

Innovation Policies and Funding in New Zealand: How Effective Are They?

**A survey of the evidence from recent evaluations,
research papers, statistical studies and policy documents**

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Ministry of Economic Development
Evaluation Team
Level 12, 33 Bowen Street
P O Box 1473
Wellington 6140
New Zealand

Preface

This report is a contribution to policy work by officials in support of the Government's economic growth agenda. Insights from evaluations of existing policies can be hard to access because they are often programme-specific and tend to look backward at specific performance issues rather than whether the wider policy objectives of the Government are being achieved. Systematic reviews, like this one, can draw out comprehensive, forward-looking insights from a range of studies (in this case more than 60 studies across the areas of innovation policy and programme performance).

This work is specifically framed around the available evidence relating to a number of higher level policy questions, in particular:

- what is innovation and which policies best support commercial outcomes from it?
- what are the hard evaluative questions that need to be asked at this (meta) level of analysis?
- are current policies for promoting innovation in New Zealand based on sound and accurate understanding of the innovative process? and
- are critical constraints or misconceptions preventing better policy outcomes?

The findings from this review are challenging. The innovativeness of New Zealand individuals and firms is well recognised internationally, but substantial efforts by departments and agencies to turn New Zealand's innovative and entrepreneurial talents into significant investment and business growth are not achieving as much as we might wish. This work identifies the considerable limitations of the "science push" approach to innovation and the difficulties facing policy makers in New Zealand's economic context. The study suggests that there are considerable opportunities for the Government to enhance the design and complementarity of current interventions without spending more.

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Executive Summary

Scope

This paper presents the results from a comprehensive, evidence-based, stock-take of major evaluations and policy analyses of Government innovation policies and funding over the last ten years (2000 – 2010). The aim of this survey, or “meta-evaluation”, is to assess the overall effectiveness of these government policies and interventions. The major findings from this work have been specifically presented to help inform the development of future innovation policies.

This study has focused on the role government plays in stimulating and supporting *commercially oriented* innovation. The evidence is therefore drawn specifically from government funding and interventions in support of R&D and business development – associated with any new products, services, technologies or processes - for which there is a clear intention or expectation of further investment in production and sales, and hence economic growth.

This definition of government assistance involves a public investment of approximately \$500 million per year, mainly under Vote: Research, Science & Technology and Vote: Economic Development. The study does not address government investment in non-appropriable (public good) research, nor does it comment on the performance of individual research institutions, firms or funding projects.

Method

The study reviewed the conclusions and investment results from over 50 programme evaluations and policy studies. It also surveyed the results from several recent statistical analyses of innovation trends in New Zealand and compared these results to some recent OECD trends and conclusions from other international papers.²

The methodology involved an analysis at two levels: at the individual funding programme level, and in terms of aggregate sector and national innovation system policy reviews and statistical reports. The conclusiveness of these results was constrained, to some degree, by a lack of detailed quantitative analysis from many programmes. Nonetheless, the overall indications on policy effectiveness were consistent within and across both levels of analysis.

Main Findings

1. The direct economic and financial returns from most individual government programmes aimed at supporting innovative research or business investments have

¹ David Webber (*Economics & Strategy Group Ltd*), Nick Hallett, David Bartle (MED), Nick Davis (*Martin, Jenkins & Associates Ltd*)

² Summaries of most of the reviewed documents have been presented in an appended report referred to as “Part B”.

been generally low. Although there have been some exceptions – i.e. specific projects which have gone on to significant commercial investment – these have been far fewer in number and scale than initially envisaged. Time lags can be an important consideration in measuring investment impacts, but these lags no longer adequately explain the majority of modest outcomes.

2. The success rates of business assistance programmes are variable, but slightly higher than for publicly-funded research. This is to be expected since these investments in innovation are mostly applied through new or existing, commercially-focused, business enterprises and therefore experience smaller or fewer obstacles to full commercialisation.
3. The generally low rates of success reported for government programmes aimed at stimulating investment in innovation are consistent with national meta-level indices for innovation. These measures also suggest that New Zealand's performance in this area has been mediocre within recent years.
4. Indirect ("spill-over") benefits are often cited as an important potential by-product of government investment in innovation. In practice, these spill-over benefits often are poorly defined and hard to measure. In most cases, especially where the direct returns to the project investment are low, their economic impact is uncertain and unlikely to be significant.
5. The evaluation evidence suggests that, where innovation expenditure programmes have stimulated or supported significant commercial investment, this has occurred more frequently within traditional sectors, rather than in new or emerging industries. This finding needs further testing, but suggests that the potential for innovation-related investment may be greater within industries that already exhibit significant scale, competitiveness and R&D expertise.
6. There is no evidence that the modest outcomes from these innovation-related investment programmes are the result of insufficient funding, missed opportunities, or gaps in the structure of financial support provided to firms and research organisations. On the contrary, the quantity and coverage of government assistance is broad and substantial, and has spread more widely in recent years as a result of concerted efforts to boost these activities. Partly as a result, however, there is considerable fragmentation in policy design and programme administration.
7. The study examined possible explanations for the unsatisfactory performance of innovation policies. It considered in particular a number of studies that address the underlying nexus between innovation funding, investment and economic growth. There are serious weaknesses in the (implicit) policy models underpinning current funding programmes in New Zealand. The issues, and possible remedies, are complex, but their understanding is crucial for future policy development.
8. For the underlying models, it is evident that:
 - the "science push" approach – i.e. providing public funding for research organisations to undertake potentially valuable, appropriate research – is severely constrained by the largely non-entrepreneurial focus and culture of these organisations, plus the many difficulties they face in securing suitable and willing domestic private partners for further development and investment in potentially valuable IP; and

- many small businesses ventures lack the capacity or desire to take innovative ideas and IP through to much larger investment and production – as most of the policy models appear to assume. In practice, there are fundamental constraints in the domestic business environment on further investment and business development. These constraints are mostly external to the innovation policy/programme design, but explain why few SMEs have used government assistance to generate much larger commercial activities.
9. The major findings from this study are largely consistent with emerging international experience. Concerns are spreading amongst industrialised countries with the limited effectiveness of many government innovation policies. The New Zealand experience is similar, though population size, location, economic structure and relative global competitiveness are unique and particularly important features of the problem.
 10. There is a strong case for the Government, including MED in particular, to develop a much more effective understanding of the innovation environment in New Zealand and to develop a much improved “intervention logic” on which to base future policy design. This should involve linking these policy interventions to national economic strategies that take much more realistic and effective account of global investment trends, the capacity of domestic industries to exploit the opportunities created by innovation and related economic competitiveness issues.

Policy Issues and Challenges Arising

The study has identified the following broad questions to help guide further policy development as proposed in item 10 above:

- Does the policy mix for investment in innovation need stronger top-down direction; how can this provided by a more realistic and effective national economic strategy that gives more effective support and incentives for business investment and growth?
- What should be the balance between publicly funded R&D that is targeted at known productivity and competitiveness issues in existing and established industries, compared to R&D in new and unproven areas of science and technology?
- Which sectors or technologies should be given greatest priority when making innovation policy investments and on what basis? For example: in what areas can New Zealand use and encourage innovation that leverages off its existing competitive advantages? Similarly, where might assistance for innovation be better focused in future in order to exploit opportunities for the largest productivity improvements?
- How can innovation policies better accommodate and support the diversity of commercialisation models, and the uneven absorptive capacity, of New Zealand industries? How can they better overcome the generally limited interface between these industries and the research sector?
- How can better alignment be achieved in practice between government financial support for innovation, R&D and business development, such that investments are better supported along the research, development and investment cycle? How can much stronger emphasis be given to commercial and entrepreneurial expertise and incentives within this cycle?
- How might government funding for the research sector be more effectively separated between the non-appropriable (public good) research – which it is mostly very good at –

and appropriable research with potentially significant economic benefits – where commercialisation models, including effective relationships with the private sector, are highly problematic?

Introduction to the Study

1. This paper provides a summary of the findings from a selective, yet comprehensive, review of the impacts and achievements of New Zealand government policies and funding on “innovation” over the last 10 years. The assessment involved a review of over 60 official documents comprising programme evaluations, research papers, economic analyses, policy reviews, and statistical reports. Most of these documents relate to New Zealand government policies and programmes that have been implemented during this period through Vote: RS&T and Vote: Economic Development³. The report acknowledges that this does not capture all innovation-related expenditure of the Government, for example that undertaken through the education⁴, agriculture, health and other sector votes.
2. Expenditures under these votes which could be considered to be directly targeted at promoting innovation amounted to \$638 million and \$227 million respectively for Vote: RS&T and Vote: Economic Development in FY 2010/11. Of the amount allocated under Vote: RS&T, approximately \$334m is directed at fully appropriable (i.e. commercially focused) research. On this basis, the Government expects to spend in 2010/11 approximately \$560m in total (i.e. across both Votes) on support for innovation with explicitly commercial objectives. This compares with a figure of approximately \$300 million ten years earlier in 2000/01.⁵
3. The evaluation documents relate specifically to funding programmes that involve direct financial assistance to commercially-oriented innovation. Annex 1 provides a full listing of the documents included. A small number of relevant papers and analyses from other international studies or sources were included for comparative purposes and to help formulate more robust conclusions.⁶
4. The overall programme of work has been carried out in two main stages:
 - i) identification and review of relevant documents, including preparation of short summaries and extracts of their main findings (published as “Part B” of this study)⁷,
 - ii) preparation of this *Discussion Paper* (Part A) which provides a summary of the evidence from recent evaluations, policy and research papers and statistical reports on issues concerning the public sector’s role in innovation in New Zealand. This paper includes the authors’ main findings and conclusions and has been revised to incorporate many comments and suggestions from internal MED presentations and discussions.
5. The key focus of this study is the relationship between innovation and economic growth and what governments can do to support this. We have endeavoured to take a comprehensive and integrated view of the evidence and to draw lessons and ideas from different organisations and programmes. In particular, we have reviewed the evidence from a wide range of New Zealand Government programmes and

³ Previously Vote: Economy, Industry and Regional Development (to 2007/08).

⁴ The analysis therefore excludes government spending through Cores and PBRF.

⁵ These estimates were compiled from data supplied to the evaluation team by MoRST and MED respectively.

⁶ These documents are referenced throughout this Discussion Paper using square brackets [], according to the numbering shown in Annex 1.

⁷ Summaries of most programme evaluations were prepared, in Part B, using a standard template for the presentation of basic information and key findings. We have not adjusted this information or these findings, though the material included is necessarily only a small part of most of the original documents.

interventions - amounting to more than \$500 million in 2010/11⁸ - from the perspective of what has worked, or not worked, and what have been the common lessons or experiences that could help shape future Government policies. We have tried, where possible, to separate the apparent constraints on successful commercialisation of innovation into those factors which are endogenous to the innovation system and those that are external, or exogenous, to policy design.

6. The result is a comprehensive, frank and essentially forward-looking examination of policy effectiveness. Innovation is critical to economic growth and MED expects that this synthesis of evaluation and research findings (“meta-evaluation”) – and the discussion it will inevitably generate – should provide a broad, evidence-based, foundation on which to develop better innovation policies.
7. While many of the papers and studies reviewed refer broadly to promoting or measuring “innovation”, this is not a tightly defined concept and it makes little sense to attempt to assess it in that way.⁹ Nonetheless, we have found it helpful to analyse and discuss these issues and interventions in more specific terms. In particular, we have focused on the value for money that the Government seeks from its spending on innovation that has an *explicitly commercial focus*. Innovation, in this sense, is seen as a driver of R&D and business investment that leads to an explicit, direct and additional contribution to economic growth.¹⁰
8. In this study, we therefore refer to most of the Government policies and funding activities relating to expenditures under Vote: RS&T as “research and development” (R&D) and those under Vote: Economic Development as “business development”. In practice, these two components of innovation are neither entirely distinct nor tightly defined: R&D may include any step along the process from discovery to full realisation of an idea. In other words, our definition of innovation-driven R&D incorporates activities that may span from “blue skies” research through to various stages of commercialisation. Similarly, business development refers to many forms of new or expanded investment that may or may not have involved significant new research or product development. In this discussion, the objectives of “innovation policy” include support for any and all of these commercially focused activities, many of which may also incorporate significant “entrepreneurial” features.
9. The programme documents, evaluations and policy analyses on which this study is based are often neither clear nor consistent in their definition and measurement of the expected “economic benefits” of many innovation-related interventions. For the purposes of this study, we have therefore confined our assessment to two major forms of economic benefit: *direct financial returns* to the assisted firm or research organisation (including any business partners), and indirect *spill-over benefits* in terms of observable growth in the organisational capabilities and business opportunities of any ancillary (non-directly assisted) firms or commercial operations. We have not sought to assess other potential benefits from these interventions – such as increases in the general capacity of a research organisation – that might result from some programmes and which might have other, downstream, benefits of an economic nature.

⁸ A general breakdown of the different forms of government expenditure on commercial innovation over this period is provided in Annex 2.

⁹ The generally accepted OECD definition, based on the Oslo Manual, refers broadly to new or improved processes and products, including those resulting from formal R&D activities as well as other potential sources.

¹⁰ The recent decision by the Government to create a board for the new Ministry of Science and Innovation that includes appointees to represent business development objectives and activities, involving NZTE in particular, is also based largely on this (“take-it-to-market”) view of innovation.

10. Most of the studies reviewed which made any mention of direct economic benefits have expressed these in terms of possible or actual increases in revenues from product sales, consulting income, licensing revenues and from sales of ownership/equity in the assisted organisation. It is evident that specific measurement of these financial benefits is often problematic. This may be for technical (measurement) reasons or may be just a function of the scope and resourcing of the evaluation.
11. This measurement problem is also especially relevant to the assessment of spill-over benefits; we found very few instances in which this type of impact is specifically identified, much less quantified in any way. This leaves open the question as to whether such benefits from the intervention are real (but un-quantified), unrealised (i.e. still only “potential”), or perhaps just too broadly and optimistically stated during the initial programme design and approval process. In general, we share the view taken in much of the international evaluation literature that if no direct and measurable economic or financial benefits have accrued to the directly-assisted organisation, then it is unlikely that significant spill-over benefits will occur elsewhere.
12. Finally, any study of this subject will be constrained, to some degree, by time and resources. We have therefore tried to select from an abundance of official or published documents a cross-section of the most topical, relevant and readily available evaluation reports, analyses and data. The evaluations of government funding and taskforce reviews covered in this study have all been commissioned by government agencies responsible for the related policy or programme implementation. It is noteworthy that the findings in these evaluations have therefore been discussed, accepted and approved for publication by these agencies. We know of no significant evaluation findings in these documents that have remained under explicit challenge by the sponsoring department, or by other agencies.
13. However, the absence of formal objections to, or critiques of, these studies is not, in itself, a guarantee of the quality of their analysis and findings. What we have tried to do, therefore, is to triangulate the outputs from these evaluations and reviews with other independently formulated analyses and data, and with the results from a small number of relevant international studies. Providing support for innovation is a complex task. Not surprisingly, there are a number of inconsistencies and contradictions in the evidence. Nonetheless, the main conclusions in this report have been formulated on the basis of a generally strong congruence in the policy and economic data, programme experience and evolving policy understanding.
14. There remain many other papers, reports and documents from the last decade that are also relevant to these issues, but which we have been unable to include in this review. On the whole, where choices have been made, we have opted for the inclusion of New Zealand-authored and New Zealand-focused studies and views. Also, some definitions of “innovation” used or implied in the source documents involve a more diverse range of activities and interventions than the “commercial R&D + business development” focus of this study. We have tried to acknowledge or reflect this, where it may be important. The point remains, however, that there is a wide field of potential information and evidence and much of the terminology and many concepts are not consistently applied.
15. Despite these constraints, we are confident that the wide range of documents selected for this study has been sufficient to enable a comprehensive, integrated and objective

view of policy effectiveness in these areas. We also consider that this selection provides a sound evidential basis for our conclusions, recommendations and further discussions on innovation policies. We acknowledge, however, that the use of predominantly evaluative material in helping shape policy has some limitations and that the sum of many evaluations and reviews may still not provide the complete picture. Our aim has simply been to capture the rationale behind current innovation policies – as they are explained in the official papers - and to analyse and condense as much of the relevant evidence as possible that assesses their effectiveness.

Part A: Review of the Evidence

16. The following sections set out a number of major policy questions associated with the design, implementation and impact of New Zealand Government policies for promoting innovation (i.e. R&D and business development). We have organised these policy questions into four groups – *The Rationale for Government Spending on Innovation, An Overview of Investment Activities and Results, The Problems, Challenges and Opportunities for Public Policies* and *Some Lessons and Ideas from International Literature and Experience*. Within each of these groups we have provided, from our review of the evidence, a short summary of findings on several key issues and questions. A fifth section, *Summary and Preliminary Conclusions*, brings together the main points and the policy directions they suggest.
17. The fundamental logic of these innovation policies – which we have accepted and incorporated in our approach to this study - is that there are significant positive and direct causal linkages between innovation, investment and economic growth. The recommendations that emerge from this study focus especially on this relationship in the New Zealand context. In particular, this study is concerned with how future policies might strengthen the contribution of innovation to economic growth.

A.1 The Rationale for Government Spending on Innovation

1. **Does the concept of “innovation” – as broadly defined in the international literature and in the Government’s stated objectives for RS&T expenditures in particular – provide an effective basis for developing public policies that align with economic “productivity” and “growth agenda” objectives?**
18. Funding for research and development and for assisting business development are important and long-standing components of government expenditure policies in New Zealand. Sustainable increases in per capita income have long been regarded as highly dependent on technological improvement. However, “innovation” as an explicit target for public funding, became more prominent during the period 1998-2002 when interest, enthusiasm and investment in internet-related business opportunities and advanced technologies in particular peaked [46]. For many, the term “innovation” captured the idea that technological change – embodied in rapid new developments in ICT, creative industries and bio-technology-based industries in particular - had generated a paradigm shift in the national opportunities and requirements for international competitiveness and for the structure of successful business models.
19. In New Zealand, these changes also impacted on the direction and objectives attached to public funding for RS&T and business development. In particular, the rhetoric surrounding funding policies shifted significantly towards encouragement and support for investigation and development of (innovative) new technologies, products and commercial opportunities. New funding models were developed that gave explicit preference to these new investment priorities – as seen, for example, in the establishment in 2001 of the “New Economy Research Fund” (NERF) and in 2004 of the Pre-Seed Accelerator Fund (PSAF). Whether, and how well, these and other similar funding initiatives have been effectively connected to, or embodied, in successive national “economic strategies” – specifically the Growth and Innovation

Framework (GIF), the Economic Transformation Agenda (ETA), or the current Economic Growth Agenda (EGA) - is a matter that is considered later in this paper.

20. The reports and documents reviewed in this study incorporate repeated references to encouraging or supporting “innovation” as a driving rationale for government funding. Most of the R&D funding activities and programmes that use this term, however, do so without specifying whether or how the “innovative” qualities of the proposed research or investment are linked to productivity or economic growth. In the case of business development assistance policies and programmes, the innovative value of such investments is often rated alongside, or even below, their direct employment and/or investment “spill-over” effects.
21. Definitions of innovation, and their applicability to New Zealand’s economic structure and stage of development, involve some complex considerations. There is increasing appreciation in some recent literature of the heterogeneous nature of innovation and how this might influence the consideration and design of policies to promote innovation, which is especially applicable to New Zealand [27,28]. A key message from that discussion is that current New Zealand policies may tend to focus on the innovation needs and developmental potential of science-based industries. This could lead to the neglect of other, “lower-tech”, industries that often have different processes for incorporating new ideas and knowledge within their production systems, but which still make significant contributions to the national economy.
22. Recent changes to the Output Classes for Vote: RS&T suggest that a particular conception of innovation prevails in much official thinking. As in many other countries, “high value” industries have secured an established place in the allocation framework for research funding.¹¹ At the same time, as noted above, the GIF and ETA have been replaced by the EGA. Thus, while both the terminology and content of some innovation policies and national strategies may be evolving slightly, it is unclear whether these changes are based on a strategically sound and consistent relationship between public funding for innovation and its contribution to increased economic output. It is also unclear whether current perceptions of innovation processes and opportunities are well-grounded in aspects of domestic R&D and business development behaviour which are unique to New Zealand’s economic structure – in particular the predominance of small firms and their competitive position, mostly, on the periphery of global product and investment markets [35,42,43,44].
23. In recent years, much lower rates of economic growth internationally and a less exuberant global economic outlook have in no way diminished the argument that the best opportunities for developing competitive industries are likely to demand at least some highly innovative features. However, as new terminology becomes much more widely used – in this case “innovation” – it also tends to lose some policy specificity and relevance.
24. Overall, terms like “innovative”, “high technology” or “high value” may still be useful for conveying broad policy goals or aspirations to scientists, researchers, entrepreneurs and other funding applicants. Most countries use the same, or very similar, terms all the time. In most of the reviewed documentation, however, they communicate very little useful information, or insight, into the real economic value of the proposed research activity or even of the path to further investment and commercialisation. In

¹¹ In 2010/11, Vote: RS&T comprises the following Output Classes: Biological Industries Research, Energy and Minerals Research, Hazards and Infrastructure Research, Health and Society Research, and High Value Manufacturing and Services Research

short, “innovation” or “high value industries” now seem to provide a somewhat blunt focus for good, New Zealand-specific, policy design.

- 2. What has been the broad rationale behind the Government's funding interventions in the different areas of innovation? Are these arguments still valid?**
25. The rationale for government funding for innovation – at least through the many policy initiatives and programmes reviewed in this study - is largely based on traditional “market failure” arguments.¹² These arguments – i.e. that the market may undertake a lower level of research, development and business investment than is desirable - include “knowledge externalities”. Both the market failure and knowledge externalities arguments refer to situations, especially R&D opportunities, in which there is a potential gap between private and social returns from investing in innovation. This includes cases where individual companies are unable to afford potentially valuable R&D, or cannot appropriate all the potential returns to the economy from certain types of new knowledge, or discovery. In this latter case, publicly funded research into new products or technologies may have potentially high pay-offs where the research outputs are applicable to multiple users. In other words, the more firms (or sectors) that can utilise new knowledge, the bigger the potential economic gain. Of course, this can (and often does) create IP ownership issues around the relevant research, as later discussed.
26. The arguments for government support for business assistance programmes are broadly similar. In this case, however, it is often more simply a lack of product expertise, marketing knowledge or risk capital that is perceived as creating a potential for under-investment by the market. Examples of government financial assistance to larger firms or private investment projects – either foreign or domestic – often seem to involve a slight departure from (or at least an extension of) these “market failure” arguments. These larger interventions are predicated on the view that some form of government participation will reduce risk, signal official support, and/or help retain valuable IP, capabilities or downstream employment benefits “on-shore”.
27. Compared to R&D, the opportunity for recipients of government funding for business development – usually private companies or entrepreneurs - to capture most of the benefits are invariably greater. There may still be an argument for public investment, but it is necessary that the wider social benefits are potentially significant, clearly specified and realistically achievable. It may also be the case that the public financial contribution is kept quite small – through seed funding or assistance for feasibility studies, for example – in line with the expected social benefits.
28. The above discussion suggests that the case for government involvement in innovation is generally stronger in areas involving “far-from-market” activities, or where the outputs of the research may have significant social, environmental or other “common good” benefits. However, as with the business development argument, support for R&D which is highly appropriable by one or a few private sector firms may also be justified where there are likely to be positive economic or social spin-off benefits for the local community or wider economy (e.g. through related employment, skills development, new community facilities, etc.). This distinction, or balance,

¹² This should not imply that more sophisticated research on the nature and opportunity for effective government interventions has not been done. Detailed analysis of the spillovers from FDI, for example, was undertaken to determine specific opportunities for developing investment promotion strategies that could benefit New Zealand. However, in this case – and on the whole – these more sophisticated arguments for intervention have not emerged in the official documents describing the objectives or design of innovation policies and programmes of the last ten years, as reviewed here.

between public and private benefits is often unclear, or unknown, at the funding decision stage.

29. Government interventions in capital markets – for example in support of start-up firms, existing small companies or entrepreneurs undertaking early-stage product developments, etc. – are generally argued on similar grounds. These include that the market offering or growth potential may be neither clear at that early stage, nor properly understood by potential investors.¹³ Part of this rationale therefore includes the argument that the market may not perceive, or be able to act sufficiently quickly on, the potential commercial and wider economic benefits that may develop. In these cases, government interventions appear to be predicated mainly on the basis that matching public funding, or other mechanisms to alter the initial private risk/reward balance, may be useful to help get the venture underway. At the very least, the aim is often to assist the proponents of the venture to engage with angel investors or other venture capital managers with more specialised knowledge, capabilities and capital funds.
30. The above arguments for these interventions around innovation have been distilled from the official documents reviewed as part of this study. In practice, uncertainty around the precise justification for government funding was a common feature of these policies and programmes. Moreover, the actual arguments or objectives recorded, or implied, in the evaluation reports of different schemes and funding programmes are not always presented exactly in these terms. In particular, evaluations found that the degree of uncertainty in policy documents in terms of their specific rationale and objectives, made it difficult to determine the relevant impacts. For example, it is apparent, in many cases that publicly-funded research which may primarily benefit a particular firm or industry in New Zealand is still considered “public good” research, or at least is for the “benefit of New Zealand”. Some implications of this increasingly unclear distinction between public and private good research are discussed later in this paper.
31. Similarly, many documents relating to government support for commercialisation of research contain only a very general (and usually weak) indication of how the expected commercialisation processes might develop around appropriable research outputs. For some public investment programmes, the engagement of potential “research users” in project governance structures – through consortiums, advisory groups, etc. – seems to have developed as a preferred mechanism for managing research projects with uncertain user-outcomes. This again reflects in part the difficulty many programme interventions seem to have, or expect, in balancing public/private interests.
32. For any given intervention, various shades of these arguments are usually applied. However, in many of the studies of research, development and business assistance interventions reviewed there was found to be a notable absence of a clear connection to a stated and coherent government strategy for subsequent investment and economic growth. This applies at both the macroeconomic – i.e. national economic strategy – and at the industry and project levels. There is often very little, if any, description of the process by which public funding of the proposed investments will

¹³ In most cases, these are, in effect, information asymmetries which can be particularly pronounced for very risky investment propositions.

lead to further public or private investment, or to economic growth. It is as if the “innovative” characteristics of the research or business project are sufficient.¹⁴

33. Accordingly, those evaluations with the terms of reference to consider this sort of issue [38, 52] found little indication of relative priorities based on any overriding assessment, or requirement for economic impact. This is further reflected in the frequent absence of useful quantitative assessments of programme impacts. This observation, reinforced perhaps by the limited returns from these areas of public expenditure as discussed in the following section, may help explain the frequency over the last 10 years with which officials and others have revisited the question “are we funding the right things?”

A.2 An Overview of Investment Activities and Results

1. **What are the nature and coverage of recent government interventions relating to innovation, research and development? Has Government assistance in these areas been spread over a wide range of sectors and forms of intervention, including from early stage investment in research and innovation through to late stage commercial development, or has it been focused more tightly on clearly identified stages, sectors or areas of potential? What is the current policy with regard to focus and alignment of the Government’s innovation policy investments?**
34. Government programmes for encouraging and supporting applied research and innovation (Annex 2) are mostly contained within Vote: RS&T. The major part of these funds is contained in various programmes that have been managed by the Foundation for Research Science and Technology (FRST). However, significant public funding is also directed to innovation, research and development in specific economic and social sectors – in most cases managed by the respective sector ministries and agencies (such as Health, MAF, Fisheries and Environment). Significant funding to the education sector – for developing research capability and research activities in tertiary institutions – is administered by the TEC, mainly through the PBRF and through support for Centres of Research Excellence (COREs).
35. Financing for “later stage” business development and investment¹⁵ is primarily channelled through MED and New Zealand Trade and Enterprise (NZTE). Government venture capital financing is provided for full commercialisation of research and development, especially through the New Zealand Venture Investment Fund (VIF). Other government funding related to commercialisation of innovation occurs through support for angel investor networks and more directly to Crown Research Institute (CRI) -related business ventures and partnerships through reinvestment of CRI surpluses. As noted in the Introduction, this review focuses mainly on government expenditure programmes evaluated by FRST, MoRST and MED, though many of its observations and conclusions may have wider application.

¹⁴ Of course, there are frequent references to a proposal’s consistency with the broad objectives of a national strategy – GIF, ETA, EGA, etc. – but these are invariably trite statements of connection that have not provided the evaluators with coherent linkages against which to assess, much less measure, the macro-economic contribution or effectiveness of the spending programme.

¹⁵ “Later stage” is a commonly used term in the documentation that implies a broadly linear process. In some cases, there may be significant feed back loops from product development, for example, back to innovative research and product modification.

36. Taken together, these funding interventions (including a small number of other funding channels such as the Royal Society and HRC) cover a wide spectrum of opportunities and needs for financing innovation, research and development. There is no obvious part of the research, development and investment cycle – from blue skies research through to government contributions to established businesses¹⁶ – for which there is no source of government financial support.¹⁷
37. Throughout the last decade, there have been a number of occasions on which the government has requested officials to assess the benefits of a more strategic “alignment” - coherence of direction and focus - of government financial support for innovation, R&D and business development. Issues have been identified around the consistency of targeting of support following independent strategic choices made by departments and delivery agencies, and the consistency of these choices with high-level government strategies intended to accelerate productivity growth.
38. Much discussion has also focused on whether it would be preferable to achieve greater “critical mass” of funding and policy support within industries or sectors offering greater economic opportunities – i.e. a “sector-based” approach as opposed to a “sector-neutral” approach. By focusing on these “high priority” sectors, it is argued that greater amounts of RS&T and business development financing could be assigned to the most promising and internationally competitive research projects, capabilities or business investments. (These questions were addressed by the OECD in their 2007 ‘Review of New Zealand Innovation Policy’ [30] in which they identified ‘...a lack of coherence across the full range of innovation-related policies’, and argued for ‘...market-friendly clever targeting’.)
39. Despite regular policy reviews and discussions that have considered and, in most cases, recommended a more sector-based approach, this review found only slight evidence of progress towards better alignment or a more sector-based approach to innovation policies¹⁸. On the whole, though, it appeared that over the last 10 years public funding has been maintained across a progressively broader range of sectors and industries and at almost all stages of the research, development and commercialisation process.
40. In summary, this review could not discern from the key documents a durable policy direction on the issues of alignment or sector targeting. The analysis for this review indicate that at times (a) the argument for greater alignment has not been made sufficiently clearly or convincingly to different ministers from across the wide range of government organisations and sector groups involved, (b) there has been a lack of specificity, or strategic coherence, at least with regard to the implications for innovation policies, in the successive efforts referred to above to provide an overarching economic strategy, (c) there has been insufficient consensus at any level on the sectors or forms of intervention that should receive priority, and/or (d) that political considerations in favour of spreading resources widely (including to some degree “patching” funds into areas of need or potential, as they emerge) have dominated the policy development process.

¹⁶ For example, through the former Strategic Investment Fund (SIF)

¹⁷ FRST staff prepared a chart which depicts the coverage of government assistance at every stage of the research and business development cycle. This chart presents a very useful depiction of the gradual “spread” of NZ innovation policy coverage over the last ten years and could, if published, helpfully illustrate this point.

¹⁸ There have been some instances of increased dialogue on priority setting between Crown agents and this has resulted in joint projects in a few selected areas, such as the current collaboration in titanium alloy powders research and development. The 2010 NZTE statement of intent identifies 17 priority sectors, several of which are new areas of work

2. **Over the last 10 years, the NZ Government policies have included attempts to promote economic growth through programmes for (a) commercialisation of research and innovation and (b) financial incentives and support for innovation and commercial investment by NZ firms in New Zealand and internationally, and for new or expanded investment in New Zealand by foreign firms. What is the evidence concerning the impacts of these programmes, including the specific rates of return on funding and broader contributions to raising innovation, investment and economic growth, for example through “spill-over effects”?**
41. The evaluation reports from many of these programmes use case studies, or qualitative surveys to measure programme effectiveness.¹⁹ These are acknowledged to have an upward bias, or to involve a number of largely unsubstantiated gains. Even so, most of the evaluations point to relatively low rates of return, compared to initial predictions or expectations, in terms of commercial outcomes from the research and/or significant newly established or expanded firms/industries. Preliminary results from an (on-going) highly detailed, quantitative analysis by MED of government assistance to firms across votes strongly support this finding [1].
42. It should be noted that several evaluations – such as the Pre-Seed Fund [16], NERF [19] and RFI [15] - concluded that more time (i.e. up to 5 years at least from the time of the evaluation) is needed for reaching robust conclusions on programme effectiveness, especially in relation to government financial assistance provided to “start-up” or “spin out” firms established from NZ-based research and innovation activities. However, the number of “highly promising” ventures still in gestation from most of these funding programmes remains small relative to the total number assisted and the sums invested, and generally much less in terms of potential economic impact than anticipated by the initial programme proposals. The NERF evaluation, in particular, found only weak links to commercialisation from most funded activities despite being a fully commercially-focused funding programme. The evaluation noted that the Government needed to give more attention and support to building research connections with entrepreneurship and to realising commercial outcomes from within this programme [19]²⁰.
43. Good *quantitative* analysis of overall programme impacts has been rare. Only two studies could be identified in which a concrete estimate of the overall economic return on the programme investment could be made – the GSR [7] and TechNZ [23] evaluations. Both of these studies acknowledged measurement difficulties, including the strong possibility that (self-) selection bias may have contributed to statistical results (investment returns) that are higher than the average for all participants. Nonetheless, both studies pointed to a modest short term increase in sales (or turnover) for the assisted firms. For the GSR study this was in the region of \$1.34 to \$2.0 for each one dollar invested. The TechNZ programme evaluation used a less statistically reliable approach but also concluded that the commercial gains for some firms may, in some cases after several years, approach \$2 in *gross business revenues* for every \$1 of government assistance provided.
44. Leaving aside the considerable measurement uncertainties (plus any accounting for the dead weight costs of taxation from which these programmes have been funded), both these studies suggest relatively low financial returns. Even a doubling of gross

¹⁹ Programme evaluations have sought to show returns in terms of attributable economic growth, such as improvement in firm performance that is additional to what would have occurred without the programme

²⁰ See, for example, page 3 in Summary - Innovation and Commercialisation recommendations

revenues may not imply any innovation-related increase in IP, skills or productivity, much less any improvement in overall profitability. The studies noted that there was a quite short period of time for most firms between the provision of financial assistance and the increase in sales. This strongly suggests that any positive effects recorded on sales after the receipt of government funding were unlikely to have been derived from successful R&D - for which longer time-frames, increased productivity and more sustained revenue growth would be evident. Rather, the evidence points strongly to a short-term displacement effects (“fungibility”) in which firms were able to reallocate their own funds from R&D to marketing and sales activities.

45. Evaluations of government assistance to research organisations for self-commercialisation of research and/or capital support for new commercialisation ventures are also largely devoid of good statistical evidence on financial and economic rates of return.²¹ In several cases, the argument is made that these programmes involve long time lags from assistance to commercial fruition. Even so, it appears that major financial successes have been rare and much more difficult to sustain commercially than originally expected.
46. Spillover benefits for related industries are invariably not assessed, much less quantified, by these evaluations. However, neither the programme design documents nor the post-implementation evaluation reports provide grounds to believe that these may have been significant where the financial gains realised directly by the primary beneficiary organisations were small or non-existent. Although a lack of evidence on spillovers in the New Zealand experience does not negate the possibility that these benefits may occur in some situations, such benefits would seem to provide an unjustifiably narrow basis for the expenditure.
47. Neither individual programme evaluations, nor aggregated assessments, of the commercial returns on public investment include the specific costs of administering these programmes. It is also not clear from the relevant studies whether the broad indications (“guesstimates”) of economic returns necessarily reflect the impacts of the government financial assistance per se, or whether they include the return on co-investments in these projects from other funding sources. What is clear, however, is that for the last ten years both estimated and measured financial returns on public investment in R&D have so far seldom met programme objectives and expectations.
48. These general conclusions on the disappointingly low economic returns from government investment in R&D – especially that undertaken with explicit commercialisation objectives or justifications - should be weighed against the potential for a small number of successful projects to produce very high returns. In other words, investments in most areas of high technology and/or commercial development of innovative products or processes involve risk and uncertainty, irrespective of whether the investment funding is coming from public or private sources. The major questions for public policies are in what circumstances is it appropriate for government funding to reach into these high risk areas, how can this be done in ways which produce a viable return on taxpayers funds, and where/or to what extent is government funding truly “essential” for drawing in much-needed private funding and expertise?
49. Overall, the evaluations suggest that public expenditures on supporting entrepreneurship and business development have been moderately more successful,

²¹ This study specifically included evaluation materials from the Pre-Seed Fund [16], SCIF [3], Venture Investment Fund [2], Angel Investor Support Programme [5], Escalator Programme [4], Incubator Support Programme [8], and Research for Industry Fund [15].

especially around incubators [8] and similar new business support²². This result is unsurprising given that these interventions are generally “closer to market”. However, it is again clear that from business development expenditures over the last 10 years only a small proportion of apparently “innovative” ideas and initiatives have proceeded from public funding to develop significant commercial scale and profitability. Most of the reviews point to external factors – such as the level of investment and expertise required to take the innovative product or process into new markets (i.e. beyond Australasia) - have constrained the growth and profitability of these activities. Several studies have also noted that sale of the enterprise, or technology, to larger off-shore companies provided some of these owners/entrepreneurs with an acceptably large, immediate and predictable return [16, 45].

3. **Does the evidence from policy and programme evaluations point to areas in which the best returns can be obtained from public investment in R&D and business development? Has a broader coverage of interventions been undertaken at the expense of providing sufficiently large sums of support to the most promising areas of innovation and commercial potential?**

50. Discussion, including recommendations, for greater concentration in innovation policies on the promotion of a small number of potentially high-growth, high-return sectors appears regularly in the policy documentation.²³ These sectors usually include several of the “high tech” industries associated with biotechnology, ICT and genomics, for example, plus “creative” industries. As noted already, part of these arguments is that the economic gains from investing in innovation could be much higher overall if government resources were focused on these “more promising” areas of scientific discovery and/or technology development. Some of this discussion also includes the question of creating leading cities or geographic regions (see Section A.4).

51. The lack of concrete evidence for investing heavily in “high potential, high growth sectors” exemplifies the challenges associated with implementing a “policy alignment” strategy. Not only has there been a lack of “hard” information on which to base these judgments, but it is also not clear that realising the hoped for potential in some of these fields would necessarily generate the scale of revenues, employment and multiplier effects that are possible from more modest advances derived from research investments in the existing larger, mainly traditional, sectors. For New Zealand, strong arguments have come from both sides: don’t spread funding too thinly, and don’t put too many eggs in an (unproven) basket of “new” industries.

52. Finding good evidence on which to base these choices and decisions is difficult for a number of reasons. Firstly, much of the recent evidence points to a tendency by researchers (and funding organisations) to overstate the objectives and expected outcomes from many research programmes – often as a means to win funding in a competitive environment. This has led applicants for funding to express the expected benefits of many proposals in terms of the possible commercial spin-off. In practice, as noted above, few programmes have lived up to expectations in this regard (though

²² This is consistent with overseas experience. Morris Teubal argues that “An important goal of innovation support policy is to help companies pass through these developmental stages. This implies using different support measures at different stages... That often means using an intervention to initiate the process of learning and then leaving companies to draw the consequences via changed behaviour—another example of the ‘kick-starting’ role of the state.”

²³ See, for example, the summary document relating to the “Alignment” project [38] and the economic geography analysis by McCann [35]. Note, however, that the paper by Smith [58] challenges the view that low tech firms and industries are necessarily less innovative.

a small number of projects have been very successful and may have exceeded their expected achievements over time).²⁴

53. Secondly, programme evaluations and other studies examined in this review do not identify specific areas or industries which have shown consistently stronger returns from recent public investment in R&D or business development. Given that larger firms generally invest more in R&D [12, 42, 43, 44], it is not surprising that the major contributions to industry revenues and economic growth from research and innovation would appear to have come from the more “traditional” sectors in which New Zealand has had scale, and an established competitive advantage, for some time.²⁵ In government assistance to business development, it also appears that success has not been sector-specific. Other factors associated with the ownership ambitions, management and marketing of the venture often appear to be much more critical [6, 9, 18].²⁶
54. Assessing the effectiveness of past funding decisions is also difficult because of the way potential gains are often presented:
 - there is an ongoing difficulty in being able to clearly distinguish R&D funding decisions between proposals that contain a partial “public good” science objective or benefit and those that have purely commercial objectives and applicability, with implications for the design of relevant goals and strategies for downstream development of both forms of innovation, and
 - both funding agencies and recipients of R&D and business development assistance have a frequent tendency to set mutually reinforcing, but imprecise and unrealistic, expectations of the economic and financial potential of commercial projects, especially in terms of financial revenues, spillover (and spin-out) effects and timeframes to realisation of project returns. Again, evaluators have difficulty unpicking actual performance metrics.
55. Finally, there is a growing awareness that the complexity and high cost of developing new materials, products and technologies requires firms to have substantial technical and financial capacity and international linkages [44, 52, 55]. There is growing concern that the capabilities and resources required to transform discoveries in high-tech industries may no longer be consistent with either the size or location of many New Zealand-based firms [40, 45]. The prominence of licensing arrangements entered into by CRIs and universities from successful public-funded innovation activities rather than full commercial development seems to support this view [16]. This may partly explain the difficulty New Zealand researchers and (small) firms continue to face in converting “successful” innovation – i.e. with high commercial potential - into major revenues and hence economic growth. In other words, there may be significant commercial potential attached to the proposed R&D, but an absence of the appropriate domestic capacity to exploit it [33, 44, 56].

²⁴ The issue of spin-out companies from FRST funding of R&D is addressed specifically, but inconclusively, in the paper on “Economic Diversification” [12]. The PSAF Evaluation [16] makes an attempt at quantifying economic spin-offs from this form of funding, but examples of anticipated large returns remain highly speculative.

²⁵ McCann [35] also highlights the greater potential of these industries for R&D investment in New Zealand.

²⁶ Government contributions to the Venture Investment Fund are in large part an attempt to use private investment industry expertise in identifying business ventures with highly innovative features where the necessary components for success are present and basically well-aligned. Nonetheless, VIF managers have not found the identification of good commercial ventures an easy task [2].

4. **What do recent surveys and measures of innovation in New Zealand undertaken by various organisations say about innovation trends, economic growth and business development in this country? What might these results suggest about the effectiveness of NZ Government interventions and productivity performance?**
56. There are two main measures of growth in “innovation” in New Zealand: a Statistics survey of business sector and a separate index developed recently by IBM and Auckland University [48, 49, 51]. While both surveys note some difficult measurement issues, they conclude from quite different empirical approaches that there has been no significant increase in the aggregate (public plus private sector) level of innovation within the NZ economy over the last 10 years. Small fluctuations in one or two periods may simply be the result of measurement factors, or may be linked to changes in the business environment, especially the level of confidence around new investment. And while there are some positive sector-specific signs of innovative activity – for example amongst small software industry firms – these have been insufficient to offset a more general decline in investment in R&D by SMEs in the export sector.
57. These results may be explained in two main ways: (a) that “innovation” is increasing but is not a sufficiently well-specified concept that it can be measured effectively by surveys of the business sector and investment decisions; and/or (b) that factors other than public investment in R&D and business support programmes have an overwhelming impact on the propensity of business and other institutions in New Zealand to undertake innovative activities and investments. These other factors may be related to the general market failures, noted earlier, the particular structure of the NZ economy and business sector opportunities and constraints, to the risk adversity of investors, or to the personal aspirations or other behavioural characteristics of the private sector.
58. These conclusions are further supported by a recent MED study of innovation and entrepreneurship [50]. This study points to evidence which places New Zealand well down the OECD rankings in terms of formal measures of innovative activity (R&D expenditure levels, patents, etc.), despite a high number of scientists. Most interestingly, the study concludes that, in the recent past at least, innovative activity in the commercial sector has been strongest in industries focused on domestic markets and relatively weak in export markets or other “high growth” sectors. The level of entrepreneurship is ranked relatively high (firm entries and exits), but this does not seem to translate into growth in medium- and larger-sized high growth firms. In other words, New Zealand has a lot of quite productive scientists, but this is not being translated into enough science-based new investment.²⁷ From the scientists’ perspective (presented in *An Evaluation of Support for People in Research, Science and Technology*, By Deloitte, July 2007, see figure p38) support for entrepreneurs was least well met. This suggested that, broadly speaking, entrepreneurs are not engaging effectively with the science community.
59. It is, of course, extremely difficult to assign precise and entirely consistent explanations to all this data. Nonetheless, this meta-level evidence on innovative activity tends to support the conclusions from the (micro level) programme evaluations that public investment in R&D and business development in New Zealand over the

²⁷ These indicators are related to numbers of scientists and do not necessarily suggest that New Zealand’s overall level of R&D is low, especially when unique aspects of its economic structure are taken into account. The problem, as the Chief Scientist has correctly identified [32], is the unsatisfactory degree to which scientific and R&D activity is translated into commercial investment.

last 10 years has not prompted the growth of innovative activities, broadly measured, nor has it enabled significant successful commercialisation of the outputs from those research activities. This overall conclusion suggests a problem of dislocation in the linkages between Government expenditures on R&D and entrepreneurship, innovation and economic growth.

60. The above conclusion does not, however, imply that public funding of R&D and business development since 2000 has made no contribution to research, development or innovative new investment. Public funding has supported a number of successful, or potentially successful, discoveries, especially in areas of public good science. It has also contributed to productivity improvements in some existing industries and has assisted the profitability of numerous small business initiatives²⁸. What the evidence suggests, however, is that the arguments made for government spending on innovation have tended to overstate their actual commercial potential and economic impact.
61. Only a small number of Australian documents were included in this study. To some degree, they point to similar hard choices in developing R&D and business assistance policies and in ensuring that publicly-funded research organisations are sufficiently well structured and focused around economic outcomes [54]. On the whole, however, the growing size and diversity of the Australian share-market reflects the fact that new firms are not only emerging more rapidly from a wider range of industries, but that they are achieving sufficient scale (resources and absorptive capacity [53]) with which to undertake and apply an increasing level of commercially-focused R&D. A number of significant, formerly New Zealand-based, firms have moved across and have contributed to this process [29].

²⁸ For example, Internal Rates of Return of up to 30% in horticultural products are reported from case studies, for example, green and gold kiwifruit, in <http://www.growingfutures.com/index/page/6>

A.3 The Problems, Challenges and Opportunities for Public Policies

1. **What do the studies and evaluations say are the market failures and other factors that impede innovation and the successful commercialisation of innovative products and services in New Zealand? To what extent do current policies and programmes appear to be addressing, or not addressing, these constraints effectively?**

62. As noted above, the policies underpinning most R&D and business development programmes are often not *specific* with regard to their economic rationale or to the nature of the market failures they are aiming to correct or offset. Arguments for these expenditures are usually couched in terms of exploring areas of science or technology that show strong economic potential, but for which there is little apparent capacity for the required investment in initial R&D by the private sector. Although proposals for individual funding grants are sometimes quite explicit regarding the expected commercial purpose and benefits of the research activity or business project, these may not provide details of why private sources are unable to commit the necessary amount of resources. In fact, in order to win competitive funding for the research, it may be in the interests of the research institution to explain only the potential use/value of the research without examining the full scope of private sector interest and capability in taking up the proposed R&D outputs. However, to be fair, in some cases this may not be clearly known, or know-able, unless at least some of the research is performed.

63. Similarly, the various channels by which successful outcomes from these public expenditures on research will ultimately attract additional private sector investment (including income for the research organisation) are mostly left to the research institutions to determine – for example through spin-out companies, joint ventures, licensing, royalties etc. However, getting private sector engagement in these activities before there is strong evidence of a commercially viable opportunity has proved difficult [15, 16]. It appears there are often very few, if any, NZ firms with the capacity (resources and risk propensity) to develop these opportunities further. Some of the evaluations suggest that questions concerning the relevant impediments to private sector uptake needed to have been addressed much earlier during the decision to commit public funding.

64. Significant efforts have been made in recent years to ensure “end-users” are more actively engaged at an early stage, including in research design²⁹. However, in most cases, this user-engagement approach has proved more manageable and effective with regard to “public good” research activities – often involving public sector user organisations - rather than around highly appropriable ideas and technologies.

65. Government assistance to New Zealand firms has most often been driven by objectives for retaining skills, jobs and productive capacity in New Zealand, for developing promising new technologies (rather than licensing off-shore), or for supporting the expansion of NZ-based firms into overseas markets. For example, Government assistance to FDI, the arguments are more generally couched in terms of attracting and promoting external investment that will bring capital and skills, create jobs and have spill-over benefits for existing NZ firms [11]. Such assistance in recent years has involved relatively little targeting of specific industries or capabilities, rather

²⁹ For example, as reported in FRST’s 2008/9 annual report, 54 percent of Research for Industry contracts attracted direct cash co-funding of 5 percent or more of contract value.

it has responded to opportunities, or individual commercial approaches, as they have arisen.

66. From the evaluations of these interventions, it appears that the linkages between R&D, innovation, entrepreneurship and investment in New Zealand have been more complex (and difficult to get right) than is suggested in the rationale presented for many RS&T and business development funding policies. Like several other studies, the CRI Taskforce [24] recognised the problems that these research institutions have experienced in terms of business uptake and commercialisation of their research outputs and the need for them to be much more accountable for delivering on economic objectives: “*CRIs can and should do much more*”.
67. The CRI Taskforce did not discuss the basic model underlying the relationship between public funding of these institutions and their constrained level of commercial output. Without examining the underlying problem, “statements of core purpose”, even with other adjustments at the margin to funding and governance, may not be sufficient to address the deep-seated problems in the relationship between the publicly-funded, commercially –focussed, R&D performed by these institutions and the needs and expectations of the business sector.
68. Evaluations of RS&T programmes suggest these problems are also evident in the publicly funded research by universities. The OECD identified the wider nature of this problem in New Zealand: “*(There is) ...a low rate of collaboration and ideas flowing from universities and research institutions to business*”. [30] The Prime Minister’s Chief Science Adviser concluded similarly: “*There is increasing recognition that the public and private R&D sectors are collectively essential to accelerating New Zealand’s development, and to promoting a trajectory towards enhanced innovation and productivity growth. It is therefore important to consider how to improve the transfer of knowledge from the public research system (which primarily comprises the universities and Crown Research Institutes) to the private sector.*”³⁰
69. With universities, it may be argued, the Government’s economic objectives are necessarily constrained by parallel expectations of improved educational performance and outcomes. However, the end problem of connecting publicly-funded innovation with private investment appears just as acute. It is also apparent that proposed solutions involving “more funding”, “less contestability of funding” (or more contestability [25]), or “changes to governance arrangements” underestimate, or misunderstand, the difficult nature of this problem, including the low effectiveness of much public funding for innovation evident from the evaluations and statistics referred to above. Recommendations by the OECD, and others, for the Government to spend more across Vote: RS&T in particular appear to give little regard to the nature and depth of these obvious failings in the current model.
70. Despite considerable attention in recent years on the “commercialisation” objective, it appears that current policies have failed to unlock the constraints on turning R&D activities into significant business investment and economic growth. It is a particular concern that while much discussion has been given to funding levels and the financial viability of research institutions, very little informed discussion has taken place around the changing economic environment in which these research activities now operate [29,45]. Globalisation, as reflected in changes in the competitive environment for many NZ industries and firms and in the composition and performance of the NZ

³⁰ Website of Prime Minister’s Chief Science Adviser, www.pmcsa.org.nz, posted 25 September 2009.

share-market, has shifted some of the goal posts for commercialisation of innovation. The limited effectiveness of innovation policies may be attributable in part to the degree to which these have followed standard international (e.g. OECD) thinking, rather than responding more specifically to New Zealand's unique economic features and competitive position within this new environment.

71. Finally, it is apparent that good quantitative analysis on the impact of government interventions is lacking in the evaluation of innovation policies and programmes. More attention must be given to measuring actual economic and financial returns from these "investments". Frequent reference to the difficulty in quantifying funding outcomes – arising from research timelines, product development "lags", market acceptance, etc. - are understandable, but these should not be used as a substitute for more rigorous and objective analysis of the real economic returns.
- 2. To what extent do the accountability requirements and bureaucratic procedures associated with government financial assistance in these areas put off some firms from seeking this assistance? In this sense, are the requirements for sound and transparent management of public finances compatible with the flexibility, high risk, commercial reality and potentially high levels of private sector appropriability (and profitability) often associated with commercialisation of innovation and research?**
72. Compliance costs have been an issue in the implementation of many funding programmes. Although there is inevitably some trade-off between efficiency and accountability in these areas, the problems identified have generally not come from the rules associated with any particular programme or form of assistance. Rather the problem has come from the *combined effect* of various programme rules and requirements that have generated overlapping and repetitive demands [14, 16, 20].
73. This problem has sometimes been exacerbated by turnover of staff within the relevant public sector agencies. This has had the effect of demanding more explanation and repeated submissions of material and information from research organisations and firms. Some reviews have suggested that a "gaming" mentality has evolved with regard to funding of research, especially amongst publicly funded research providers [14].
74. These problems are generally less apparent in business development schemes. However, there is evidence that some potential applicant firms have been deterred or alienated by bureaucratic process and/or compliance costs. The picture varies considerably between firms who found the government assistance efficient and vital, to others for whom it made only a minor difference to their chances of success and to some who expressed regret at their involvement. Overall, it appears that it is not the accountability requirement that is resisted by funding recipients, but rather the efficiency with which some monitoring and compliance procedures have been conducted including time demands on management and time delays. The problem referred to above of over-inflated commercialisation expectations has also added to the intensity of (and possible frustration with) monitoring demands.
75. In the science sector, steps have been taken to improve efficiency and reduce compliance costs in the context of individual programmes and funds. Overall, however, it seems the demands are still high relative to the level of assistance. Previous policy reviews have suggested that the problem could be addressed by

reducing the number of different funds (and their associated requirements on applicants), by some organisational consolidation (FRST and MoRST were amalgamated to form the Ministry of Science and Innovation in February 2011), by re-balancing the proportions of core and competitive research funding for CRIs (underway), by rethinking some of the underlying approaches and expectations for commercialisation, and by stepping back from attempts to impose administratively intensive and centralised management of researcher/developer/investor relationships.

76. A practical example of how this is being addressed is that FRST and NZTE have established a network of 'Regional Business Partners' to support business growth and innovation in their regions and become the first point of contact for businesses around New Zealand seeking government assistance. The combined approach across ministries should simplify processes for businesses.
- 3. What aspects, if any, of the relationship between publicly funded research providers – particularly CRIs and universities – and the NZ business sector have been identified as presenting obstacles to the commercialisation of outputs from publicly funded research? Does the evidence around the commercialisation of publicly funded research suggest a need to further re-think and revise institutional mandates and incentives in the research sector in order to secure greater and more efficient investment outcomes from existing capacities, resources and outputs?**
77. Public funding of R&D within major research institutions in recent years has mostly been associated with high expectations on the capacity of these entities for successful commercialisation of their science outputs. In hindsight, these expectations have been unrealistic. Research is one thing, taking this work to the next stage of profitable investment (and hence to economic growth) is quite another. Recent policies may have encouraged research institutions to over-promise on the commercial outcomes, simply to secure the required funding.
78. This conclusion is supported to some degree by business sector views on the relative importance of publicly-funded institutions in supplying information for innovation. The Statistics New Zealand 2009 Survey of Innovation in New Zealand [50] found the percentage of NZ business respondents who used the following sources of information for innovation³¹:
- 74% existing staff
 - 61% customers
 - 54% new staff (appointed in last two years)
 - 46% suppliers
 - 44% books, journals, patent disclosures or internet
 - 8% universities or polytechnics
 - 6% Crown research institutes, other research institutes, or research associations
79. This result does not imply that the private sector has a poor view of the quality of work performed by these institutions. On the contrary, many companies and organisations contract directly and successfully with them on a wide range of research needs. However, as a whole, the private sector does not look to these institutions as a key *originating* source of innovation with high commercial potential. Innovation can have

³¹ Statistics New Zealand has quite specific definitions of innovation and research and development based on OECD definitions – these can be found in their relevant publications.

important linkages to R&D but the international evidence suggest that the linkage is complex and in some key sectors may be not be critical³². This view, if correct, suggests the need to reconsider some aspects of the underlying premise for the present public funding model for R&D.

80. Programmes to “seed” or help capitalise promising areas of research have made mostly small contributions on this issue [16, 24]. It appears that the underlying model – in which research organisations are funded to help turn some of their research outputs into commercial opportunities - has met with unexpected challenges. Recent taskforce recommendations are aimed at helping the publicly funded research organisations get back to doing what they do best - providing high quality scientific research. For appropriable research, the terms on which funding is provided will need to be reconsidered carefully. This is less of a problem where the scientific output is commissioned directly by the industry user, but much more problematic in areas of publicly funded research that may involve highly promising but less immediately applicable IP – such as high tech materials, pharmaceuticals and biological discoveries. There is still much work to be done to overcome the intellectual property ownership obstacles to public researcher / industry user relationships that appear to have developed in recent years. The documents reviewed suggest that only one or two (relatively larger) research institutions have created structures that are successful at managing these business activities, including building and maintaining effective relationships with potential investors and firms.
- 4. Is there evidence to support the view, expressed on occasion by the OECD for example, that New Zealand (as a very small economy in highly competitive global markets) just needs to do much more of what it has been doing in terms of providing assistance to innovation, research and development?**
81. There is no strong evidence that commercial opportunities and returns have been lost through any aggregate under-funding of R&D or business assistance activities. Although many of the programmes reviewed include quite small expenditures (for individual projects and in aggregate) insufficient funding, per se, is not seen by the evaluations to be a binding constraint on performance or outcomes. (The limited duration of some contracts was sometimes found to be a constraining factor).
82. There is, however, a recurring argument in the documentation that the available funds may have been dispersed across too many different programmes with competing objectives, duplicative compliance requirements and unrealistic expectations. At times, this has caused frustration and administrative inefficiency. Much of the evidence suggests a need to re-think relevant aspects of funding policies to reduce fragmentation and overlap, to consolidate some funding activities, and to identify ways for strengthening the linkages from R&D to innovation and economic growth.³³
83. Business development assistance has shown fewer problems of fragmentation but could also be simplified and consolidated. Recent evaluations show that the most useful and effective interventions are where the assistance is quickly obtained, clear and realistic in its reporting requirements and expectations. Several studies point to the lesson that the allocation of government funds for retaining or attracting individual

³² The OECD Innovation strategy has, for example emphasised regulatory factors. See also 28, 53, 60

³³ A review of the business assistance in 2006 [9] noted that many funding decisions did not seem to be following GIF priorities.

firms – either through major capital contributions or other one-off financial enticements - is invariably risky and seldom effective.

84. Some documents question the applicability (generally, but especially to New Zealand) of a broad-based approach to innovation policy [27, 28, 51]. In essence, this approach contends that New Zealand, like many larger developed countries, should maintain an essentially un-targeted, or “sector-neutral”, programme of support for R&D and business development. This may, however, overlook the fact that the structure of production in smaller economies is often quite specialised and based on traditional (and emerging) - but relatively narrow - areas of competitive advantage. In these situations, it is suggested that the greatest returns to investing in innovation (i.e. the greatest economic gains) may well come from directing the limited quantity of public funding available for innovation at more narrowly-defined areas of economic potential.
- 5. Is the current emphasis on science and innovation helpful for good policy design? Are current policy objectives for increasing innovation fundamentally consistent with NZ’s economic structure and competitive strengths?**
85. Policies for investing in research and development in New Zealand need to accommodate the prevailing economic structure and the very specific opportunities, needs and threats faced by different sectors. Innovation remains critically important, but the underlying models for taking research through to successful commercialisation may be very different from the initial thinking that often envisaged a patent/spin-out (or “dot.com start-up”) approach. More attention to the specific global market opportunities facing New Zealand, including how and where major R&D investment location decisions are now made, would seem to be a necessary part of any new policy mix under consideration [32].
86. Political emphasis on the potential contribution of innovation to New Zealand’s economic future is important and mostly helpful, but this carries a risk of highlighting the “new”, while overshadowing the need for much improved productivity in many existing industries and organisations. For example, research in the biological sciences has been critical to both growth and protection of many of New Zealand’s primary industries, particularly pastoral, forestry and some horticulture (apples and kiwifruit). However, success in these areas does not require the public science system to learn what firms exist, how they operate and the issues that they face. Nor does it necessarily require centralised efforts to drive researcher/user platforms for ensuring subsequent development and investment. What these sectors mostly need are well-targeted, highly skilled and profit-focused research/investment programmes that deliver solutions, or at least new opportunities, straight into the hands of existing companies with the capital and capability for further development.
87. Second, the emphasis on “innovation” has tended to cloud the essential differences between research in public-good areas of science and those with more distinctly commercial, or appropriable, outputs. For commercial outputs very often there is little distinction made, or attention given, to the degree to which different forms of “innovation”, or private sector partnership strategies, are necessary to commercialise research or solve completely different sorts of problems, or to meet completely different needs and applications.
88. Third, political emphasis on the importance of innovation for economic growth has a tendency to be interpreted (or presented) as a need for government to spend more.

More spending is not a priority in New Zealand's case; public funding of R&D has increased significantly over the decade reviewed here (about 6% p.a. on average) and has remained generally comparable with, or slightly below, the average for OECD countries [41]³⁴. It is not the volume of government spending that is the problem; the quality and effectiveness of spending, including especially the degree to which research outputs and (mostly small) business investment support are converted into significant commercial investment, plus the encouragement it provides to private R&D spending are the crucial issues that now confront policy development. Has the right split between basic research, applied and experimental research been achieved and proportioned between research organisations and private businesses?

89. In summary, the emphasis given to "innovation" over the last ten years has had positive benefits in driving more ambitious research and discovery in many areas. In other ways, however, it may also have had a limiting, or over-simplifying, effect on policy design and development. This has applied particularly to the design of appropriate commercialisation strategies in the New Zealand business environment, to insufficient attention to productivity improvements in existing industries as a specific research policy objective, and to differences between public good and private research outputs. There is a need for much better problem definition in determining the case for research funding or business development assistance as well as a need for much more realistic assessment of what this funding might contribute within the wider economy. In future, ensuring that industry-focused R&D can be successfully incorporated/absorbed by profit-oriented economic enterprises that remain based in New Zealand may also require a smarter and more realistic understanding of New Zealand economic structure and its real competitive opportunities.

A.4 Some lessons and ideas from international literature and experience

1. **What does the international literature say about the roles of small, medium and large firms with regard to innovation, research and development and how well do these theories and studies fit with documented studies, experience and business development assistance policies in New Zealand? Do the theory and evidence presented in international studies and literature concerning the benefits of scale and intensity in production - including agglomeration of high potential industries and expertise within certain regions or large cities - apply to the role of Auckland city (or perhaps the greater Auckland region) within the NZ economy?**
90. The studies reviewed confirm the considerable importance for the New Zealand economy of small and small-medium sized firms (by international standards) [44, 58, 6, and 9]. The evaluations also confirm that much of the public expenditure through Vote: RS&T and Vote: Economic Development accrues to small or very small enterprises. These are important potential sources of innovation within the economy, but the reality is that the proportion of firms that go on from much of this early stage government funding to expand into medium or larger profitable, NZ-based, businesses is very low. Powerful international factors driving business decisions, including the distribution and agglomeration of business activities in key locations around the world, appear to be working against the conventional model of business investment and expansion inherent in these spending programmes [33, 35].

³⁴ Refer, Chart 2.6, p. 20 (of the source document).

91. Although it appears that many small firms are getting started within New Zealand – through innovative products, services and technologies – few are carrying on to reach sufficient scope to be internationally competitive. The result is that much of the hype generated occasionally by apparent “discoveries” of new technologies, materials, processes etc. from within the publicly-funded research providers is having little sustained economic impact through investment by new businesses. In contrast, R&D which feeds directly into established industries and processes seems to lead more directly to economic growth via sustained increases in efficiency and productivity.
92. Overall, this pattern of the outputs from R&D, useful advances to established and internationally competitive industries but few major new areas of business development, seems entirely consistent with international trends in business development and spatial relocation decisions. Capital market limitations are an important contributing factor in this picture, but they are not a key constraint on the current rate of innovation, nor on the ability of the New Zealand economy to grow large and successful new businesses on the basis of discovered (i.e. “innovative”) new products and services.
93. Some recent literature on economic growth highlights the importance of agglomeration effects for improving economic productivity. New Zealand faces serious disadvantages in this regard, especially through the absence of large firms that can successfully carry (innovative) new technologies, products and services to larger (international) markets. There will continue to be a strong off-shore pull for many non-traditional industries, even though the initial R&D may have been started in New Zealand.
94. In addressing these trends, several of the reviewed papers discuss the potential benefits from promoting agglomeration in the Auckland region, and/or in the greater Auckland/Waikato/ Bay of Plenty region [33, 35, 39, 40, 43]. This quest for agglomeration effects underpins arguments for improving the infrastructure and governance of Auckland City and to help Auckland achieve some form of “world class” city capabilities.
95. While most theories of agglomeration (economies of scale and concentration effectively) support this concept, there appears at the moment only limited, preliminary, evidence that establishes its applicability to Auckland, or to economic structures in New Zealand more generally.³⁵ The key problem is that Auckland (though large in population terms within New Zealand) is not a large city by international standards. It is also not strategically located with regard to input processes or export markets as are the large cities on which most agglomeration theories are based. In other words, concrete linkages to improved innovation have not been made.
96. In New Zealand’s case, major advances in R&D and innovation have tended to occur in regionally dispersed locations which are close to relevant industries, including traditional sources of expertise. There may be some advantages for small business growth in agglomeration in the Auckland region, but real disadvantages for sectors with highest innovation potential in moving sources of R&D away from surrounding expertise, resources and customers/users. Once again, there may be a need to interpret and apply international experience to the New Zealand economy with considerable care.

³⁵ Some recent work commissioned by MED – as yet unpublished - suggests that there may be small industry productivity advantages associated with agglomeration or other factors in the Auckland region, compared to the rest of New Zealand.

97. The general impression from the documents underpinning this review is that much more research is required to establish which economic sectors and businesses in New Zealand may actually benefit from agglomeration and which may be preferably located within other regional environments that are conducive to building innovation and other competitive features. From an international economic perspective, most regional locations in New Zealand are only marginally more remote, or disconnected, from world markets or centres of innovation and expertise than is Auckland.

A.5 Summary and preliminary conclusions

98. This section draws on the synthesis of evidence and findings described in the preceding sections. It presents an overall perspective on the effectiveness of recent innovation policies and what the evidence suggests or implies for developing better policies. As with much of this study, the focus is on innovation that has a potential to contribute directly to New Zealand's commercial opportunities, investment and growth.

1. The returns to Government investment in innovation

99. Programme evaluations and statistical analyses point to modest economic returns from public investment in commercially-focused, innovation over the last 10 years with most returns having been experienced in established industries rather than new high-tech or high value areas. Although some studies indicate that the gross revenues of some firms have increased slightly following government support, and that some research institutions have received (mainly small) revenue streams relating to IP sales and licensing, there is little evidence of outstandingly successful public funding interventions that have generated significant and sustained economic or financial returns.
100. These findings – at the level of individual programmes – are strongly supported by recent macro-economic data. National studies of innovation activity in New Zealand, including the data in the charts in Annex 3, point to flat or even declining levels of innovation and associated investment. New Zealand experience of attributable returns from government direct financial support for business innovation is disappointing. This conclusion is not inconsistent with overseas experience, such as Australia. The Australian Productivity Commission recently concluded that “public funding support produces sizable benefits”, but this mostly relates to *public good* research through universities and other public institutions [56]. In addition, this assessment includes an assumption of large spill-over benefits from a few highly successful projects.
101. New Zealand's apparent low economic returns from public funding of commercially-focused innovation – including highly uncertain spill-over benefits - do not necessarily imply that the quality of scientific research, or R&D, has been unsatisfactory. The evidence here also points to much useful *public good* research that has been undertaken – especially in the environment sector. There also appear to be some good examples of research organisations working effectively with private clients to enhance productivity and commercial returns, especially where the private sector maintains a direct contractual relationship with the researcher and is assured of unfettered ownership of the associated or resulting IP. Similarly, the level and quality of entrepreneurship amongst many small and medium enterprises appears to be consistently high. The concern for public policy is that the innovative activity supported by government funding has generated so few examples of major, highly profitable,

new investments. Overall, the evidence indicates that the contribution from government spending on innovation to economic growth has been minor – certainly well below the levels envisaged or implied in many official statements and programme objectives.

102. Based on the evidence, it is clear that the amount of funding invested by Government in innovation that has predominantly commercial or economic objectives is not the problem that is sometimes suggested. There have been substantial and sustained increases in funding over this period, particularly through Vote: RS&T, well in excess of the average rate of inflation. The real problem is that, overall, this investment of public funds in R&D and business development has not translated into significant new levels of commercial investment, much less major opportunities for economic growth. This outcome appears to be well understood in many policy reviews and policy discussion papers, but the reasons for it have so far not been adequately identified. Any increase in spending therefore seems unjustified by any available analysis, and unless and until the underlying problems are identified and addressed.

2. The structure, coverage and focus of current policies

103. Public policies for promoting innovation have evolved to the point where some financial support is now provided at every stage of the innovation process from initial research through development, testing, financing and full commercialisation. This study concludes that there are now no obvious “gaps” in the availability of government assistance which might be argued from a critical weakness – or missed opportunity - in the structure, coverage or even quantity of government funding. We note, too, that this widely based support for the innovative process has been generally in line with OECD recommendations for a comprehensive and sustained regime of government assistance. (The only significant exception being New Zealand’s decision not to maintain an R&D tax credit scheme.)
104. Nonetheless, this broad-based assistance for innovation has been the subject of on-going debate. Over the last 10 years, the merits of greater targeting of funding interventions - involving a more specific “industry focus” and increased “critical mass” in the funding allocated – have been raised many times.³⁶ It appears that these debates remain unresolved with very little shift in actual funding policies towards the promotion of specific industries or technological processes. Part of the problem may have been that the concept of targeting has been constrained to selecting industries or sectors in a way that implies a risky (and unfashionable) “picking winners” approach. Given the generally limited economic impact of current policies, and in light of the substantial evidence now available, this debate needs to be re-defined, re-examined and if possible resolved.
105. Like many countries, the policy rhetoric surrounding public investment in commercially-focused innovation in New Zealand in recent years has consisted mainly of high-level statements favouring “high technology”, “high value” and “knowledge-based” industries, “platforms”, “world class cities” etc. What these broad statements have failed to communicate, however, is how and where viable and significant new industries will develop around or out of specific investment decisions. More especially, successive national economic “strategies”³⁷ for lifting growth and living standards

³⁶ Again recently by the New Zealand Institute in its “A goal is not a strategy” publication [26].

³⁷ Initially, “Growing an Innovative New Zealand” [46] followed by the “Growth and Innovation Framework”, the “Economic Transformation Agenda” and the “Economic Growth Agenda”.

have failed to define how public investments in R&D and business development will flow or contribute to investment in significant new industries that incorporate new processes, or newly discovered IP.

106. Funding research in the hope that the publicly-funded research organisations, or small business project leaders, will themselves then generate the other necessary elements for subsequent major investment in highly competitive new industries or economic activities is a model that simply has not worked. Public investment in innovation needs to fulfil a much more strategically defined role in addressing known problems in low productivity, in expanding growth potential of major existing industries and in supporting private investment in major new opportunities³⁸.

3. Commercialising research

107. The lack of effective connections between innovation policies and a sound economic strategy based on New Zealand's actual competitive advantages and global economic opportunities is not the only impediment in the relationship between innovation, investment and economic growth. This study concludes that the low economic returns from public funding of innovation also reflect policy challenges and organisational constraints in the publicly funded research sector (including public and private organisations).
108. Review of the evidence reveals two consistent problem areas: (i) insufficient experience and confidence by the private sector in working with the publicly-owned research organisations, and (ii) a difficulty for these institutions in taking potentially promising research through to full and successful commercialisation, that involves major new investment and that leads to significant economic growth. Recent steps to introduce Government-subsidised R&D vouchers for small business have been shown from evaluation of overseas experience to be useful. However, given the challenge for New Zealand's innovation policies, reflected for example in the figures in Annex 3, significant additional initiatives appear to be urgently needed.
109. On the positive side, there is much evidence that New Zealand scientists and researchers are highly skilled and productive by international standards. Many of the institutions that have received public funding in recent years are judged to have a high standard of scientific output, even if the eventual commercial value of much that work has proved less certain. There is little doubt that the research output from NZ institutions has responded, at the margin, to shifts in public policy direction, but the institutions themselves have remained predominantly public good-oriented in culture, outlook and performance³⁹.
110. The evaluations and policy papers reviewed during this study are highly consistent on this issue. The Capital Markets Taskforce [29] stated: "*Researchers, commercialisation staff and institutions also need to be given the right incentives to maximise the value to New Zealand from research.*" The 'crown company model' was also cited [24] as one of the factors that may have prevented these organisations from playing a more effective role in facilitating the linkages between innovation, investment

³⁸ That part of the R&D sector in which government has a stake (including primary industry agencies, science and innovation agencies and tertiary education agencies) could also seek to operate to a minimum standard of sector-wide analytical techniques, such as use of cost-benefit analysis, for assessing opportunities and setting priorities.

³⁹ Some universities and CRIs have pursued a partial commercial model with mixed success, such as IRL's *BioPharm* and Auckland University's UniServices Ltd and have built on this experience...

and growth. However, it is evident that institutional constraints and deficiencies of entrepreneurial talent and incentive are not the only explanation.

111. Other reasons may include the fact that, as a whole, the financial resources of the publicly funded research sector are (necessarily) limited. Also, much of this funding is quite fragmented, due in part to the policy dispersion factor noted above. This has contributed to an environment that is more competitive than collaborative. Many of the reports reviewed in this study point to institutional behaviours aimed at protecting or enhancing funding opportunities ahead of identifying and promoting commercially successful research. At the same time, private sector frustration in working with these organisations reflects a mixture of distrust (especially around IP ownership issues), perceptions of excessive bureaucratic delay or demands (mainly attributed to the public funding agencies) and unclear contractual obligations and performance responsibilities between the parties [16, 22]. Too often, it seems, funding policies have assumed, or tried to impose, a working relationship between the research organisations and private interests that suits the needs and culture of neither party. It is evident that the underlying “science-push” model in which public funding of R&D tries to incentivise public/private collaboration with a potential for significant commercial investment and profit outcomes is not working.
112. Collaborative models that have sometimes worked well in relation to “public good” science and innovation research have not served commercially-focused R&D in the same way. The distinction is important: it is clear that Government cannot successfully “purchase” commercial R&D on behalf of potential private investors. A clear line needs to be drawn between the funding and collaboration models that work for “public good” science and those that are needed to work for private sector investment and growth. Government expectations of what public funding can achieve with regard to the performance of these organisations, including especially the successful commercialisation of their research activities, could then be redefined accordingly.

4. Making business assistance more effective

113. Evidence from evaluations of government assistance to business development – primarily through Vote: Economic Development - highlights several similar issues regarding the linkages to investment and growth. However, in this case, the amounts invested annually are significantly smaller in total and the results slightly more positive in terms of identifiable economic outcomes. This may be largely because this form of assistance is often more directly connected to actual private investment. Nonetheless, the evidence also points to only small gains overall.
114. There seems little doubt that government financial assistance can play an effective role in helping to gather information and to build capability and competitiveness for small firms. On this basis alone, programmes that facilitate for NZ firms the analysis and entry of new markets or investment opportunities have a useful role to play as a tool within a broader strategy for economic growth. Government financial assistance to foreign investment, on the other hand, has proved much more problematic in recent years. Although some financial provision for attracting foreign investor interest and engagement remains necessary, it has proved difficult to design and administer such assistance in ways that avoid it becoming a substitute (however temporary) for commercial viability. Large contributions of public funds, or other special incentives, to single firms – whether NZ or foreign – have a very disappointing record in terms of influencing longer term location and other production decisions. It may be possible

also to link this form of assistance more directly to investment in R&D in New Zealand, as Singapore has managed to achieve, though MED does not appear to have done the analysis required to test this strategy.

115. Like R&D, the key issue for the design and implementation of business assistance is how to choose (and best support) entrepreneurial ventures that will make a significant and long term contribution to the New Zealand economy. The problem of SMEs growing from their NZ base before moving off-shore through sale, or relocation of their major operations closer to overseas markets has plagued the implementation of these programmes. The Capital Markets Taskforce agrees: “...we see *insufficient commercialisation of innovation, and too few of the resulting companies grow to become global players.*” [29, p.2] Evidence of the strength of the off-shore pull is in both the programme evaluation reports and, arguably, even more obvious in the changing number, size and composition of listed companies on the NZ stock exchange. As with R&D, there is a substantial problem in fully harnessing New Zealand’s entrepreneurial capacities for long term economic gain. Unless this problem can be overcome, the connection between government financial assistance to early stage investment and resulting revenues, jobs and economic growth will remain tenuous and weak. Once again, the solution seems to lie in smarter policy design, rather than increased funding.
116. The study has revealed a number of areas in which there are opportunities for MED to enhance the contribution that innovation policies could make to investment and growth in the New Zealand economy. These areas include especially the development of explicit policy linkages between public spending and support for innovation and an overall economic strategy, as outlined in Conclusions 1, 2 and 3 above. They also include undertaking the detailed analysis required to properly inform decisions on the merits (or otherwise) of targeting a higher proportion of innovation spending at new technologies and industries and at the opportunities for significant productivity improvement in existing industries. MED could also assist the design and evaluation of innovation policies by defining relevant quantitative objectives and information which might encourage and enable more effective contributions to future economic growth.

5. Improving innovation policies

117. There is no doubt that a significant part of the recent evidence on the effectiveness of innovation policies is disappointing. The fact that other countries are uncovering similar problems, particularly in regard to programmes involving a “science-push” approach to commercialisation of innovation, is little consolation [52, 55]. However, with the information now available, developing more effective policies is both necessary and possible. This study suggests, as a starting point, addressing the following key questions:
- Does the policy mix for investment in innovation need stronger top-down direction; how can this be provided by a more realistic and effective national economic strategy that gives more effective support and incentives for business investment and growth?
 - What should be the balance between publicly funded R&D that is targeted at known productivity and competitiveness issues in existing and established industries, compared to R&D in new and unproven areas of science and

technology?

- Which sectors or technologies should be given greatest priority when making innovation policy investments and on what basis? For example: in what areas can New Zealand use and encourage innovation that leverages off its existing competitive advantages? Similarly, where might assistance for innovation be better focused in future in order to exploit opportunities for the largest productivity improvements?
 - How can innovation policies better accommodate and support the diversity of commercialisation models, and the uneven absorptive capacity, of New Zealand industries? How can they better overcome the generally limited interface between these industries and the research sector?
 - How can better alignment be achieved in practice between government financial support for innovation, R&D and business development, such that investments are better supported along the research, development and investment cycle? How can much stronger emphasis be given to commercial and entrepreneurial expertise and incentives within this cycle?
 - How might government funding for the research sector be more effectively separated between the non-appropriable (public good) research – which it is mostly very good at – and appropriable research with potentially significant economic benefits – where commercialisation models, including effective relationships with the private sector, are highly problematic?
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Reference Documents

Annex 1

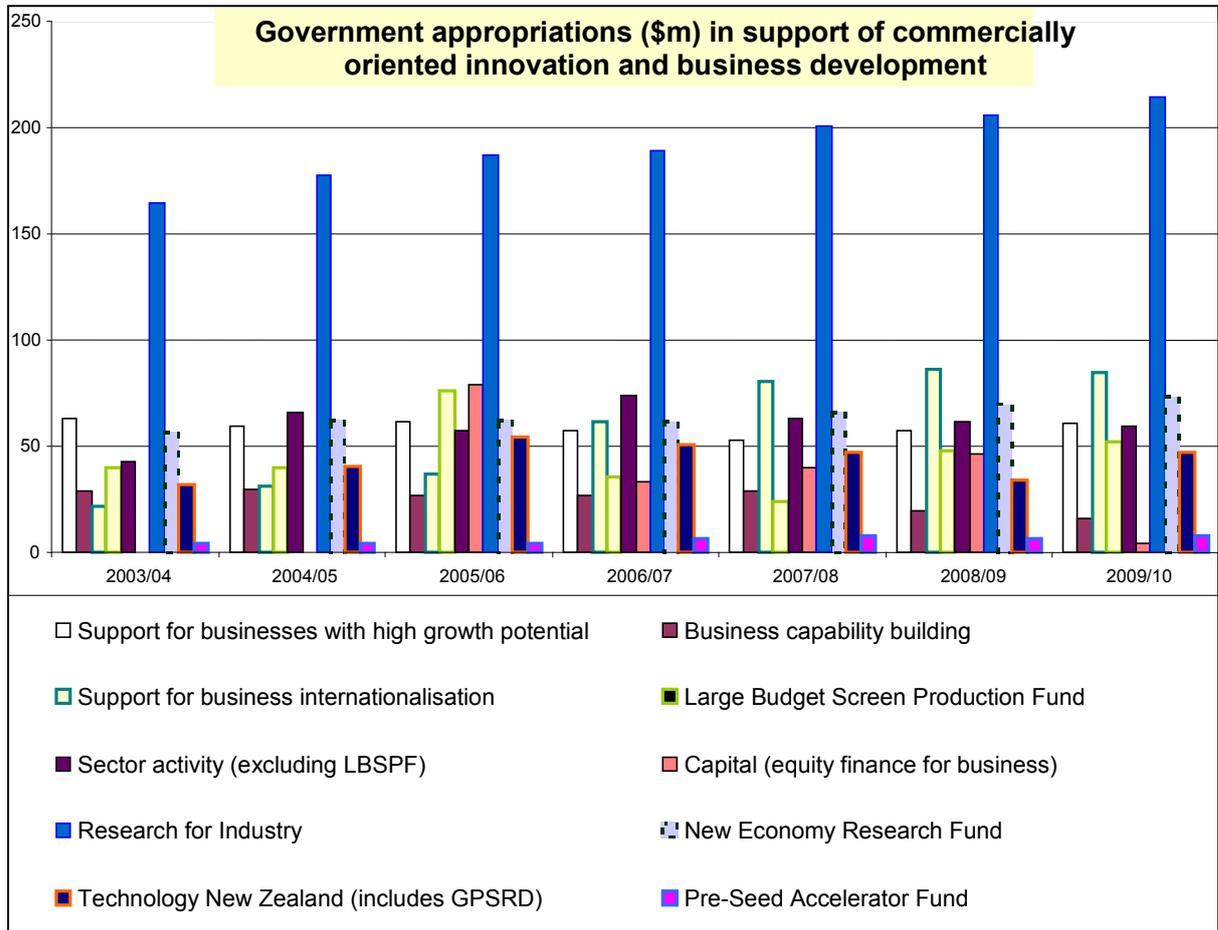
See Part B of the Study for Summaries and Extracts from these Documents

Ref. No.	Funding Scheme / Programme	Evaluation Document /Author(s)	Year of Eval Rpt.	Expenditure Vote
1	Evaluation of the impact of Cross Vote government assistance on firm performance	Module 1 report (draft), MED	2010	Econ Dev.
2	Venture Investment Fund (VIF)	Evaluation Report of VIF, MED	2009	Econ Dev.
3	Seed Co-Investment Fund (SCIF)	VIF Performance Report	2009	Econ Dev.
4	Escalator Programme	Escalator Output Class 1 Evaluation Report, MED	2009	Econ Dev.
5	Angel Investor Support	Baseline evaluation, MED	2009	Econ Dev.
6	Review of Business Assistance (2)	Officials Report, MED	2009	Econ Dev.
7	Growth Services Range	Evaluation Report, MED	2009	Econ Dev.
8	Incubator Support Programme	Evaluation Report, MED	2008	Econ Dev.
9	Review of Business Assistance (1)	Officials Report, MED	2006	Econ Dev.
10	Strategic Investment Fund (Feasibility Grants)	Evaluation Report, MED	2006	Econ Dev.
11	Strategic Investment Fund (MGLG Component)	Evaluation Report, ESG Ltd for MED	2006	Econ Dev.
12	Economic Diversification Study	Infometrics Ltd Report, MED	2006	Econ Dev.
13a	Review of NZTE's sector facilitation activities	MED Evaluation Report	2006	Econ Dev.
13b	Evaluation of Output Class 2: Sector Programmes	MED Evaluation Report	2010	Econ Dev.
14	Stable Funding Environment Initiative: Phase 1	MoRST Evaluation Report, ESG Ltd	2009	RS&T
15	Research for Industry Fund	FRST Evaluation Report, Infometrics Ltd	2009	RS&T
16	Pre-Seed Accelerator Fund	MoRST Evaluation, ESG Ltd	2008	RS&T
17	Measurement of spin-outs from Foundation-funded research	FRST Evaluation	2007	RS&T
18	Technology for Business Grants (TBG) Scheme	Performance Evaluation, FRST Evaluation	2006	RS&T
19	New Economy Research Fund	MoRST Evaluation, Abt Associates Inc.	2005	RS&T
20	Research organisation schemes: Portfolio Evaluation Synthesis	FRST Evaluation	2005	RS&T
21	ICT Value Mapping Study	FRST Evaluation	2004	RS&T
22	Intellectual Property Survey (TBG-funded firms)	FRST Evaluation	2003	RS&T
23	TechNZ Fund	Evaluation Report, Infometrics Ltd	2001	RS&T

Ref. No.	Policy Studies, Analyses & Taskforce Reports	Document Reviewed /Author(s)	Year of Pub.
24	Crown Research Institutes Review	Taskforce Report	2010
25	2025 Taskforce	Second report, November (Section 11.1 – 11.3)	2010
26	A Goal is Not a Strategy, 2010/1	New Zealand Institute Report	2010
27	Recent debate in the literature on the nature and value of innovation policy	MED paper	2010
28	The Heterogeneous Nature of the Innovation Process and Relevance to New Zealand	MED paper	2010
29	Capital Markets Taskforce	Taskforce Report	2009
30	OECD Review of NZ Innovation Policy	Final Review Report, OECD	2009
31	NZ Superannuation Investment Fund	Investment Policy Statement	2009
32	Improving the translation of publicly funded research for economic benefit	Office of Prime Minister's Science Advisory Committee	2009
33	Drivers of Firm Location and Industry Sector Success in the Auckland Region	MED report by Ascari Partners Ltd. (et al.)	2009
34	Alignment – Lessons from UK & Finland	MED Presentation	2009
35	Economic Geography, Globalisation and New Zealand's Productivity Paradox	NZ Economics Papers, Vol. 43 No. 3, P. McCann	2009
36	Innovation in the Digital Content Sector:	MED paper	2008
37	Innovation Concepts Report (Health technologies)	MED Report prepared by Law & Economics Consulting Group	2008
38	Alignment Project	MED paper	2007
39	Auckland Innovation Centre Feasibility Study	MED prepared by I Grow NZ Ltd & Vantage Consulting	2007
40	The effects of agglomeration on economic activity: The Empirical Evidence	R. Crawford, MED Occasional Paper 06/03	2006
41	Research and Development in New Zealand – A Decade in Review	MoRST Publication	2006
42	New Zealand Large Firms Study	MED paper	2006
43	Large firms, innovation and economic Growth: Theory and Evidence	MED paper	2006
44	Business R&D, Innovation and Economic Growth: An Evidence-Based Synthesis of the Policy Issues	N Davis, MED Occasional Paper 06/08	2006
45	Growing a born global: Sale to an MNE as a strategy to counter resource disadvantage	Unpublished paper by Professor Sally Davenport, Victoria University,	2005
46	Growing an innovative New Zealand	Office of the Prime Minister	2002
47	Just how innovative are New Zealand firms: quantifying & relating organisational & marketing innovation to traditional science & technology indicators	R Fabling, MED Occasional Paper 07/04	2007
48	National innovation policy assessments	Recent statements from Chief Science Advisor, MoRST CEO and Secretary to the Treasury	2010/1 1

Ref. No.	Statistical Analyses and Other Data	Document Reviewed /Author(s)	Year of Pub.
49	Innovation Index of New Zealand	Annual Report, IBM / University of Auckland	2010
50	Innovation in New Zealand 2009	Statistics New Zealand	2010
51	Economic Development Indicators Report	MED, Statistics New Zealand, The Treasury	2011
	International Reports and Studies		
52	The OECD Innovation Strategy	OECD	2010
53	Exploding the Myths of UK Innovation Policy	Centre for Business Research, Cambridge	2010
54	What Governs Firm-Level R&D: Internal or External Factors?	Melbourne Institute Working Paper 13/09	2009
55	British Innovation Policy: Lessons for the United States	Will Straw	2009
56	Public Support for Science and Innovation	Australian Productivity Commission	2007
57	Absorbing Innovation by Australian Enterprises	Scott-Kennel J, Scholl of International Business Victoria University	2007
58	The Innovation Gap: Why policy needs to reflect the reality of innovation in the UK	National Endowment for Science, Technology and the Arts	2006
59	"A Perspective on the Knowledge Economy in the Australian Context"	Keith Smith Chair in Innovation, School of Management, University of Tasmania	2004
60	Where innovations create value	Bhide, A. Professor of Law, Harvard University, McKinsey & Co	2009
61	Evaluation report of national Innovation strategy for competitiveness, Chile,	Teubal M. et al	2010

Annex 2

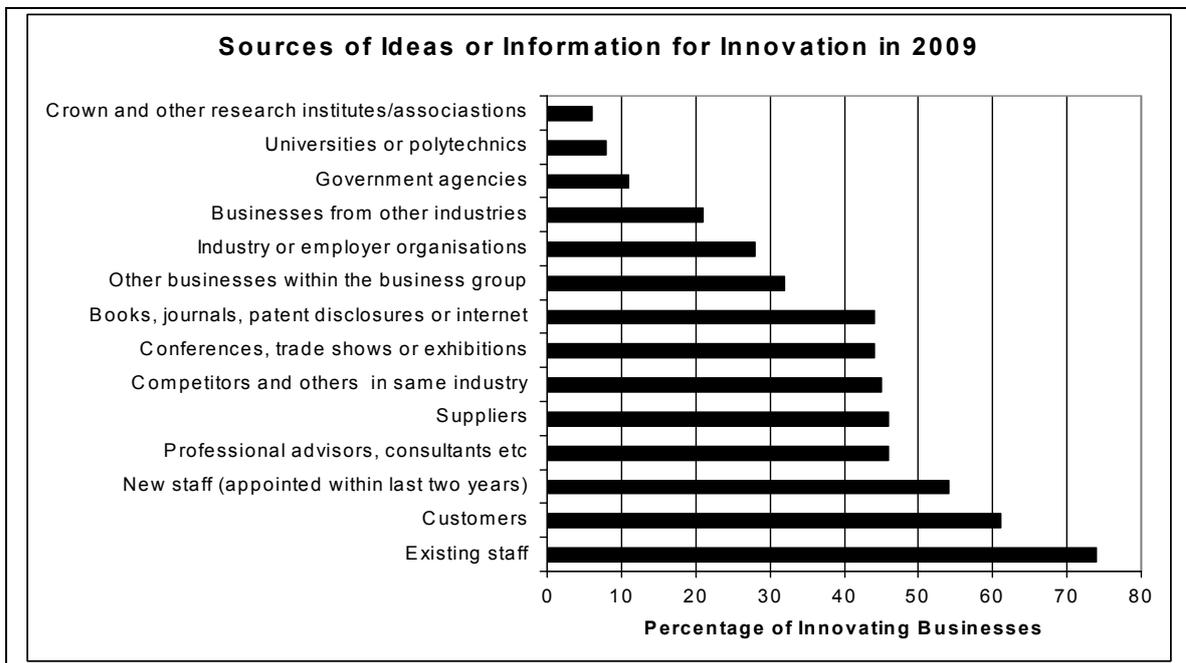
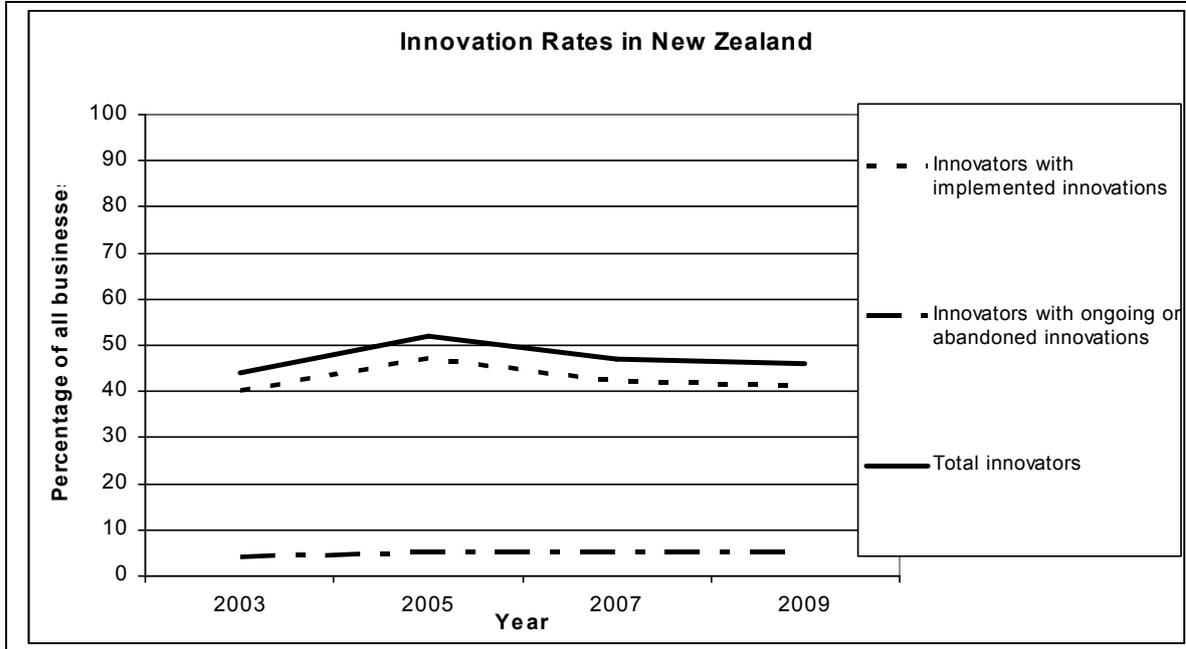


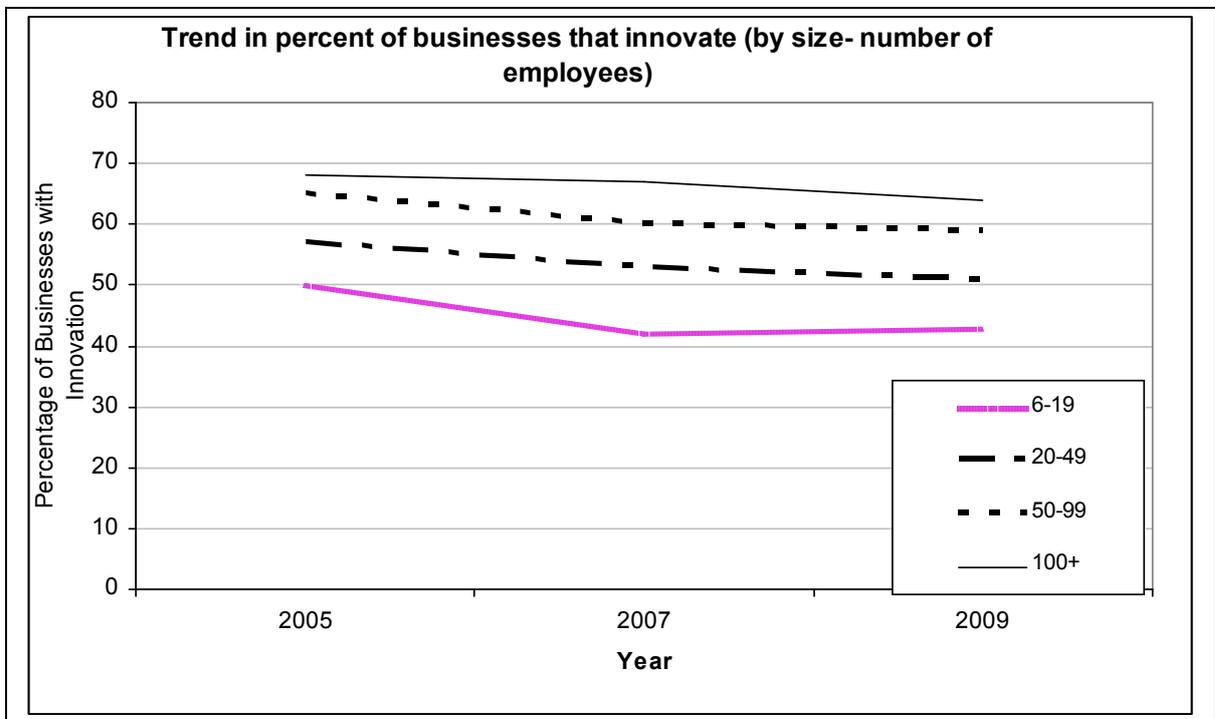
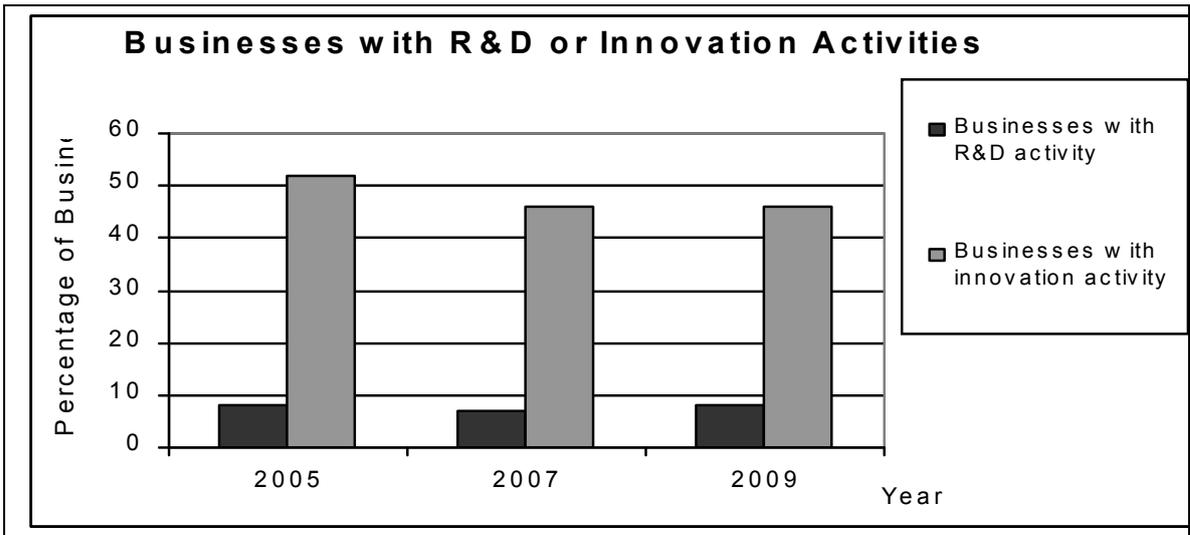
Source: *Estimates of Appropriations for the Government of New Zealand*
<http://www.treasury.govt.nz/budget/2009/estimates>

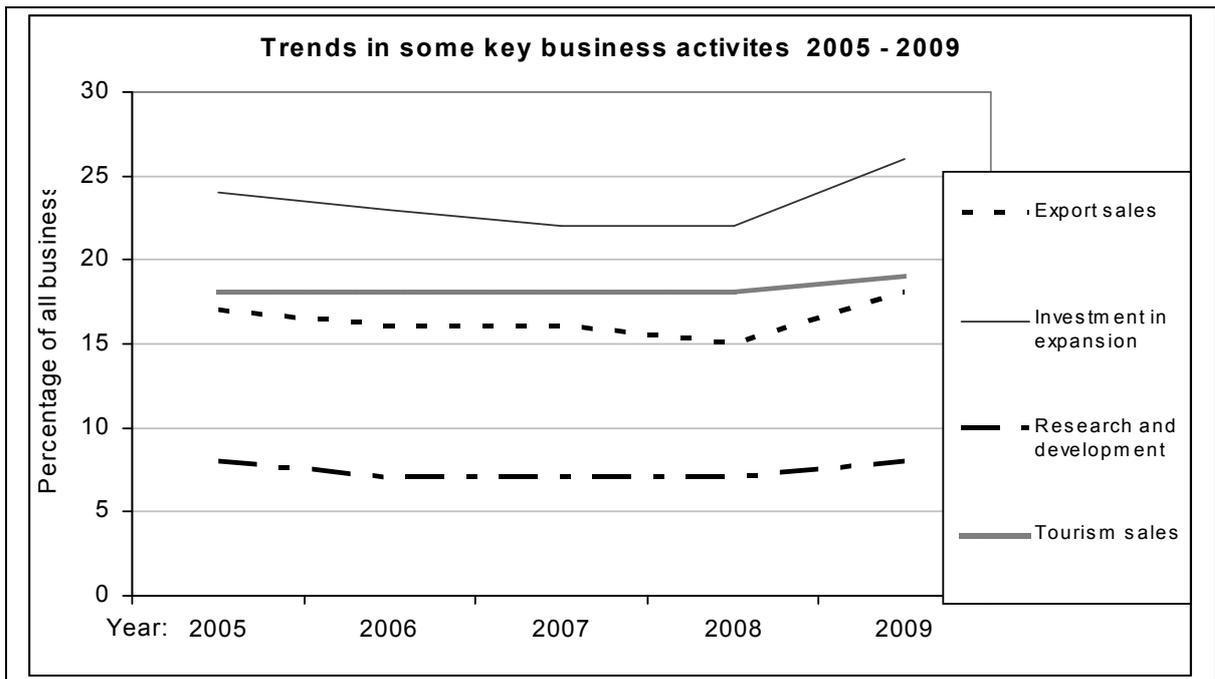
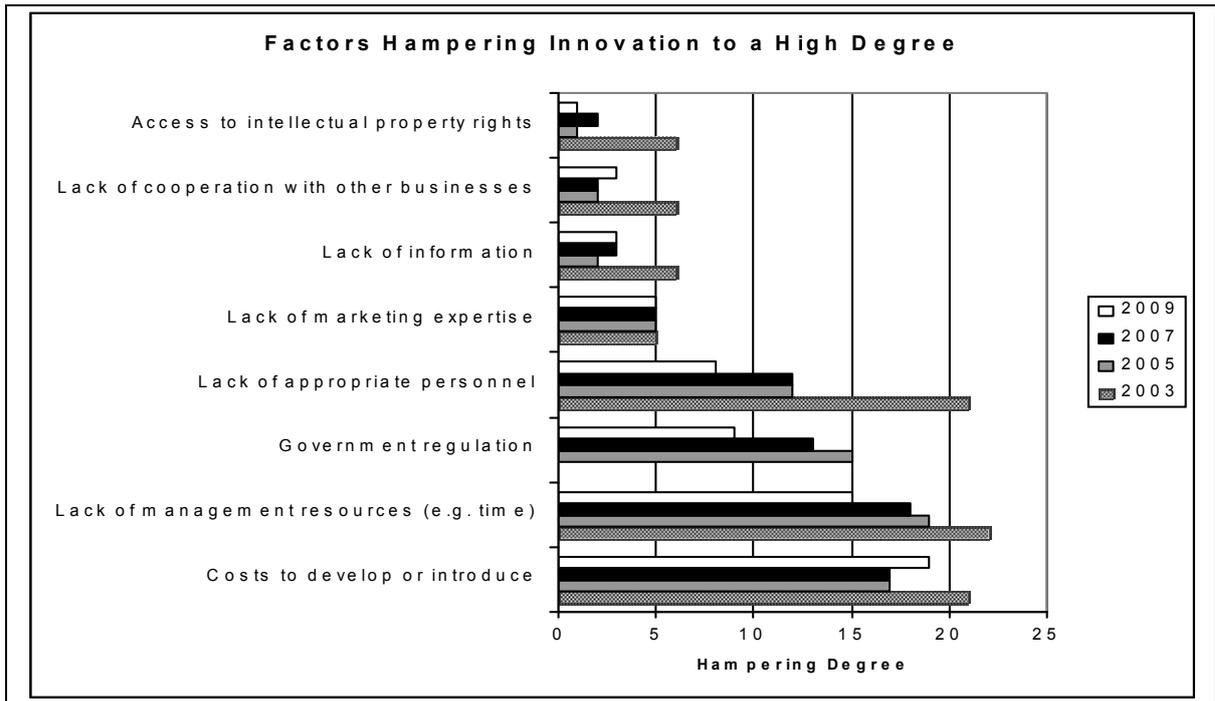
Annex 3

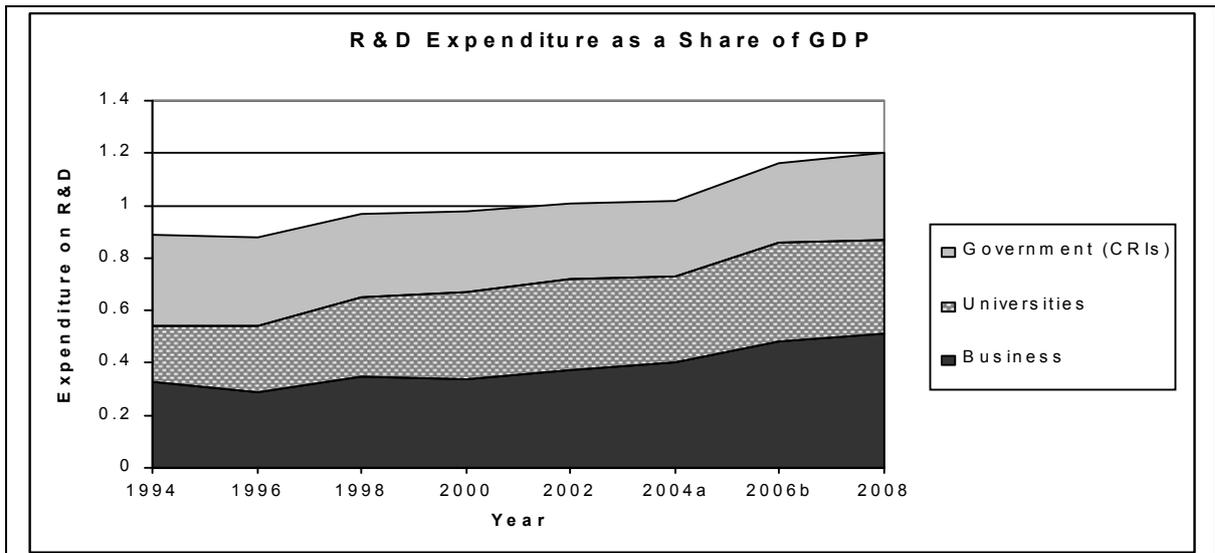
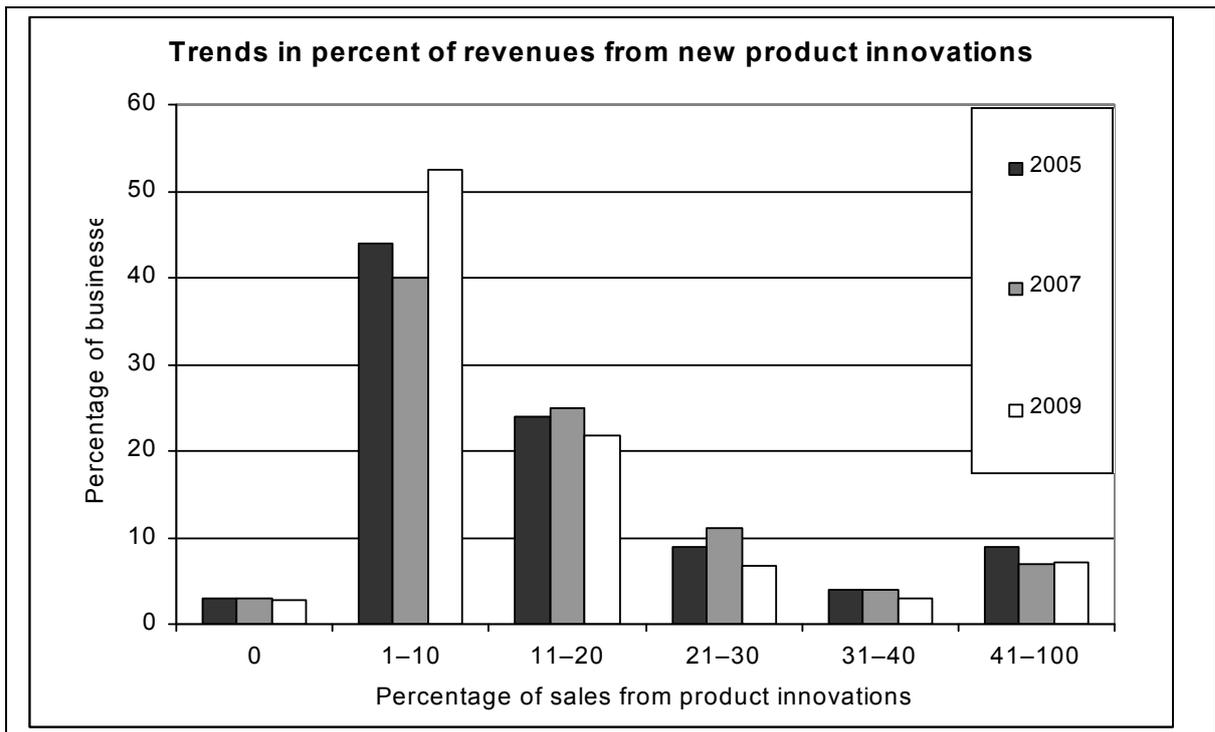
Selection of statistical indicators on aspects of innovation in New Zealand

(Source: Statistics NZ Business Operations Survey- firms with turnover greater than \$30,000 and six or more employees)









All data other than R&D expenditure as a share of GDP were sourced from the Statistics NZ Innovation in New Zealand (2003, 2007, 2009) reports which were drawn from the Statistics NZ Innovation Survey (2003) and Business Operations Surveys (2007, 2009). R&D expenditure as a share of GDP was sourced from Ministry of Research, Science and Technology (MoRST, 2006), 'Research and Development in New Zealand - A Decade in Review', www.morst.govt.nz and Statistics New Zealand (2008), 'Research and Development Survey: 2008', www.stats.govt.nz

Some differences in methodology occurred between years although in the examples used these had only a minor influence on the data. See Statistics NZ (2009), 'Innovation in New Zealand', www.stats.govt.nz for more details.