owned under tradable freehold title, and commonly owned by individuals. The ability of landowners to easily trade their property rights is a fundamental means by which economic efficiency in land use can be achieved – with land tending to trade to its highest valued use over time. Moreover, owner-operated farming the world over is regarded as an efficient solution to incentive problems in agriculture. However, significant areas of agricultural land in New Zealand are corporately owned, and/or not easily tradable (and hence not easily capable of being used to raise mortgage finance), by virtue of institutional ownership and governance arrangements affecting Maori-owned land.

Te Ture Whenua/Maori Land Act represents such an important institution affecting the productivity of rural land. It provides for the creation of corporate ownership structures for different classes of land owned by Maori, and places restrictions on the alienation (as defined in the Act, including the granting of short-term leases, mortgages, etc) of such land. The Maori Land Court is responsible for determining matters of ownership regarding Maori land, and has powers to intervene in the governance of collective entities responsible for managing such land. The Act was passed in 1993 in part as a reaction against previous institutions, notably the Native Land Court, the purpose and effect of which was to convert corporately owned Maori land into individually owned land that was then more capable of being acquired off Maori. The result of the Native Land Court system was the wholesale dispossession by Maori of their land. While understandable, the reaction contained in Te Ture Whenua/Maori Land Act now places significant burdens on Maori land management that diminishes its productivity. Table 4.6 summarises the land types defined in Te Ture Whenua/Maori Land Act and their associated alienability.

Table 4.6 – Land Types and their Alienability under Te Ture Whenua Maori/Maori Land Act

Land Type	Alienability under Part 7 of Act
Maori customary land	Inalienable under the Act
Maori freehold land	Restricted by Act
General land owned by Maori	Not restricted by Act
General land	Not restricted by Act
Crown land	Not restricted by Act
Crown land reserved for Maori	Not restricted by Act

Source: www.legislation.govt.nz.

Under section 171 of the Act any contract for the sale or removal of any timber, flax, minerals, or other valuable thing attached to or forming part of any land is also deemed an alienation and subject to restrictions.

To illustrate the scale of the potential issues with Maori-owned land, Sanderson (2002) puts the total number of titles involving Maori land at more than 25,000, with an average size of 58 hectares, and an *average* of 62 owners per title. With 2.3 million total ownership interests, this compares with the ownership of the other 94% of the New Zealand land area (Controller and Auditor-General (2004)). Whitehead and Annesley (2005) report that 50% of Maori land blocks have not been surveyed, and up to 30% of Maori land is hard to access.

Kingi (2000) reports that the greatest concentration of Maori land occurs in the East Coast of the North Island, Bay of Plenty, and the Central Plateau Regions, much of which is of lower productive potential than other farm land. Evidence from Harmsworth (2003) confirms this, with more than 80% of Maori land unsuitable for agricultural land use (classes 6, 7 and 8), and of poorer quality of average New Zealand land, as detailed in Table 4.7.

Table 4.7 – Harmsworth (2003) Evidence on Maori Land Use Capabilities

Land Use Capability Class	2002 Maori Land Area (ha)	% of Total NZ Land	% of Maori Land	Description of Land Use Capability
1	2,771	0.7%	0.34%	Most versatile multiple-use land – virtually no limitations to arable use
2	18,419	4.6%	2.25%	Good land with slight limitations to arable use
3	40,339	9.2%	4.9%	Moderate limitations to arable use restricting crops able to be grown
4	81,147	10.5%	9.9%	Severe limitations to arable use. More suitable to pastoral and forestry
5	3,386	0.8%	0.4%	Unsuitable for cropping – pastoral or forestry
6	275,484	28.1%	33.7%	Non-arable land. Moderate limitations and hazards when under a perennial vegetation cover
7	259,370	21.4%	31.7%	With few exceptions can only support extensive grazing or erosion control forestry
8	127,023	21.8%	15.5%	Very severe limitations or hazards for any agricultural use
Other	9,927	3.0%	1.2%	Non-arable land. Moderate limitations and hazards when under a perennial vegetation cover
Total	817,866	100.0%	100.0%	

Source: Harmsworth (2003).

Te Puni Kokiri (2002) reports 64% of all Maori land is managed through Maori trusts constituted under Te Ture Whenua Maori /Maori Land Act – 50% (750,000 hectares) by Ahu whenua Trusts and 14% (210,000 hectares) by Maori Incorporations. According to Kingi (2005), Maori are New Zealand's largest collective group of corporate farmers. By contrast, while state-owned Landcorp Farming is a significant exception, most other farming in New Zealand remains owner- or family-operated.

Menard and Klein (2004) observe that, unlike virtually every other mature industry, farming has remained a largely family-owned business. They explain this in terms of agriculture's seasonality and randomness, which complicates the design and enforcement of effective incentive contracts. As a result, having farmers or farm families as owner-managers outperforms joint ownership arrangements such as corporations. Consequently, it should come as no surprise if corporately-owned farms on Maori land are less productive than owner-operated farms on non-Maori land.

While comprehensive research on the question is not available, survey evidence in Ussher (2002) reports that Maori-owned farms in Northland were operating at 65% of the profitability of non-Maori owned farms. While conservative stocking policies were implicated, other factors identified in the report included:

- Governance issues;
- Poor access to independent information and advice;
- A lack of education and training in new technologies;
- Access to skilled managers and workers;
- Limitations of the land such as topography, soil fertility, drainage, etc;
- Responsiveness to market signals; and
- Restricted access to development capital.

The first and last of these in particular are explicable in terms of the restrictions imposed on Maori-owned land under Te Ture Whenua Maori, and can be expected to strongly influence the productivity of such land. Similar analysis by Livingston (undated) on behalf of MAF using data from Central North Island dairy farms also finds farms on Maori land to face capital constraints, resulting in lower gearing ratios and greater use of share-milking arrangements (presumably to lessen capital requirements). With such farms having to sacrifice a greater share of farm returns to sharemilkers, and also facing higher administration costs (presumably as a consequence of multiple ownership), it is no surprise that such farms reported lower farm surpluses than farms on non-Maori land.

To complicate matters further, where Maori landowners die intestate, their interests become managed by the Maori Trustee. Controller and Auditor-General (2004) reports that the Trustee is responsible for administering 7% (106,000 hectares) of Maori land, involving 111,000 client accounts, of which only 37% have valid addresses or bank accounts. This implies that the land

associated with the balance is essentially un-owned. Maori Affairs Select Committee (2001) unsurprisingly records that the Trustee has delivered a “mixed” financial performance, and identified issues to do with the Trustee’s accountability.

The ownership and control of Maori land is a sensitive and important issue. Maori will naturally be reluctant to risk losing what little land remains under their control, and hence can be expected to resist adopting more tradable ownership rights, and taking on higher levels of debt for on- and off-farm investment. A challenge is to identify how these issues can be addressed while simultaneously providing Maori landowners with their requisite level of ownership security.¹⁰ Corporate ownership of Maori land is also an historical artefact that is hard to avoid. The fact remains, however, that this presents very real tradeoffs in terms of the productive use of Maori land, much of which is already of marginal land use capability.

Given the range of issues raised in just this one area and considerable sensitivity of the subject we hesitate to suggest more than that considerable further research into the nature and causes of any productivity deficits on Maori-owned land be undertaken. This will likely implicate governance and land tradability issues, as well as ownership security issues, and so research into addressing these particular issues is warranted. At the very least this will also require much better data collection on Maori land ownership and farming activities, to facilitate identification, measurement and resolution of any problems.

Crown Forest Assets Act

MAF (2006) reports that there is currently around 490,000 hectares of plantation forest – 27% of the land in exotic forests – owned and managed via a special class of cutting rights called Crown Forestry Licences (CFLs), of which there are 71. To protect possible Maori interests in forest land owned by the Crown, the Crown Forest Assets Act (CFAA) mechanism was implemented in 1989. This enabled the Crown to privatise its softwood plantation forest assets through the sale of CFLs while retaining ownership of the associated land for possible inclusion in Treaty settlements. As a consequence of the Treaty settlement negotiations process, various iwi (tribes) are increasingly assuming ownership of the land beneath CFLs. As they do, termination notices are given to CFL licensees in accordance with the CFAA and CFL provisions, requiring them to surrender their licences in respect of forest areas no longer required for their ongoing forestry operations, and to complete doing so within 35 years of receiving such notice. In this way unencumbered ownership of such lands successively returns to those iwi. In some instances the Treaty settlement process has resulted in CFL land being deemed not liable to return to Maori, in which case the Crown is free to deal with that land as it would any other Crown land.

¹⁰ Similar issues in respect of the governance of Maori fisheries assets are addressed in Meade (2003).

The CFAA regime is clearly a compromise regime intended to preserve possible Maori interests in forest land owned by the Crown while allowing licensees a measure of ownership security over their tree crops via CFLs. Additional aspects of this compromise relate to what use CFL land can be put to before and after a termination notice is issued to licensees, and what compensation must be paid to licensees at the conclusion of their lease.

Prior to a termination notice being issued to a licensee, standard CFL terms permit the licensee to use the land for any purpose (subject to normal land use rules). However, once a termination notice is given CFL land can only be used for forestry purposes. Additionally, should CFL land be deemed liable to return to Maori and a termination notice is given, the new iwi owners are not obliged under CFL terms to compensate the licensee for any improvements remaining upon the land at the end of the CFL term. Conversely, if the land is deemed not liable to return to Maori, the Crown may issue a 35 year termination notice at any time, in which case only forestry activities may be undertaken from then, but if it does so, it must compensate licensees for any improvement remaining at the end of the CFL term.

As a consequence licensees face hold-up risk if they make any improvements to the land which they cannot realise before their CFL ends, or if they make non-forestry improvements that are not permitted, after the land is deemed liable to return to Maori and a 35 termination notice is given. This risk will therefore cause them to invest less in the CFL land than they might if they were not subject to such a hold-up risk. Ironically, iwi who would be owners of such CFL lands might prefer that licensees make such extra investments, but they are unable to give ex ante assurances to licensees that they will agree to vary the CFAA requirements should they become licensor (because they cannot guarantee they will be able to secure the land via settlement negotiations).

Given the significant share of New Zealand's forest estate affected by the CFAA mechanism, it would be worth exploring whether this hold-up problem can be ameliorated with the agreement of affected iwi and licensees, prior to CFL land being returned to iwi. This would be no small task, but it might enable improvements to CFL land that improve forest sector productivity, or alternatively, enable CFL land to be put to higher-valued use pending settlement of Treaty claims, to the benefit of iwi, licensees and the Crown.

Tenure Review

As mentioned above, the Tenure Review process established under the Crown Pastoral Land Act allows leaseholder farmers to negotiate the conversion of their leasehold interest into freehold, in exchange for ceding parts of their leasehold area having heritage and conservation values to the conservation estate. Where this exchange does not adequately compensate them for ceding their leasehold interests, top-up compensation is also negotiated. The existing leases have 33 year

terms with a perpetual renewal right enjoyed by the lessee. However, they also limit the use to which the leased land can be put – allowing only pastoral farming, and even then with restrictions as to stocking, burning and tillage.

The Tenure Review process therefore provides a possible “win-win” outcome for both the Crown and lessees. It represents an important institutional innovation, removing an impediment to higher-valued land uses, at least in respect of freeholded areas. Leaseholders become landowners, and can then make their own tradeoffs between farming, tourism and other land uses on the freeholded areas, including possible subdivision of land areas adjacent to waterways. The Crown and conservation lobbies are able to add sensitive or significant land areas to the conservation estate that could otherwise be subject to pastoral farming in perpetuity at leaseholders’ election.

The process is not without its critics, however, not least those who dislike the notion of residential subdivision beside alpine waterways. However, the proper counter-factual under existing arrangements is not that those waterways remain undeveloped and are publicly available; it is that they are used for pastoral farming and with leaseholders entitled to restrict access across their land to those waterways. Furthermore, retiring leasehold areas from agriculture can have the perverse effect that introduced weeds that were controlled by grazing then proliferate on land newly added to the conservation estate.

Alternatively, Quigley (2004) argues that the excision of leasehold areas and their addition to the conservation estate is an unduly restrictive means of achieving the preservation of heritage and conservation values. He suggests that conservation objectives could be adequately achieved through the use of land covenants while allowing leaseholders to freehold their leasehold interest. That way the landowners would have greater land use options available to them (those denied by adding relevant areas to the conservation estate) while ensuring conservation objectives are met. This would also involve less fiscal cost to the Crown, as it would pay less compensation to leaseholders for excised land areas, and might even receive net consideration for agreeing to the change. Such an approach would allow greater areas of land in the South Island high country to be put to higher-valued uses.

We therefore suggest that covenanting be examined as an alternative or addition to the current Tenure Review process of transferring areas of leasehold land to the conservation estate, in order to enhance the overall productivity of the affected land areas while also meeting desired conservation and heritage objectives. Indeed, covenanting for the protection of sensitive areas on private land is already an option used by DoC, so in principle such a variation would not be novel.

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Landcorp Farming

Landcorp Farming is New Zealand's largest corporate farmer, with over 1.5 million stock units. It is also state-owned, under the State-owned Enterprises Act, with principally commercial objectives. Unlike other corporate farmers, it owns farms throughout the country, and increasingly it operates them on an integrated basis. Unlike many Maori corporate farmers, Landcorp is free to raise debt capital by granting mortgages over its land holdings, since it is not required to retain land ownership. Indeed, it sometimes sells farms from its portfolio and acquires other farm land. It is also contracted to manage a large area of Central North Island forest land that is being deforested and converted into dairying by private landowners. Most of its dairy land is operated under 50:50 sharemilking agreements, which can be useful devices to mitigate some of the incentive issues associated with corporate farm ownership.

Landcorp is an unusual artefact of the corporatisation and privatisation processes of the 1980s and early 1990s. Like many other commercial state assets of the area, it might have been sold to private parties, but instead remained in the Crown portfolio, and is not likely to be offered for sale under current government policy.

As a large, integrated corporate farmer Landcorp boasts of being able to increase revenue by stocking and land use changes, boost productivity through genetics, nutrition and technology transfer, and enhance its asset efficiency through rationalisation of its farm portfolio. It provides a useful counter-example to more common farming practice in New Zealand – that based around owner-operator farms, although increasing corporate ownership is arising. It also provides a benchmark that could be used for performance comparisons with other corporate farms, such as Maori-owned corporate farms.

As such, Landcorp presents some useful angles for further inquiry. Landcorp's performance could be compared with that of non-corporate farms to determine if there are clear advantages or disadvantages with either approach, so that either model could be improved by what is learned. Similarly it could be used along with owner-operated farms as relevant comparators in determining the extent of any productivity shortfall on Maori-owned corporate farms, as suggested above. Alternatively, by offering it for sale to private owners a natural experiment would arise in that the new owner would be free to either persist with the existing corporate model or either refine or abandon it, without political constraints on how best it was redesigned.

Conclusion

Flexibility in changing land into higher-valued uses (such as multiple land uses) – including the ability to transfer land ownership to users with superior information, incentives and abilities – are

key institutional characteristics conducive to agricultural sector productivity and growth. In the main, New Zealand has a number of institutional features supporting that flexibility. However, it also has a number of institutional features impeding that flexibility. In places these impediments are a natural consequence of the tensions between social and environmental goals that cannot or are not managed on a decentralised market basis, bringing administrative decision processes into the fore. Alternatively they reflect cultural concerns about land ownership security, or embedded historical accidents from the colonisation process. In some respects, however, these impediments are amenable to review, testing and ongoing refinement. We hope that our suggestions above give useful guidance on which questions might best be examined in order to enhance agriculture sector growth and innovation.

One important further area affecting land use flexibility not yet discussed is climate change policy. Given this subject's importance we defer that discussion to Section 4.4. Next though we turn to institutional factors relating to other factors of production, namely labour, capital and water.

4.3.2 Labour

Characteristics and Key Institutions

Labour as a productive factor combines many ingredients – the total working age population, labour force participation rates, hours worked, skill levels, work ethics and the like. Some such factors are amenable to policy influence, such as mortality rates through health provision, immigration through immigration policy, participation rates through childcare subsidies, skill levels through education policy, and work ethics through laws against theft and fraud, hiring and firing constraints and social welfare parameters, etc. In turn the cost of labour, affecting its mix with other factors such as capital in the productive process, can be influenced by policy also. Minimum wages and holidays, anti-discrimination or pay equity laws, centralised bargaining requirements, and so on.

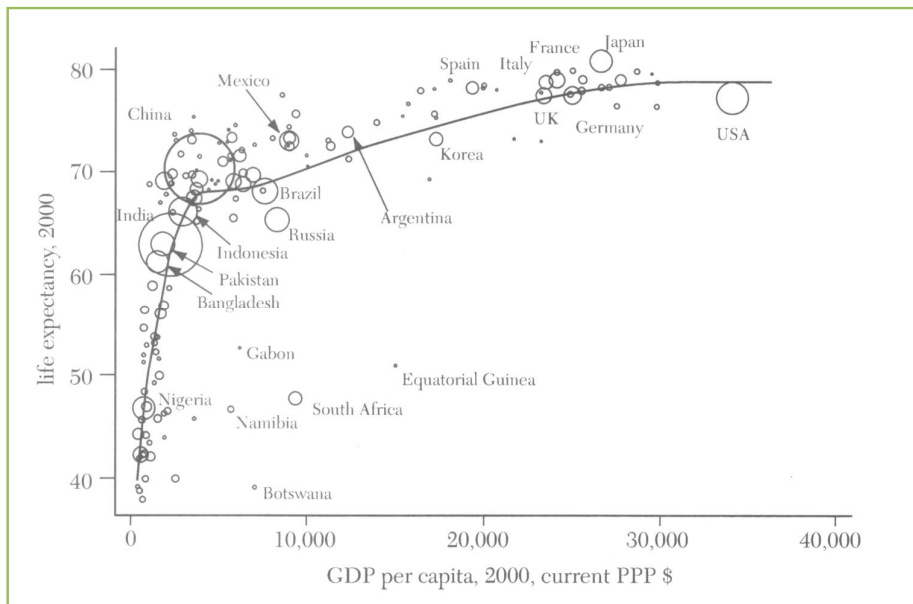
Important institutions affecting these matters include the Health Act, Education Act, Employment Relations Act, Holidays Act, Immigration Act, and Human Rights Act, along with their associated policies. It is beyond the scope of this report to provide a detailed assessment of each of these key institutions, and a good summary of relevant issues can be found in Treasury (2004). We instead provide high-level discussions on matters such as health, education, and employment regulation, also touching on issues relating to seasonal labour supply since these feature prominently in the horticulture sectors in particular.

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Health

In 2000 the World Health Organization took a lead in advancing research into the growth effects of health by setting up the Commission on Macroeconomics and Health (CMH). The CMH's purpose is to “analyze the impact of health on development and examine the appropriate modalities through which health related investments could have a positive impact on economic growth and equity in developing countries.” Deaton (2003) surveys the relevant literature, concluding that while income differences do not cause health differences per se, the question of causation from health to economic growth is still not settled. The following graph reproduced from Deaton (2003) illustrates the clear correlation between health status (proxied by life expectancy at birth (LEB)) and income per capita. The relationship is clearly most sensitive for countries with poor health status and low income.

Figure 4.2 – Deaton (2003) Association between Income and Health



Source: Deaton (2003).

Table 4.8 overleaf summarises research on the association between health and growth (and other variables).

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Table 4.8 – Summary of Research between Health Status and Economic Growth

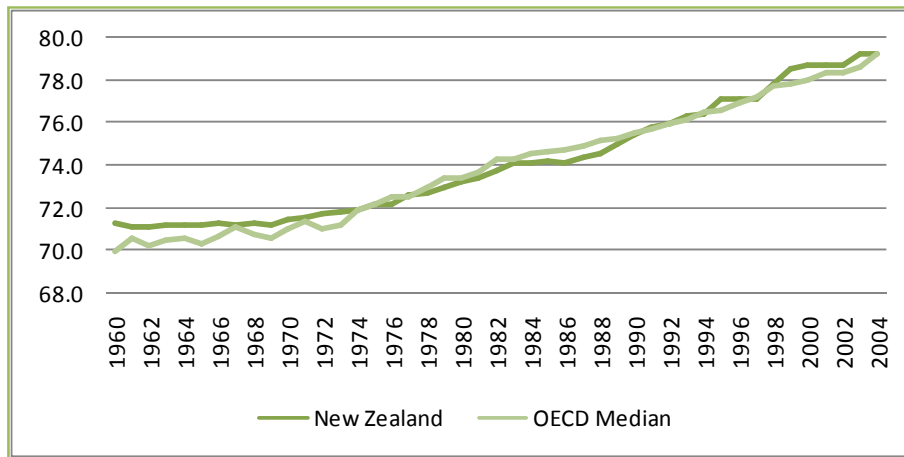
Study	Data	Estimates
Bloom and Sachs (1998)	Africa versus rest of world 1965 – 1990	Annual percentage growth gap between countries X and Y = $3.5 \times \{ \ln(\text{LEB}_X) - \ln(\text{LEB}_Y) \}$. Thus the growth gap for LEBs of 77 and 76 would be 0.05% p.a.
Barro and Sala-i-Martin (1995)	122 countries (including NZ) 1965 – 1985	13 year increase in LEB estimated to increase growth by 1.4% p.a. (Crudely, 1 year increase in LEB adds 0.11% to annual growth).
Bloom et al. (2001)	Panel of countries 1960 – 1990	1 year increase in LEB adds 0.04% to annual growth.
Bhargava et al. (2001)	100 countries 1965 – 1990	1% change in adult survival rates adds 0.05% to annual GDP growth for low-income countries, but negative change indicated for high income countries.
Sachs et al. (2001)	Various	Malaria prevalence associated with growth decline of 1% or more p.a.
Gertler and Gruber (2002)	Indonesia 1991 and 1993	Illness associated with a 0.84% decline in baseline consumption.
Strauss and Thomas (1998)	US and Brazil 1992	Brazilian males enjoy almost 8% higher income (uneducated males 4%) for 1% extra height.

Note: LEB = life expectancy at birth, used to proxy health status.

As indicated by these estimates, significant growth differences can be predicted for countries with large differences in LEBs. However, for most developed countries, only small growth improvements can be predicted for incremental gains in their population's health status. Turning to New Zealand in particular, life expectancy variations are relatively small (see, for example, life expectancy tables by gender, ethnicity and region published by Statistics New Zealand). Moreover, New Zealand's LEB compared favourably with that in other developed countries, as illustrated in Figure 4.3 overleaf.

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Figure 4.3 – New Zealand LEB versus OECD Median 1960-2004



Source: www.oecd.org.

This suggests – as for New Zealand’s institutions generally – that there are unlikely to be obvious improvements to New Zealand’s health-related institutions that could markedly improve LEB, and thereby, to materially improve the country’s economic growth. There is, however, evidence of differences in the quality of health services in rural and urban areas, and of regional differences in LEBs (for example, a lowest average regional LEB of 73.3 years in Gisborne, versus the highest of 77.8 years in Canterbury).

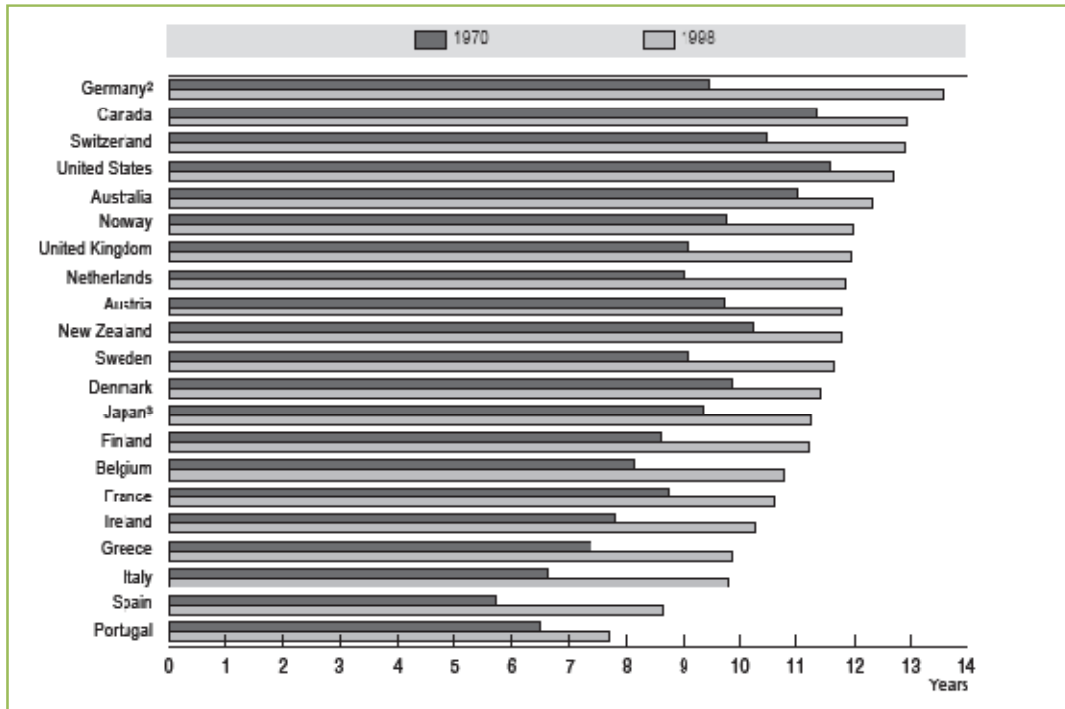
While even these differences do not predict sizeable growth gains from improving health status in the lower-scoring regions, the fact of ongoing issues in rural health service delivery might be a constraining factor in attracting skilled workers into rural areas. Hence research into whether or not the availability of quality rural healthcare is constraining the recruitment and retention of rural workers might reveal if refinements are required to rural healthcare delivery in order to support agriculture sector growth and innovation.

Education

Bosworth and Collins (2003) report only a weak influence of education on growth, but other studies such as those of Bassanini and Scarpetta (2001b) report sizeable income effects. Using data for 21 OECD countries (including New Zealand) over 1971-98 they estimate that the estimated long-run effect on income of one additional year of education is about 6%. Moreover, as discussed in Section 3, Aghion and Howitt (2005) argue that a higher human capital stock should foster growth by enabling countries to catch up with the technology frontier. Higher education should thus make a bigger difference for countries close to the technology frontier, while primary and secondary education should be of greater benefit to less advanced economies. This is possibly more relevant to the agriculture sector in New Zealand than it is in others, given the country’s current high levels

of agricultural productivity. Treasury (2004) reports that New Zealand has a wider variation in educational outcomes than other OECD countries, although it ranks relatively favourably overall. The latter is demonstrated in Figure 4.4.

Figure 4.4 – OECD Average Years of Education for Working Age Population 1970 and 1998



Source: Bassanini and Scarpetta (2001a, p. 15).

As for the health discussion above, there is unlikely to be obvious institutional approaches to boosting New Zealand workers' educational status in any sizeable way. Calls for raising the school leaving age merit further consideration, given the human capital demands of today are significantly higher than they were when the current leaving age was determined. However, the possible gains in growth terms are possibly slight, and Treasury (2004) suggests that improving the educational attainment of the country's lowest achievers would have uncertain growth payoffs.

As for R&D in New Zealand, it is possibly more important that the country imports skilled human capital as much as it develops it, provided the local stock of human capital is adequate to absorb the value of imported skills. In this regard the factors identified by Sheehan and Wyckoff (2003, p. 31) as being important for internationally skilled innovators remain pertinent. They include "social capital in the form of well-functioning institutions, a trusting environment between businesses and governments and basic infrastructure such as communications and education ... [and] quality-of-life factors that make a location appealing to a cadre of innovators who are highly mobile."

Labour Market Regulation

We have already referred in Section 3 to the evidence in Bassanini and Ernst (2002) examining the interplay between labour market institutions, product market regulation and innovation. They found that labour market flexibility is associated with higher R&D intensity in all countries with decentralised wage-bargaining or little coordination, though a negative association arises in countries with coordinated industrial relations in industries having a more cumulative knowledge base. Since the former more closely describes New Zealand's arrangements, we would assume that greater labour market flexibility is desirable for innovation and hence growth.

Botero et al. (2004) investigate labour market regulations in 85 countries (including New Zealand), and whether such regulations can be attributed to efficient responses to market failures, the political leanings of governments, or to the origins of countries' legal systems. While they find evidence in support of the efficiency argument, they note that tighter labour market regulation has adverse consequences for labour force participation and unemployment, especially for the young. There is also some support for the view that left-leaning governments will favour stricter labour regulation than other types of government. However, the most significant explanation they found for labour market regulation was legal origin, with socialist, French and Scandinavian legal origin countries having much higher regulation than common law countries (such as New Zealand). Moreover, tighter labour market regulation tends also to be associated with tighter product market regulation (i.e. constraints on entry). In comparing labour market regulations in New Zealand and Portugal, these authors generally held New Zealand out as being at the relatively flexible end of the labour regulation spectrum.

As discussed in Treasury (2004), the shift in New Zealand from the Employment Contracts Act to the Employment Relations Act represents a net reduction in labour market flexibility, but that the effects to date have been limited. For this reason, and given the evidence from Botero et al. above, there is unlikely to be any simple institutional innovation that could be expected to improve agriculture sector growth and innovation.

There is, however, very little research available on the effects of the change to the Employment Relations Act. Borland (2005) provides a framework for such research to be progressed, but to date such research has not been published. We therefore suggest that the growth and innovation impacts of New Zealand's labour market regulations should be conducted periodically to determine whether refinements are warranted. Such research could include assessment of the effect of the Holidays Act provisions on seasonal employers in agriculture, such as meat processors, as well as the wine, apple and kiwifruit sectors.

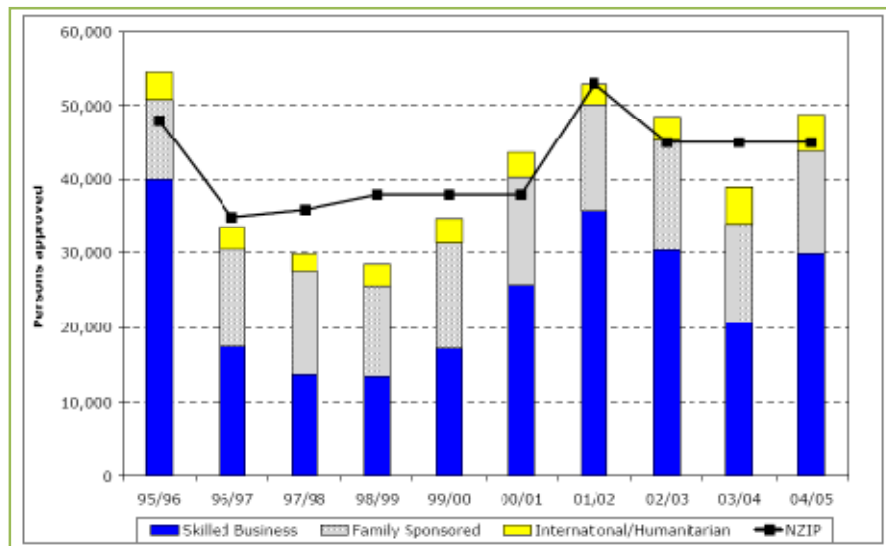
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Immigration and Seasonal Workers

Coppel et al. (2001) review immigration trends and their economic impacts in a sample of OECD countries (excluding New Zealand). Their review suggests that most studies reveal small net gains from immigration to host countries in terms of output per capita, with the distribution of such gains depending on the relative qualifications of the native and immigrant populations. Moreover, most of the countries surveyed have moved to favouring immigration by skilled labour, implying that competition for such labour will also have increased. Finally, immigrants tend to flow into sectors other than agriculture, suggesting immigration policy may not be effective in meeting agriculture sector labour shortages.

Evidence from Moody (2006) indicates that the bulk of immigration into New Zealand is in the skilled business category, as illustrated below. However, she suggests that New Zealand's immigration policies are in some respects directed towards minimising immigration impacts on native workers, which may have efficiency implications affecting growth. Indeed, evidence from Europe following the accession of 10 new countries to the EU in 2004 show that those countries that opened up their labour markets to workers from those countries – Ireland, Britain and Sweden – experienced strong growth. Purvis (2007) cites research attributing two percentage points of growth in Ireland to migrant workers, and migration to Britain for a 0.25% increase in forecast growth over the next five years.

Figure 4.5 – New Zealand Residence Approvals 1995/6 to 2004/5



Source: Moody (2006, p. 6).

Note: NZIP = Immigration Programme.

MoRST (2006) assesses the migration of skilled people to and from New Zealand over the decade to 2004. Its findings are not discouraging. People with university-level qualifications comprise 30-

40% of long-term migrants to and from New Zealand, with a slightly higher figure for incoming migrants, implying a possible net gain in skilled migrants. While New Zealand loses skilled workers to Australia, it gains them from the UK, Asia and North America. All-in-all the evidence MoRST presents suggests a “brain exchange” rather than a “brain drain”.

While the skill composition of net migration to New Zealand appears positive for innovation in New Zealand agriculture, certain sub-sectors face ongoing issues in securing seasonal workers. These include apples and kiwifruit, as well as grapes/wine. Meat processors identify issues more with the cost of labour than with its availability, perhaps reflecting a more stable, unionised workforce. The horticulture sectors, however, complain of inconsistent and low-skilled seasonal workers, and have expressed reluctance in making investments in secure seasonal labour supply. Increasingly, however, steps have been taken to improve seasonal labour force coordination in these sectors, for example with some horticultural operators sharing the cost of short-term housing facilities.

The government’s Recognised Seasonal Employer Scheme has been established to enable up to 5,000 Pacific Island workers (excluding Fiji) to work in these seasonal industries, however, when the scheme commenced in May 2007 only one employer was able to satisfy the required criteria, whereas in Marlborough alone more than 3,500 workers are required for pruning grapevines for six months from that month.¹¹ Eligibility requirements include the provision of accommodation, raising concerns about compliance costs, and prompting employers to consider sharing such costs.

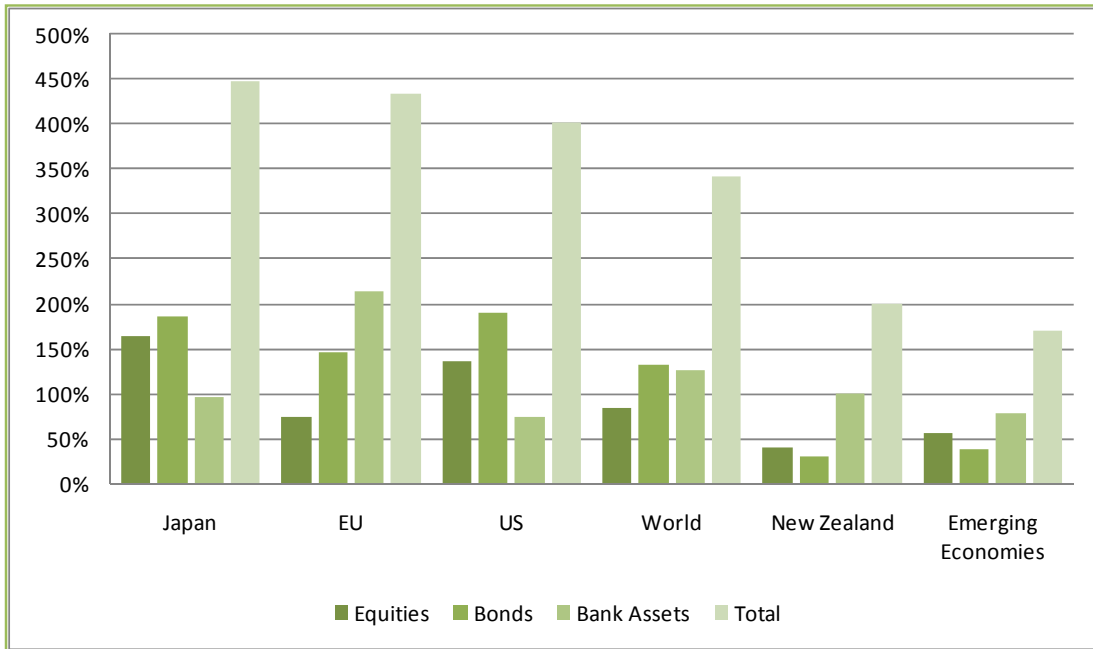
While this scheme offers one solution, another would be to take a much more flexible stance on the employment of other transitional labour supplies such as backpackers and other holidaymakers. Yet a fairly hard stance has been taken in recent times towards the employment of “illegal” workers. We suggest that immigration and temporary holidaymaker work rules should be re-examined to ensure they give sufficient priority to agriculture sector growth considerations over apparently misplaced concerns about native worker displacement. If there were native workers being displaced by backpackers working in orchards and vineyards, then surely there wouldn’t be a seasonal labour shortage.

4.3.3 Capital

Figure 3.7 shows that the New Zealand venture capital industry grew significantly over 1995-00, and in 2000 compared favourably with a number of other OECD countries. Figure 4.6 overleaf provides another snapshot of the relative degree of financial market development in New Zealand.

¹¹ “Seasonal Plan Yields One Eligible Employer”, *The Dominion Post*, 17 May 2007.

Figure 4.6 – Capital Sources as Percentage of GDP



Sources: IMF (2006), www.nzx.com www.rbnz.govt.nz.

Compared to the US, EU and Japan New Zealand’s total capital market size as a percentage of GSP is relatively small. The country’s capital mix is also skewed more strongly towards banks assets than in other developed countries, and its equity market is relatively small. This is not inconsistent with the evidence in Allen et al. (2006) discussed in Section 3. They predict and find that economies dominated by physical assets-intensive firms tend to have a bank-based financial system, while those with knowledge-based industries and intangible assets-intensive firms tend to have market-based financial systems. The cost of capital may also be relatively high in New Zealand, in part because of relatively high interest rates.

Having said this, New Zealand’s financial market institutions (e.g. investor protections) and monetary policies compare favourably with those in other developed countries, and it has open and free capital markets (locally and in terms of access to foreign capital). Moreover, agriculture sector firms are commonly able to raise debt capital, and often equity capital. While many agricultural concerns in New Zealand lack the scale to justify a listing on New Zealand’s main stock exchange, NZX, a number have taken advantage of lower compliance cost boards such as NZX’s alternative exchange (NZAX), as well as other trading venues such as Unlisted. Larger concerns such as Fonterra and PPCS have debt listed on NZX’s debt exchange, NZDX, or can issue debt directly into overseas markets such as the EuroKiwi market. The land-based nature of many agriculture sector enterprises also means banks can secure loans against land, or in some cases against stock. Hence the liquid supply of capital to agricultural concerns would not appear to be a constraint on agriculture sector growth and innovation. Indeed, investor appetite for

agriculture sector exposure and biotechnology investments make the prospect of supplying capital to these sectors relatively appealing.

If there is a concern with agriculture sector capital access it is possibly more on the demand side, or rather the inclination of cooperative agriculture concerns to raise capital outside of the pool of producer-owners. Evans and Meade (2005) examine this issue and conclude that conventional cooperatives worldwide face difficulties in accessing external capital. However, in New Zealand especially, where a permissive regime exists for refining cooperative structural arrangements, cooperatives have been adept at modifying their ownership form when the costs of the capital constraint outweigh the costs of compromising on the traditional cooperative model. Examples include Fonterra's adoption of New-Generation-Cooperative (NGC) like attributes, and its capital structure review process. PPCS' current high gearing levels have caused some concern in the meat processing sector, but it is exploring merger options with fellow cooperative Alliance which may resolve this, and PPCS' bankers have not yet been compelled to call in their loans despite technical breaches of the company's loan covenants. Third parties have also stepped in to offer financial innovations enabling cooperative owners to realise some of their investment in the cooperative while formally retaining ownership and control (e.g. Dairy Equity, and Dairy Investment Fund). Hence any cooperative capital constraint in these sectors is not carved on stone.

As discussed in Section 4.3.1, capital constraints are potentially tighter for Maori corporate farmers than elsewhere in the New Zealand agriculture sector. Unlike other sectors, these farmers face institutional constraints on their ability to mortgage their land, and to sell it. These constraints are reinforced by social attitudes such as the importance of owning particular land in a particular locale. If there is worthwhile inquiry to be undertaken into agriculture sector capital access in New Zealand then, as in Section 4.3.1, it is this particular area that we would recommend receive attention.

4.3.4 Water

Water Allocation and Ownership

The use of New Zealand's natural water resources for agriculture is governed by the RMA. Under Part 6 of that legislation farmers can apply to regional and local authorities for resource consents (in respect of water, water permits) of up to 30 years in duration, on terms and conditions that the consenting authority imposes under the Act. Such consents are allocated on a first-come-first-served basis, and decisions to grant consents are made administratively (without a requirement to weigh the relative economic benefits of competing uses).

Having said this, water permits are transferable under section 136 of the Act, although with restrictions, and typically are tied to particular uses or land. In practice such permits are traded when land is sold, being bundled with the land. Hence, although the initial allocation is determined administratively, to some degree there is capacity for “Coasian trades” to occur, albeit with possibly high transaction costs, enabling those permits to find their way towards higher and better use (if not outright highest and best use).

Issues can arise, however, in terms of the security of the permits’ terms, with the Environment Court able to change the term of a granted permit ex post (as has occurred on the Whanganui River), and also in terms of the administrative process used to weigh competing demands for water uses. This proved especially problematic on the Waitaki River when determining whether water rights should be granted for Meridian Energy’s Project Aqua” hydro scheme, which faced competition from farmers and recreational users of the river. Not only was there no clear way for the “national benefits” of the hydroelectric development to be weighed against those of farmers and recreationalists, but the process of determining the allocation raised its own issues. One was the cost and uncertainty of the decision process itself, the other was the fact that the security of Meridian’s existing water consents upstream of the proposed development came into question.

Another example of such a contest for water rights is in the Central North Island where existing hydro-generators have opposed increased water allocations to newly created dairy farms on previously forested lands. The Marlborough District also faces increasingly intense competition for water, with winemakers such as Tohu Wines challenging the increased allocation of water rights for residential growth. The need for an efficient mechanism to ensure water rights find their way to highest and best use – whether that be in agriculture or otherwise – is increasingly pressing.

Government’s response to the Waitaki contest has been to consider issuing a national policy statement on water as provided for under the RMA. Such a move would constrain the ability of regional authorities in making decentralised decisions about water allocations, requiring them to administratively weight wider national considerations with local ones. An alternative solution, and one which has received substantial analysis in New Zealand, is a shift towards a national market in fully tradable water rights such as those already established or being established in other countries. Examples of such analysis include Begg (1995), Ford et al. (2001), Counsell and Evans (2005) and Hawke (2006).

While government announcements indicate an intention to improve the transferability of water permits – a positive step enhancing the ability of water users to trade such rights to their best use – this goes only part of the way.¹² One apparent obstacle to an open debate of a national water market is a political unwillingness to discuss the private ownership of water. This appears to stem

¹² “Guidelines Set to end Water Free-for-All”, *The Dominion Post*, 11 April 2006.

from a public perception that water is either special or some sort of birthright. It also appears to reflect fears of a possible confrontation between the government and Maori over customary ownership of water (similar to the one government yielded to in 1986 when implementing the Quota Management System (QMS) for fisheries).

This political unwillingness manifests itself in government assertions that it “manages” New Zealand’s water resources on behalf of all New Zealanders, although ministers occasionally substitute the word “owns” for “manages”. It is also reflected in an apparent fiction created by the RMA itself that declares water permits (like resource consents) to not be real or personal property (section 122). However, the very nature of a water permit – an exclusive right to take water for economic use and to transfer that right to others for consideration – bears the key hallmarks of a property right in economic terms. And even section 122 pares back its disclaimer by affording such permits the status of property for certain purposes (sub-sections 2 and 3). While the government’s wariness of picking fights over water ownership can be understood, this does not change the fact that water is already privately “owned” to some degree in New Zealand, and can be sold. It is ironic that most New Zealanders do not question the desirability of tradable land ownership, or of tradable food ownership, but are wary of tradable water ownership. No one “makes” land in the same way that no one “makes” water, and food is just as essential for life as water, yet an open debate about water ownership in New Zealand encounters significant stumbling blocks.

That water can and is owned outright in New Zealand is further demonstrated by the fact that once natural water has been abstracted or dammed under a water permit, the party that possesses the water can do whatever they please with it within the terms of their consent. If they were entitled to bottle the water, they would indisputably have private property rights in the bottled water for so long as they retain its possession. If they convert abstracted or dammed water into milk or grapes, they certainly own that water in its transformed state, and can sell it to whomever they please. If they own shares in a private irrigation scheme that entitle them to take some share of the water stored from that abstraction or damming, they can sell their right to that stored water to third parties by selling their ownership in the irrigation scheme, even if the associated stored water outlives the original water permit (illustrating how time-limited water permits do not imply time-constrained water ownership rights).

The potential for Maori to challenge the private ownership of water under the Treaty of Waitangi remains, and would appear to exist even if the government does not seek to improve existing allocation mechanisms and water permit tradability. This suggests that to some extent any reluctance to advance the development of a free, transparent and flexible national water market is misplaced. In any event, even if some or all natural water in New Zealand should be found to belong to Maori, and if government decided to recognise such rights as it did in the establishment of the QMS, this need not upset existing water rights, and at most may simply involve a change in “landlord”. Open questions remain as to how water should be charged for – an issue that

government will need to confront in any event as scarcity value in water continues to rise (as is amply demonstrated when dry winters lead to significant spikes in wholesale electricity prices).

Given this discussion we hesitate to suggest that further research is required (although no doubt it is), because a significant amount of existing research already indicates problems with the existing administrative allocation mechanism under the RMA, and the potential desirability of a free and transparent tradable water market. There appears to be an acknowledgement of the question, but a political reluctance to consider the answer. Until this impasse is resolved inquiry should be directed towards refining the administrative allocation mechanisms under the RMA, such as introducing an economic benefits test in competing applications for permits, and to enhancing tradability of such permits.

Water Quality

New Zealand receives a relatively poor rating for maintaining its water quality.¹³ Increasingly intensive farming – in relation to both fertiliser use and animal waste – has received significant attention as a cause of degradation to water ways. In part the problem of water degradation reflects imperfections in the property rights regime for water ownership implemented under the RMA. Where water is imperfectly owned and exhibits elements of a commons, private parties have reduced incentives to monitor water degradation, to avoid it happening to their water rights, and to seek damages from third parties causing degradation. Hence, it is worth examining whether better definition of water ownership rights might go some way towards creating stronger private incentives to avoid water quality degradation.

The RMA is the currently primary institution through which such degradation is regulated. Environment Waikato's nitrate "cap and trade" scheme represents a hybrid market- and administrative-based solution to managing such degradation. Deforestation restrictions imposed by Horizon Regional Council in respect of forests in hill country susceptible to soil slip erosion exemplifies the alternative administrative approach. Under each approach some measure of administrative determination is required as to the permissible level of degradation, but beyond that there is a choice between market-based and administrative policy instruments for achieving that level. To some degree experimentation is both required and warranted to best determine how to design and implement such mitigation schemes. We suggest that thought be given to trialling mixtures of hybrid market and administrative approaches in different regions where clear methods and policy instruments are not available, as a means of identifying the most efficient approaches. Furthermore we recommend that administrative decisions regarding optimal levels of degradation be determined based on economic as well as scientific criteria, as the economically optimal level

¹³ "NZ's Water Pollution Record Slammed in International Report", *New Zealand Herald*, 5 April 2007.

of degradation will be positive provided both the costs of mitigation and profits from degradation are positive.

Coordination Mechanisms to Mitigate Consequences of Droughts?

On a related note, experience with droughts in both New Zealand and Australia (particularly in the lamb sector) demonstrates the negative externality suffered by producers when stock is dumped on the market for lack of feed. With climate change predicted to increase the frequency and severity of droughts in some parts of the country, this may become an increasingly frequent issue.

It might be worth exploring some sort of stock feed coordination mechanism to ensure that supplies of feed can be better used in times of drought. Alternatively, some form of market instrument to ration spikes in the number of stock sent to slaughter during droughts could similarly relieve this negative externality.

4.4 Climate Change Policy

It is still unknown what shape New Zealand's domestic policies will take for meeting the country's Kyoto Policy obligations in the first commitment (CP1) period running from 2008 through 2012. Since 2002 various policy elements have been announced, and in some cases remain in force (e.g. the government retention of carbon credits and harvest/deforestation liabilities in respect of forests, and of emission liabilities in pastoral agriculture). Other policy elements have been abandoned (e.g. the proposed carbon tax on energy).

Following a major review of climate change policy setting in 2005, the government has signalled two broad future directions for climate change policy development:

- Carbon emissions will be priced within and beyond CP1; and
- All sectors (forestry, agriculture, transport, and energy) will face cap and trade regimes for carbon emissions from 2008.

Having some measure of clarity about these directions is to be welcomed after five years of policy uncertainty and about-faces. It comes too late to mitigate the strong incentives already created under the Kyoto Protocol to deforest pre-1990 forests ("non-Kyoto forests") before 1 January 2008, incentives made worse by certain earlier policies as well as uncertainties about those policies (e.g. see Meade (2006)). However, it gives a clearer signal to parties making long-term investments that they need to factor carbon costs into their investment decisions.

However, considerable uncertainty remains. Precise details of New Zealand's climate change policies are still unresolved on the eve of CP1, for example regarding the level of sector-specific emission caps both initially and over time, whether or not emission rights will be tradable across sectors, and how emission rights will be allocated both initially and over time. Details of the Kyoto Protocol's successor regime beyond 2012 are yet to be agreed internationally, and may change the parameters if not the form of any domestic mitigation programmes. And even if all of these details were known right now, sectors subject to the new regime cannot know what prices will arise under the cap and trade schemes, and hence have only limited ability to factor carbon costs into their investment decisions.

Because of the latter there remains merit in considering a broad-based carbon tax instead of a cap and trade scheme, made revenue neutral through offsetting reductions in other forms of tax (particular distortionary taxes such as income tax, given their adverse impact on growth). While the cap and trade model offers certainty as to the permitted level of emissions, it does so with an uncertain carbon price and hence may be economically more burdensome than a carbon tax. A carbon tax provides investors with certainty as to the carbon price they will face, while the level of emissions achieved by the tax is uncertain. Certainly investors face the risk of changes to the future level of any carbon tax – particularly where property rights are not constitutionally protected – but experience with the European Union Greenhouse Gas Emission Trading Scheme (EU ETS) demonstrates that investors face just as much risk from changes to future cap allowances under a cap and trade scheme.

It is suggested that the New Zealand government is better placed to bear the fiscal risk of an uncertain level of emissions under a carbon tax regime than private investors are to bear the risk of an uncertain carbon price under a cap and trade scheme. Hence we suggest that further consideration is given to the use of a broad-based carbon tax (made revenue neutral through offsetting reductions in income taxes). Such a scheme could be run in parallel with the proposed cap and trade approach – in effect “splitting the difference” on the government's and investors' respective risks under each approach, and providing an opportunity to monitor how each scheme works in practice. Alternatively, investors could be given the choice of which scheme to opt into, allowing self-selection by investors as to which scheme works best for them.

The challenge the government faces is to create an incentive-compatible scheme that induces private parties to mitigate their emissions in ways that reduces the government's consequent fiscal exposure under the Kyoto Protocol. Until now the government has taken a narrow view of how best to manage its Kyoto-related fiscal exposure, and implemented policies that in fact worsened that exposure (witness in 2005 the advent of deforestation in New Zealand, and the lowest rates of new forest planting, in fifty years). To achieve such an incentive-compatible scheme, it clearly must provide a negative signal to carbon emitters, and positive signal to carbon sequesterers. The proposed cap and trade scheme should achieve the former, but other than the Permanent Forest

Sinks Initiative (PFSI), the government is yet to achieve the latter. While the PFSI allows investors in new forest plantings to participate in the carbon credits their forests will generate, it is a highly restrictive scheme with potentially very long-term (99+ year) liabilities. We therefore suggest that the partial or complete allocation of both carbon credits and harvest liabilities – without PFSI-like long-term covenants – be reconsidered in respect of post-1990 forest plantings (“Kyoto forests”). This is a much simpler approach than the PFSI, and enables foresters to better manage their risks.

The lingering difficulty with the Kyoto Protocol is that its arbitrary distinctions – notably between non-Kyoto and Kyoto foresters – creates unforeseen equity issues for those foresters who made their investment decisions even before the Kyoto Protocol was signed. While pure efficiency considerations suggest that the Kyoto Protocol requires the deforestation of non-Kyoto forests to be priced, government’s response to this creates equity issues that in turn can adversely affect dynamic efficiency.

By revealing that it is prepared to expropriate investors’ property by ex post “taxing” their historical investment decisions, government has signalled to investors that it is “predatory” in the terminology of Azam et al. (2005). These authors develop a model in which the government’s type – benevolent or predatory – is unknown: the economy grows for so long as restraint is observed, but reverses when a government engages in predatory actions. Having revealed itself as predatory, investors are now wary of government to such a degree that they choose to deforest before 1 January 2008 (creating a worse CP1 position for government) rather than letting their forestry assets mature and adapting to a world in which deforestation faces an additional price – a form of prisoner’s dilemma.

If the government wishes to elicit a less inefficient outcome from future forester behaviour, it will need to signal to forestry investors that it is of Azam et al.’s “benevolent” type. We suggest that one means of doing so that might be considered is to mitigate or even eliminate the wealth effect created by devolving deforestation liabilities to non-Kyoto foresters, while still implementing either a cap and trade scheme and/or deforestation tax to ensure the incentive-compatible signals are in place. For example, one model would be for the government to pay a “non-deforestation bond” to non-Kyoto foresters, repayable in the event that deforestation then occurs. This leaves such foresters more neutral in a forest valuation sense, while providing a clear disincentive to deforest, and at the same time avoids the government appearing to be “predatory”. The government could afford to pay a bond up to the amount of its expected deforestation liability under the Kyoto Protocol, since it avoids that expected liability if deforestation is averted. Given the sums concerned, government could afford to do so out of general revenue, but alternatively could use any carbon credits not allocated to Kyoto foresters to help fund this transfer.

The equity issues arising under Kyoto also raise the likely differential impact of climate change policy on Maori landowners (whether farmers or foresters). Because of the institutional constraints

faced by Maori on alienating certain classes of Maori-owned (often marginally economic) land, combined with the cultural affinity of iwi with particular land in particular locales, it can be predicted that climate change policy will affect such landowners to a greater degree than owners of other types of land. Landowners with investment flexibility can respond to climate change policy by changing their land use (e.g. deforesting before 1 January 2008 to avoid any future deforestation costs), or by changing their land (i.e. selling out of assets exposed to climate change policy risks and buying other assets that are not so exposed). In doing so they can reduce the impact of climate change policy on their asset values.

For owners of Maori land, particularly where there are multiple absentee owners, the governance costs of agreeing to strategies to mitigate the impact of climate change policies place them at a disadvantage. This is only compounded where they face alienation restrictions or outright prohibitions, and a cultural affinity with their particular land (and not with land in other locales). It is also compounded where they have issued long-term rights over their land, such as forestry rights, to third parties. These mean they cannot sell exposed land and buy other, less exposed assets, or easily change their existing land uses into less exposed uses. Like investors with illiquid assets in their portfolio, they are likely to be left holding riskier portfolios than other investors as a consequence (e.g. see Longstaff (2005)). We therefore suggest that part of the inquiry into Maori land issues recommended in Section 4.3.1 also consider any differential impacts of climate change policy on owners of Maori land, and whether the productivity of such land will be enhanced by implementing measures to ameliorate any such differential impacts.

4.5 Other Institutions affecting Selected Agriculture Sub-Sectors

Having traversed a number of high-level institutions that are likely to affect growth and innovation in our selected agricultural sub-sectors, we now turn to a number of specific institutions that merit further examination. These include institutions relating to:

- The emerging “multinationalisation” of New Zealand agri-food concerns;
- The emerging horizontal diversification of New Zealand agri-food concerns (including the possible case for a “meta-coop”?);
- The general recognition of positive and negative externalities arising from agricultural land use;
- Export market property rights security (relating to export tariff quotas, and export licensing); and
- An increasing rationale for cross-country agri-food supply chain coordination.

4.5.1 Multinationalisation

We outlined in Section 2 the emergence of a new business strategy across a number of the agriculture sub-sectors we have examined. This strategy involves New Zealand agri-food producers exporting their know-how as much as their produce, leveraging expertise in genetics/varieties and export networks by applying that know-how in other countries. This can be beneficial where those other countries offer lower cost structures (such as cheap land and labour, or lower shipping costs) and/or are further behind the technology frontier than New Zealand producers (meaning productivity gains more easily achieved). Alternatively, by procuring international supply to complement their own supply New Zealand producers enhance the scale economies of their processing and marketing channels, and broaden their supply seasons, which enhances their negotiating position with international supermarket chains and buying groups. Such procurement also enables them to coast off of the advantages enjoyed by producers in those countries such as FTA access to otherwise protected markets, and access to local production subsidies. The approach also reduces New Zealand producers' exposure to adverse movements in the New Zealand dollar, and to adverse consumer reactions based around "food miles" or "buy local" campaigns.

This emerging strategy also raises issues. For one it strains the "100% Pure NZ" branding model, in that producers no longer market produce specifically of New Zealand origin. While maintaining country-of-origin distinctions may be useful in some ways, it may be unhelpful in others (e.g. in deflecting "food miles" criticisms). It also raises the question as to how best existing support agencies should be oriented. New Zealand Trade & Enterprise (NZTE) has until now been involved in facilitating exports of New Zealand products, and identifying possible business partners offshore. It is possible that its role – like that of some of its counterparts overseas – should be expanded to more explicitly support outbound foreign direct investment (ODI) by New Zealand agricultural producers. Singapore's experience in this area is discussed in Blomqvist 2002, while an assessment of the issues from the perspective of Ireland's FORFAS is provided in FORFAS (2001),

MAF too should consider its role in facilitating, or at least not impeding, the successful development of this new approach. Its mission includes contributing "to the prosperity of New Zealand through its focus on land-based industries and rural communities ... [and] to New Zealand's sustainable development ... enhancing its natural advantage." We suggest that if the emerging business model described above continues to develop, MAF may need to reconsider whether its current mission remains appropriate, and if it might be able to export its agricultural sector regulatory know-how in ways that supports the multinationalisation of New Zealand food concerns in overseas countries with inferior such know-how.

4.5.2 Horizontal Diversification – the Case for a Meta-Coop?

Horizontally diversified food concerns have been in New Zealand for a number of years. Talley's and ANZCO are two obvious contemporary examples – one a New Zealand owned diversified food supply company; the other a Japanese owned diversified food supply company. With AFFCO being controlled by Talley's, and through its interest in Dairy Trust looking to further expand into the dairy sector (e.g. through purchasing a stake in Open Country Cheese Company), the process of horizontal diversification continues.

This process complements the multinationalisation model discussed above. Just as New Zealand agri-food producers benefit by being able to market their product sourced from foreign producers, so too can they benefit by being able to supply products across a variety of food types. Each strategy enhances producers' ability to negotiate with international supermarket chains and buying groups.

While there are no apparent institutional obstacles preventing this horizontal diversification from occurring, it is conceivable that there will come a point where competition concerns may arise. This might be the case, for example, if Fonterra should decide to purchase PPCS, given it would then have significant market power in the New Zealand food supply, albeit in different food groups. If the strategy of horizontal diversification proves to be successful, we cannot rule out an attempt at forming a cross-sector "meta-coop" (or indeed, simply a diversified investor-owned firm for that matter), in which case a similar level of pragmatism as was exhibited in the mega-merger that led to Fonterra's formation may again be required if it is to proceed. Hence, flexibility in the consideration of necessary institutional adjustments in response to increasing horizontal diversification in agriculture may be required.

4.5.3 General Recognition of Agricultural Externalities

With the advent of the Kyoto Protocol to control carbon emissions, a nitrates cap and trade scheme introduced around Lake Taupo, and administrative rules in the Rangitikei-Manawatu region to control hill country erosion, New Zealand agricultural producers face mushrooming regimes for the management of agricultural externalities. At the same time foresters in particular are dissatisfied with the recognition they receive for the positive externalities provided by forestry, such as carbon sequestration, reduced soil erosion, improved water quality, recreational and amenity values, and so on.

One perspective on all of these considerations is that they reflect a plethora of mis-specified property rights. Since no-one "owns" water quality, there is no transparent market for trading forest attributes that contribute to water quality. A nitrates cap and trade system seeks to establish

property rights to clean water in the form of controls on nitrate emissions. Foresters are not compensated for the recreational and amenity values their forests provide because they cannot effectively charge for the enjoyment of those values.

Taken together this suggests merit in considering a more generalised approach to recognising the values – positive or negative – of agricultural externalities. By creating additional forms of property rights arising from agricultural activities, agricultural producers should be able to generate additional value from their activities. This already happens when such producers invest in branding that, for example, differentiates their produce in terms of sustainability, for which discerning customers will be prepared to pay a premium. By adopting a more consistent approach to putting a price on negative externalities, the costs and difficulties of attempting to comply with multiple mitigation regimes might be reduced. We therefore suggest that a more generalised approach to recognising the values of agricultural externalities be examined.

4.5.4 Export Market Property Rights Security

Certain of the agricultural sub-sectors considered in this report rely on export market tariff quotas or export licensing. These include dairy quotas into the EU and US, lamb and beef quotas into the EU, and beef quotas into the US. They also include Horticultural Export Authority (HEA) authorisations for kiwifruit producers other than ZESPRI exporting into Australia.

Under the Dairy Industry Restructuring Act (DIRA) Fonterra's control of the dairy quotas is time-limited, and at the end of that period will need to be allocated on some basis. Under the Meat Board Act the New Zealand Meat Board is required to operate and establish meat quota management systems, which currently involves short-term (i.e. three year) allocations of quotas. Similarly HEA authorisations are time-limited.

These quotas represent valuable property rights. However, since the sectors concerned may need to make long-term investments to fully exploit export market access that last beyond the allocation periods of the relevant quotas, there is a risk that the quota and export licensing allocation mechanisms adopted in each of these sectors “hold up” such investments. This would therefore give rise to sub-optimal investments in exploiting those markets.

We therefore suggest that analysis is made of the optimal approach to quota and export licensing allocations, to ensure they do not “hold up” related investments and thereby hinder growth.

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4.5.5 Cross-Country Coordination

Finally, just as intra-sector (and possibly cross-sector) coordination within New Zealand's agriculture sub-sectors can result in processing, exporting and marketing efficiencies, the same might be said for cross-border cooperation. Examples of possible areas of such cooperation include:

- “New World” wine branding, advertising and marketing in Europe;
- Coordination with Australian lamb producers to mitigate the effects of lamb dumping in the UK due to the Australian drought;
- Coordination with Chilean and South African horticulture exporters to avoid simultaneous marketing of apples and kiwifruit in Europe; and
- Joint venture R&D to develop new varieties and breedlines where local producers lack the scale to control such development.

We therefore suggest that consideration is given to the rationale, mechanics and attractiveness of such cross-border cooperation, whether on an intra-sector or cross-sector basis.

4.6 Summary

The survey in this section has been intended to highlight areas for further inquiry based on the empirical lessons regarding the impact of institutions and industry structures on growth and innovation. In particular, our attention has focused on institutions and structures relevant to the New Zealand agriculture sector. We began with a discussion of general institutions that might be expected to affect growth, and then institutions affecting innovation. We then looked at institutions affecting agricultural factors of production in particular – being land, labour, capital and water. Climate change policy was highlighted as an emerging area of institutions important to agriculture sector growth. Finally, we surveyed five other broad areas in which institutions might be expected to affect agriculture sector growth and innovation – multinationalisation, horizontal diversification, the general recognition of agricultural externalities, the security of export market property rights, and cross-country coordination.

A general theme we identified early in this report is that while New Zealand's high-level institutions are commonly rated among the highest in the world, this is not cause for complacency. New Zealand's high ratings are not uniform across different classes of institution. Even if they were, a case can be made for New Zealand needing to have superior institutions to other countries not so

affected by issues of scale and distance. Moreover, any such ratings are merely snapshots, and for New Zealand to remain internationally competitive it is important that its institutions continue to evolve at a rate that maintains or enhances their relative position as institutions evolve and improve in other countries. Ultimately, institutions cannot be evaluated in isolation, but must be considered in the light of the interactions between institutions, both domestically and internationally.

The priority areas we identified for further inquiry relate primarily to a few, higher-order institutions. In particular, we suggest that further research be undertaken into exploring institutional innovations that ensure New Zealand's property rights protections are adequate to support emerging strategies in the agriculture sectors surveyed. Enforceable constraints on the expropriation of private property are one area to explore, as is the optimal degree of alignment with, and monitoring and enforcement of, international property rights agreements. Another area relates to the quality of New Zealand's regulatory institutions, and the processes for making, amending and removing regulations. Improving the country's openness to trade was also identified as an important area, although only to the extent this does not interfere with emerging strategies to side-step trade barriers (such as multinationalisation).

In respect of institutions affecting innovation, the priority areas for further inquiry relate to the extent of government's role in research, the focus of public research, and the arrangements concerning CRIs. Among the first set of questions are issues to do with whether government should involve itself beyond basic research, whether it should seek to influence research towards particular objectives or sectors, and the identification of coordination failures hindering innovation and policy instruments that best alleviate them. The ongoing critical appraisal of research programmes to ensure their alignment with economic growth and other innovation objectives is also suggested. Finally, the ownership of selected CRIs by their New Zealand customers, or by universities, is also raised as an important issue to further explore. A review of the Crown Research Institutes Act to ensure clarity surrounding CRI objectives appears worthwhile, as would be the ongoing review of the appropriate funding arrangements for CRIs.

In terms of institutions affecting productive factors, our priority areas for further inquiry all relate to land. Of particular interest is how to better align objectives and coordination among the major institutions affecting land management in New Zealand – notably LINZ and DoC (and their respective legislation), and the RMA. Other RMA-related inquiry would consider improving the security and tradability of resource consents, the cost-benefit analysis of environmental regulation, and the greater use of market-based instruments to manage environmental issues. A particularly important area for further research relates to the institutions affecting the ownership, control and financing of Maori-owned land, given the productivity issues, data deficits, capital constraints and other problems associated with the productive use of such land.

Other notable areas for further inquiry include innovations in water ownership and management are suggested for further exploration, as are changes to the current approach towards climate change policy. In each case improving the security of long-term property rights and striking the right balance between centralised and decentralised resource management are important considerations affecting investment, innovation and growth. Another area of potential property rights insecurity relates to export market access rights, particularly in the dairy and meat sub-sectors, thus warranting further inquiry.

Examination of how DoC land management (including its policies towards the use of DoC land for tourism activities) affects the productivity of adjacent land is also suggested. The size and structure of government expenditure and financing would merit further inquiry, alongside further consideration of greater private sector involvement in infrastructure provision. Flexibility in the design and application of competition laws, and in industry restructuring, is recommended in the light of the increasing use of hybrid organisational forms, multinationalisation and horizontal diversification in the agriculture sector. The use of covenants instead of transferring land into DoC ownership and management to achieve reform objectives in the high country tenure review process is proposed. Examination of measures to mitigate investment hold-up problems inherent in Crown Forestry Licenses under the Crown Forest Assets Act is suggested. Finally, testing the advantages of corporate farming through performance benchmarking against Landcorp Farming, or its sale by government, is also proposed.

The role of MAF in supporting emerging agriculture sector strategies deserves particular mention. With multinationalisation of New Zealand food concerns becoming a growing theme, MAF's mission may require revisiting. The possibility of greater cross-country agriculture sector coordination potentially complements this trend. Furthermore, how MAF engages with other government agencies affecting these areas, such as New Zealand Trade and Enterprise and Investment New Zealand, may also become increasingly important, and hence merit further examination. Finally, how and whether MAF can export some of its regulatory know-how to other countries so as to enhance the benefits of multinationalisation, or cross-country coordination, is another question worth particular exploration.

The other proposed areas for further inquiry cover topics as diverse as:

- The level and mix of government support for R&D;
- HASNO/ERMA arrangements;
- The availability and quality of rural healthcare services;
- Raising the school leaving age;
- The growth and innovation impacts of employment regulation;
- Immigration policy and work visa arrangements;
- Coordination mechanisms to mitigate processing surges in response to droughts; and
- General approaches for recognising and responding to both positive and negative externalities in agriculture.

We suggest that the priority areas of inquiry should be expected to be the most fruitful, although others (such as those relating to MAF's role) may also prove important. In no case can it be said that there is obvious "low hanging fruit", and in all cases the policy challenge is not to identify deviations from ideals, but rather feasible innovations that can be expected to yield net gains in dynamic efficiency terms. Ultimately the aim should be to identify blockages to desirable institutional innovations that might otherwise be expected to arise endogenously. As suggested in the opening quotation in Section 1 from Ruttan (2002), doing so with foresight remains a particular challenge. The more reassuring news – exemplified by the other opening quote in Section 1, from Johnson (1997) – is that agricultural producers have proved themselves adept at responding to new opportunities as they arise. Indeed, recent institutional innovations emerging from New Zealand agricultural concerns suggest they are also adept at creating those opportunities.

5. Conclusions

In this report questions about institutions and industry structures are directed towards growth and innovation in selected New Zealand agriculture sub-sectors – in decreasing order of export importance: dairy, sheep and beef, forestry, kiwifruit, wool, wine, and apples and pears. These questions are naturally related to issues concerning these sectors' evolving comparative advantage – how best to structure or adapt the “rules of the game” to best support or enable the evolution of that comparative advantage? This in turn touches on the question of how New Zealand's institutions compare with and interface with those overseas (e.g. WTO rules), and evolve over time to maintain the country's competitive position.

Historically the New Zealand agriculture sector has proved adept at both responding to market challenges, and introducing innovations to improve productivity and competitiveness. These innovations have variously involved the application of new technologies, changes in capital intensity, and changing land use. Changes in land use have not simply involved the shifting of production from one type to another (e.g. from sheep and beef, or forestry, into dairy), but also into multiple land uses (e.g. farming plus tourism).

Flexibility and diversity in land use requires institutional flexibility, and hence it is natural to inquire of New Zealand institutions affecting how land is used. The interface between the government's two main land management agencies – LINZ and DoC – as well as between these institutions and those affecting land management in the private sector (e.g. the RMA), therefore loom large. While LINZ's purposes are sufficiently broad so as to not inherently impede growth-enhancing changes in land use, important questions remain as to how well DoC and the RMA contribute to growth and innovation. Institutions affecting flexibility in the ownership and management of Maori-owned land are also of particular importance in this regard, where natural cultural imperatives also arise,

Even if it is assumed that DoC and the RMA should have purposes not directed at growth and innovation in the agriculture sub-sectors considered, there remains scope to inquire as to how they might each be organised so as to achieve their goals in ways that are least inconsistent with, or most supportive of, agricultural growth and innovation. On the other hand, it is possible that their goals might be achieved in harmony with the pursuit of agricultural sector growth, depending on the balance of administrative and market-based mechanisms used. Presently this is particularly pertinent in respect of both water management and climate change policy.

Our report has identified a range of institutions which might be further examined in order to identify possible innovations that could contribute to improved agriculture sector growth and innovation. A summary of some of the priority areas of inquiry was presented in Section 4.6. Aside from institutions affecting productive factors such as land, labour, capital and water, we have identified issues surrounding property rights security, regulatory quality, and openness to trade as being

among some of the more important. Climate change policy, the size and structure of government, flexibility in competition laws, and variations to the current high country tenure review process offer further areas for potentially fruitful exploration. Reviews of arrangements for New Zealand's CRIs – to improve the clarity of objectives and the targeting and security of research funding, and to protect the competitive position of CRI customers – are also proposed. The full range of suggestions is traversed in Section 4.

Importantly, a new business model is clearly emerging across a number of New Zealand's agriculture sectors. Under this model traditional comparative advantage in efficient temperate-climate farming is being augmented – as opposed to supplanted – by the export of farming, processing and marketing/exporting technology to other countries. It includes vertical relationships to the highest upstream level, and increasing inbound and outbound foreign direct investment, suggesting the ongoing (indeed, increased) need for flexible agriculture sector institutions. The role of MAF, in particular, needs to be re-evaluated in the light of this emerging model, to ensure MAF complements rather than impedes its development.

The emergence of this model relates to the extent to which New Zealand farmers are close to the current production possibility frontier. Whether or not they are the important question arises as to where those farmers are more likely to generate additional returns? One approach is to continue innovating and shifting the frontier out further (which is going to happen incrementally over time to varying degrees, and perhaps with step jumps). Another is to export existing know-how to parts of the world amenable to the application of New Zealand technology and institutions and/or cheaper factor inputs (land, labour), thereby expanding the production possibility frontier in those countries. The emerging model indicates that New Zealand farming concerns are increasingly inclined towards the latter.

While not traversed in this report, but at length in Evans and Meade (2005), the often dominant presence of cooperative rather than investor-owned firms in New Zealand agriculture is neither unusual nor an automatic cause for concern. There is evidence to suggest that cooperatives face constraints in raising capital, which might hinder their growth and innovation, however, there is also ample evidence to suggest that cooperatives either adapt or abandon their cooperative form when capital constraints prove binding. Conversely, cooperatives are often the only viable organisational form where capital is not otherwise available. New Zealand is relatively unusual in not having institutional arrangements artificially favouring the cooperative model in agriculture, so the fact that cooperatives arise and evolve in the New Zealand context suggests that existing arrangements are sufficiently flexible.

Finally, as indicated in the introduction to the report, we hesitate to offer prescriptions for improving institutions relevant to agriculture sector growth and innovation. Rather it has been our intent to inform a consideration of New Zealand's institutions using relevant international evidence on the

impact of institutions and industry structures on growth and innovation. The outcome of that consideration is a list of areas for further research, and a suggested prioritisation of the research areas that might be the most fruitful. The bad news is that it is not an easy task to immediately identify obvious areas for institutional improvement. The good news is that on closer examination there are areas of potentially fruitful inquiry.

* * *

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Appendix A.1 – Components of World Bank Ease of Doing Business Index

Source: www.doingbusiness.org

Which indicators make up the ranking?	
Starting a business Procedures, time, cost and paid-in minimum capital to open a new business	Protecting investors Indices of the extent of disclosure, extent of director liability and ease of shareholder suits
Dealing with licenses Procedures, time and cost of business inspections and licensing (construction industry)	Paying taxes Number of tax payments, time to prepare tax returns and total taxes as a share of commercial profits
Employing workers Difficulty of hiring index, rigidity of hours index, difficulty of firing index and firing cost	Trading across borders Documents, time and cost to export and import
Registering property Procedures, time and cost to register commercial real estate	Enforcing contracts Procedures, time and cost to resolve a commercial dispute
Getting credit Strength of legal rights index, depth of credit information index	Closing a business Recovery rate in bankruptcy

* * *

Appendix A.2 – Components of Heritage Foundation Index of Economic Freedom

Source: www.heritage.org

The 10 Economic Freedoms. Overall economic freedom, defined by multiple rights and liberties, can be quantified as an index of less abstract components. The index we conceive uses 10 specific freedoms, some as composites of even further detailed and quantifiable components. A detailed discussion of each of these factors and their component variables follows this overview.

- **Business freedom** is the ability to create, operate, and close an enterprise quickly and easily. Burdensome, redundant regulatory rules are the most harmful barriers to business freedom.
- **Trade freedom** is a composite measure of the absence of tariff and non-tariff barriers that affect imports and exports of goods and services.
- **Monetary freedom** combines a measure of price stability with an assessment of price controls. Both inflation and price controls distort market activity. Price stability without microeconomic intervention is the ideal state for the free market.
- **Freedom from government** is defined to include all government expenditures—including consumption and transfers—and state-owned enterprises. Ideally, the state will provide only true public goods, with an absolute minimum of expenditure.
- **Fiscal freedom** is a measure of the burden of government from the revenue side. It includes both the tax burden in terms of the top tax rate on income (individual and corporate separately) and the overall amount of tax revenue as portion of GDP.
- **Property rights** is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state.
- **Investment freedom** is an assessment of the free flow of capital, especially foreign capital.
- **Financial freedom** is a measure of banking security as well as independence from government control. State ownership of banks and other financial institutions such as insurer and capital markets is an inefficient burden, and political favoritism has no place in a free capital market.

- **Freedom from corruption** is based on quantitative data that assess the perception of corruption in the business environment, including levels of governmental legal, judicial, and administrative corruption.
- **Labor freedom** is a composite measure of the ability of workers and businesses to interact without restriction by the state.

Equal Weight. In the *Index of Economic Freedom*, all 10 factors are equally weighted in order not to bias the overall score toward any one factor or policy direction. As described earlier, economic freedom is an end in itself. The ability of economic freedom to establish a foundation for the rapid development of wealth for the average citizen explains contemporary interest, but it is not a valid rationale to weight some components over others. Nor would it be proper to weight the *Index* in a manner that caused the relation between democracy and economic freedom to be statistically stronger.

* * *

Appendix A.3 – Components of Fraser Institute Economic Freedom of the World Index

Source: www.fraserinstitute.ca

- 1. Size of Government: Expenditures, Taxes, and Enterprises**
 - A. General government consumption spending as a percentage of total consumption
 - B. Transfers and subsidies as a percentage of GDP
 - C. Government enterprises and investment as a share of total investment
 - D. Top marginal tax rate (and income threshold at which it applies)
 - i. Top marginal income tax rate (and income threshold at which it applies)
 - ii. Top marginal income and payroll tax rate (and income threshold at which the top marginal income-tax rate applies)

- 2. Legal Structure and Security of Property Rights**
 - A. Judicial independence – the judiciary is independent and not subject to interference by the government or parties in dispute
 - B. Impartial courts – a trusted legal framework exists for private businesses to challenge the legality of government actions or regulation
 - C. Protection of intellectual property
 - D. Military interference in rule of law and the political process
 - E. Integrity of the legal system

- 3. Access to Sound Money**
 - A. Average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years
 - B. Standard inflation variability in the last five years
 - C. Recent inflation rate
 - D. Freedom to own foreign currency bank accounts domestically and abroad

- 4. Freedom to Trade Internationally**
 - A. Taxes on international trade
 - i. Revenue from taxes on international trade as a percentage of exports plus imports
 - ii. Mean tariff rate
 - iii. Standard deviation of tariff rates
 - B. Regulatory trade barriers
 - i. Non-tariff trade barriers
 - ii. Compliance cost of importing and exporting
 - C. Actual size of trade sector compared to expected size
 - D. Difference between official exchange rate and black-market rate

- E. International capital market controls
 - i. Foreign ownership/investment restrictions
 - ii. Restrictions on the freedom of citizens to engage in capital market exchange with foreigners – index of capital controls among 13 IMF categories

5. Regulation of Credit, Labour, and Business

- A. Credit market regulations
 - i. Ownership of banks – percentage of deposits held in privately owned banks
 - ii. Competition – domestic banks face competition from foreign banks
 - iii. Extension of credit – percentage of credit extended to private sector
 - iv. Avoidance of interest rate controls and regulations that lead to negative real interest rates
 - v. Interest rate controls – interest rate controls on bank deposits and/or loans are freely determined by the market
- B. Labour market regulations
 - i. Impact of minimum wage
 - ii. Hiring and firing practices – hiring and firing practices of companies are determined by private contract
 - iii. Share of labour force whose wages are set by centralized collective bargaining
 - iv. Unemployment benefits – the unemployment benefits system preserves the incentive to work
 - v. Use of conscripts to obtain military personnel
- C. Business regulations
 - i. Price controls – extent to which businesses are free to set their own prices
 - ii. Burden of regulation
 - iii. Time with government bureaucracy – senior management spends a substantial amount of time dealing with government bureaucracy
 - iv. Starting a new business – starting a new business is generally easy
 - v. Irregular payments – irregular, additional payments connected with import and export permits, business licenses, exchange controls, tax assessments, police protection, or loan applications are very rare.

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Appendix A.4 – Components of World Economic Forum Global Competitiveness Index

Source: www.weforum.org

1st Pillar: Institutions

A. Public Institutions

1. Property Rights
 - 1.01 Property rights
2. Ethics and corruption
 - 1.02 Diversion of public funds
 - 1.03 Public trust of politicians
3. Undue influence
 - 1.04 Judicial independence
 - 1.05 Favouritism in decisions of government officials
4. Government inefficiency (red tape, bureaucracy and waste)
 - 1.06 Wastefulness of government spending
 - 1.07 Burden of government regulation
5. Security
 - 1.08 Business costs of terrorism
 - 1.09 Reliability of police services
 - 1.10 Business costs of crime and violence
 - 1.11 Organized crime

B. Private Institutions

1. Corporate ethics
 - 1.12 Ethical behaviour of firms
2. Accountability
 - 1.13 Efficacy of corporate boards
 - 1.14 Protection of minority shareholders' interest
 - 1.15 Strength of auditing and accounting standards

2nd Pillar: Infrastructure

- 2.01 Overall infrastructure quality
- 2.02 Railroad infrastructure development
- 2.03 Quality of port infrastructure
- 2.04 Quality of air transport infrastructure
- 2.05 Quality of electricity supply
- 2.06 Telephone lines (hard data)

3rd Pillar: Macroeconomy

- 3.01 Government surplus/deficit (hard data)
- 3.02 National savings rate (hard data)
- 3.03 Inflation (hard data)
- 3.04 Interest rate spread (hard data)
- 3.05 Government debt (hard data)
- 3.06 Real effective exchange rate (hard data)

4th Pillar: Health and primary education

A. Health

- 4.01 Medium-term business impact of malaria
- 4.02 Medium-term business impact of tuberculosis
- 4.03 Medium-term business impact of HIV/AIDS
- 4.04 Infant mortality (hard data)
- 4.05 Life expectancy (hard data)
- 4.06 Tuberculosis prevalence (hard data)
- 4.07 Malaria prevalence (hard data)
- 4.08 HIV prevalence (hard data)

B. Primary education

- 4.09 Primary enrolment (hard data)

5th Pillar: Higher education and training

A: Quantity of education

- 5.01 Secondary enrolment ratio (hard data)
- 5.02 Tertiary enrolment ratio (hard data)

B. Quality of education

- 5.03 Quality of the educational system
- 5.04 Quality of math and science education
- 5.05 Quality of management schools

C. On-the-job training

- 5.06 Local availability of specialised research and training services
- 5.07 Extent of staff training

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6th Pillar: Market Efficiency

A. Good markets: Distortions, competition, and size

1. Distortions

- 6.01 Agricultural policy costs
- 6.02 Efficiency of legal framework
- 6.03 Extent and effect of taxation
- 6.04 Number of procedures required to start a business (hard data)
- 6.05 Time required to start a business (hard data)

2. Competition

- 6.06 Intensity of local competition
- 6.07 Effectiveness of antitrust policy
- 6.08 Imports (hard data)
- 6.09 Prevalence of trade barriers
- 6.10 Foreign ownership restrictions

3. Size

- 0.00 GDP – exports + imports (hard data)
- 6.11 Exports (hard data)

B. Labour markets: Flexibility and efficiency

1. Flexibility

- 6.12 Hiring and firing practices
- 6.13 Flexibility of wage determination
- 6.14 Cooperation in labour-employer relations

2. Efficiency

- 6.15 Reliance on professional management
- 6.16 Pay and productivity
- 6.17 Brain drain
- 6.18 Private sector employment of women

C. Financial markets: Sophistication and openness

- 6.19 Financial market sophistication
- 6.20 Ease of access to loans
- 6.21 Venture capital availability
- 6.22 Soundness of banks
- 6.23 Local equity market access

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7th Pillar: Technological readiness

- 7.01 Technological readiness
- 7.02 Firm-level technology absorption
- 7.03 Laws relating to ICT
- 7.04 FDI and technology transfer
- 7.05 Cellular telephones (hard data)
- 7.06 Internet users (hard data)
- 7.07 Personal computers (hard data)

8th Pillar: Business sophistication

A. Networks and supporting industries

- 8.01 Local supplier quantity
- 8.02 Local supplier quality

B. Sophistication of firms' operations and strategy

- 8.03 Production process sophistication
- 8.04 Extent of marketing
- 8.05 Control of international distribution
- 8.06 Willingness to delegate authority
- 8.07 Nature of competitive advantage
- 8.08 Value-chain presence

9th Pillar: Innovation

- 9.01 Quality of scientific research institutions
- 9.02 Company spending on research and development
- 9.03 University/industry research collaboration
- 9.04 Government procurement of advanced technology products
- 9.05 Availability of scientists and engineers
- 9.06 Utility patents (hard data)
- 9.07 Intellectual property protection
- 9.08 Capacity for innovation

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Appendix B – Summaries of Research on R&D and Productivity

Source: Congressional Budget Office (2005).

Note: Elasticity of R&D refers to the percentage change in output resulting from a 1% increase in R&D stock, while rate of return measures refer to the change in output caused by a \$1 increase in the R&D stock.

Table 1.
Selected Estimates of the Elasticity of Private R&D from Cross-Sectional Studies

Study	R&D Elasticity ^a	Sample
Minasian (1969)	0.11 - 0.26	17 U.S. firms (chemical industry); 1948 to 1957
Griliches (1980a)	0.03 - 0.07	39 U.S. manufacturing industries; 1959 to 1977
Griliches (1980b)	0.07	883 U.S. firms; 1957 to 1965
Schankerman (1981)	0.10 - 0.16	110 U.S. firms (chemical and oil industries); 1963 cross-section
Sveikauskas and Sveikauskas (1982)	0.22 - 0.25	144 U.S. manufacturing industries; 1959 to 1969
Cunco and Mairesse (1981)	0.20	182 French manufacturing firms; 1972 to 1977
Subsample 1	0.21	98 firms in scientific sectors
Subsample 2	0.11	84 firms in nonscientific sectors
Griliches and Mairesse (1984)		
Sample 1	0.05	133 U.S. firms; 1966 to 1977
Sample 2	0.19	77 U.S. firms (scientific sectors); 1966 to 1977
Griliches (1986)		491 U.S. firms
Subsample 1	0.11	1972 cross-section
Subsample 2	0.09	1977 cross-section
Jaffe (1986)	0.20	432 U.S. firms; 1973 and 1979
Englander, Evenson, and Hanazaki (1988)	(0.16) - 0.50	16 industries across six countries; 1970 to 1983
Mansfield (1988)	0.42	17 Japanese manufacturing industries
Griliches and Mairesse (1990)		
Sample 1	0.25 - 0.41	525 U.S. manufacturing firms; 1973 to 1980
Sample 2	0.20 - 0.56	406 Japanese manufacturing firms; 1973 to 1980
Hall and Mairesse (1995)	0.05 - 0.25	197 French firms; 1980 to 1987
Wang and Tsai (2003)	0.19	136 Taiwanese manufacturing firms; 1994 to 2000

Source: Congressional Budget Office based on Mairesse and Sassenou (1991), Mohnen (1992), and Australian Industry Commission (1995).

Note: R&D = research and development.

a. Parentheses indicate negative numbers.

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Table 2.
Selected Estimates of the Elasticity of Private R&D from
Time-Series Studies

Study	R&D Elasticity ^a	Sample
Minasian (1969)	0.08	17 U.S. firms; 1948 to 1957
Griliches (1980b)	0.08	883 U.S. firms; 1957 to 1965
Cuneo and Mairesse (1984)	0.05	182 French manufacturing firms; 1972 to 1977
Subsample 1	0.14	98 firms in scientific sectors
Subsample 2	0.03	84 firms in nonscientific sectors
Griliches and Lichtenberg (1984b)	(0.04)	27 U.S. manufacturing industries; 1959 to 1976
Griliches and Mairesse (1984)	0.09	133 U.S. firms; 1966 to 1977
Griliches (1986)	0.12	652 U.S. firms; 1966 to 1977
Jaffe (1986)	0.10	432 U.S. firms; 1973 and 1979
Bernstein (1988)	0.12	7 Canadian manufacturing industries; 1978 to 1981
Hall and Mairesse (1995)	0 - 0.07	197 French firms; 1980 to 1987
Verspagen (1995)	(0.02) - 0.17	14 industries in 11 OECD countries; 1973 to 1988

Source: Congressional Budget Office based on Mairesse and Sassenou (1991), Mohnen (1992), and Australian Industry Commission (1995).

Note: R&D = research and development; OECD = Organization for Economic Cooperation and Development.

a. Parentheses indicate negative numbers.

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Table 3.
Selected Estimates of the Rate of Return to Private R&D

Study	Rate of Return to R&D ^a	Sample
Teleckyj (1974)	0 - 0.30	33 U.S. industries; 1948 to 1966
Mansfield (1980)	0.27	16 U.S. firms (chemical and petroleum industries); 1960 to 1976
Teleckyj (1980)	0.20 - 0.27	20 U.S. manufacturing industries; 1948 to 1966
Lirk (1981b)		
Subsample 1	0	174 U.S. firms; 1971 to 1976
Subsample 2	0.07	33 U.S. firms (chemical industry); 1971 to 1976
Scherer (1982)	0.13 - 0.29	87 U.S. manufacturing industries; 1964 to 1969 and 1973 to 1978
Griliches and Mairesse (1983)		
Regular sample	0.28	528 U.S. and French firms; 1973 to 1978 ^b
Industry dummies	0.12	528 U.S. and French firms; 1973 to 1978 ^b
Ocagiri (1983)		
Subsample 1	0.26	123 Japanese firms (scientific sectors); 1969 to 1981
Subsample 2	(0.47)	247 Japanese firms (other sectors); 1969 to 1981
Clark and Griliches (1984)	0.20	924 U.S. manufacturing plants; 1970 to 1980
Griliches and Lichtenberg (1984a)	0.04 - 0.30	193 U.S. manufacturing industries; 1959 to 1978
Ocagiri and Iwata (1986)		
Regular sample	0.20	135 Japanese firms; 1966 to 1973
Industry dummies	0.17	135 Japanese firms; 1966 to 1973
Ocagiri and Iwata (1986)		
Regular sample	0.17	168 Japanese firms; 1974 to 1982
Industry dummies	0.11	168 Japanese firms; 1974 to 1982
Mansfield (1988)	0.42	17 Japanese industries; 1960 to 1979
Goto and Suzuki (1989)	0.22 - 0.56	40 Japanese manufacturing firms; 1976 to 1984
Staracchini (1989)	0.10 - 0.30	15 U.K. manufacturing industries; 1954 to 1984
Lichtenberg and Siegel (1991)	0.13	2,207 U.S. firms; 1972 to 1985
Griliches (1994)	0.12 - 0.46	142 U.S. manufacturing industries; 1958 to 1989
Hall and Mairesse (1995)	0.06 - 0.34	197 French firms; 1980 to 1987
Jones and Williams (1998)	0.35	12 U.S. manufacturing industries; 1961 to 1989

Source: Congressional Budget Office based on Mairesse and Sassenou (1991), Mohnen (1992), and Australian Industry Commission (1995).

Note: R&D = research and development.

a. Parentheses indicate negative numbers.

b. The sample consisted of 342 U.S. firms and 185 French firms.

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Table 4.
Selected Estimates of the Elasticity of Private R&D from Studies
Using Aggregate Data

Study	R&D Elasticity	Sample (Variable Studied)
Nadiri (1980)	0.06 - 0.10	United States (labor productivity); 1949 to 1978
Patel and Soere (1988)	0.61	United States (TFP); 1967 to 1985
Lichtenberg (1992)	0.07	98 countries (per capita output); 1960 to 1985
Cce and Moghadam (1993)	0.17	France (output); 1971 to 1991
Cce and Helpman (1995)	0.23	G7 countries (TFP); ^a 1971 to 1990
Cce and Helpman (1995)	0.08	Non-G7 OECD countries (TFP); ^a 1971 to 1990
Australian Industry Commission (1995)		
Subsample 1	0.02	Australia (TFP); 1975 to 1991
Subsample 2	0.14	Australia (output); 1975 to 1991

Source: Congressional Budget Office based on Mairesse and Sassenou (1991), Mohnen (1992), and Australian Industry Commission (1995).

Note: R&D = research and development; TFP = total factor productivity; OECD = Organization for Economic Cooperation and Development.

a. The G7 countries are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

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