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Knowledge and Cooperation for Regional Development: The Effect of Provincial and Federal Policy Initiatives in Canada and Australia[1]

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Abstract *This paper examines how federal systems of government in Canada and Australia deal with the challenges of promoting regional innovation and knowledge-based industries. It focuses on selected cases of federal and regional (provincial or municipally based) policy initiatives and structures that support cross-sector collaboration between 'knowledge institutions' (such as universities) and locally based industries. The study reveals both anticipated commonalities in and unexpected differences between the Canadian and Australian innovation environments and policy approaches. Federalism, resource-based economies and sparse population have led to similar concerns and solutions. However, building local innovation systems and networks is a question of building on social capital and Canada seems rather more inventive and effective than Australia in turning social capital into sustainable organisations. Several regions of Canada have developed very strong community involvement in networks and institutions for improving technological skills, awareness and programmes—examples which provide valuable lessons for Australia.*

Keywords: regional development; innovation systems; government policy; community development.

Introduction

This paper arises from a study examining how federal systems of government in Canada and Australia deal with the challenges of promoting regional innovation and knowledge-based industries. The two countries share many economic, political and institutional characteristics including a federal Westminster system of government, a traditionally resource-based economy, and a relatively small, geographically dispersed but metropolitan population.

The present paper focuses on selected cases of federal and regional (provincial or municipally based) policy initiatives and structures that support cross-sector

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collaboration between 'knowledge institutions' (such as universities) and locally based industries. It presents primarily Canadian examples, but draws comparisons with the author's previous work on Australia.[2]

The study aimed to: (a) identify the relative importance of global, national and local factors in determining the direction of government policies in both countries; (b) examine the relationship between federal and regional government initiatives; and (c) assess the effectiveness of particular policy and organisational initiatives. The underlying research question is whether, in a federal system, one can identify successful models of support for regional innovation that are widely applicable (e.g. in both Canada and Australia), or whether the unique characteristics of each country, province and region require a uniquely tailored suite of public policies, programmes and institutions. In other words, how far is it possible for regional innovation policy makers in Canada and Australia to learn from each other's experience?

Methodology

The methodology used was primarily qualitative, being based on semi-structured discussions with Canadian researchers in the field, and interviews with policy makers and the 'users' of the government programmes. Use was also made of the rapidly growing body of published and unpublished literature on innovation and regional development in Canada. Particularly valuable was the access afforded to the members of the Innovation Systems Research Network (ISRN), their meetings and their working papers.[3] Existing statistical data (mostly from Statistics Canada) are used to describe the characteristics of Canada's national and provincial research and innovation systems[4] and economic base.

Of necessity, the paper selects certain regions of Canada for study. After reviewing federal government activities, the paper takes provincial examples mainly from the Ottawa region, Calgary, Alberta and British Columbia. These are regions where public intervention has been particularly intense, usually because of the low innovation intensity of traditional industries or, in Ottawa, because of the concentration of public research and universities. These regions appear good comparators with the Australian experience. The strongly manufacturing based regions of southern Ontario (Toronto region) and Quebec (Montreal), where innovation clustering is likely to be led by existing industries and trade associations (such as automobiles), were considered less usefully comparable with the Australian experience.

Knowledge and Regional Development

Aspects of Regional Innovation Policy

A key question in analysing regional innovation policies is to what extent can one identify common trends that are responses to 'globalisation' and growing 'knowledge-intensification' of industries, rather than reflections of unique local factors? Studies from Europe[5] suggest that support for the university environment ('acting on the higher education landscape') and measures targeted specifically at enhancing the innovation capabilities of SMEs are, first, important for building knowledge-intensive industries and, second, particularly open to influence by regional governments. This finding appears borne out by the work in Australia.

A second set of questions pertains to the changing organisational structure and role of 'knowledge organisations', notably universities and government research agencies. Of particular importance are the 'intermediaries' like research councils, technology transfer bodies and especially the newer cross-sectoral R&D centres or partnerships. What are the most appropriate structures/arrangements for these 'hybrid institutions' (in the sense that they sit between the established public/private sectors), and what effect is their emergence having on established public sectors' knowledge organisations, especially the research councils and universities?

However, it is also apparent that regional innovation systems differ dramatically, depending on their endowment of industries, knowledge institutions, pool of skilled people, technological infrastructure, and industrial and political history etc. A brief overview of R&D and the economic environment for regional innovation in Canada (with some Australian comparisons) is therefore helpful.

Changing Balance of Federal/Provincial Relationships

Canada and Australia display rather similar patterns of investment in research and development (R&D). Both are categorised as medium R&D investors by comparison with other OECD countries, spending between 1.5% and 2.0% of their GDP on R&D. Within this range, Canada's expenditure has been somewhat higher than Australia's, driven largely by higher spending in the business sector and higher education sectors. In 2000, Canada spent 1.9% of its GDP on R&D compared to just over 1.5% in Australia (Table 1).

The balance between the different research sectors is also similar. In both countries, businesses are the largest performers of research, followed by the universities and the federal government agencies. Of the main sectors, the state or provincial

Table 1. R&D expenditure in Australia and Canada, by sector of performance, 1990 and 2001

	Australia			Canada		
(a) Percent of GDP	**1990–91**	**2000–01**	**% change**	**1990**	**2001 (est.)**	**% change**
Business enterprises	0.54	0.72	34.6%	0.76	1.07	40.7%
Higher education	0.36	0.41	16.0%	0.44	0.62	40.2%
Commonwealth/federal government	0.27	0.21	–22.1%	0.24	0.18	–26.3%
State/provincial government	0.16	0.14	–12.0%	0.04	0.02	–47.5%
Total	1.34	1.53	14.1%	1.51	1.91	26.9%
(b) Percent of GERD	**1990–91**	**2000–01**	**% change**	**1990**	**2001 (est.)**	**% change**
Business enterprises	39.9%	47.1%	18.0%	50.4%	55.8%	10.9%
Higher education	26.6%	27.1%	1.7%	29.6%	32.7%	10.5%
Commonwealth/federal government	20.4%	13.9%	–31.7%	16.1%	9.4%	–42.0%
State/provincial government	11.9%	9.2%	–22.9%	2.9%	1.2%	–58.7%
Total	100.0%	100.0%	–	100.0%	100.0%	–

Note: Private non-profit R&D is omitted.

Source: Statistics Canada, *Science Statistics: Total Spending on Research and Development in Canada, 1990 to 2001, and Provinces, 1990 to 1999*, Statistics Canada, Ottawa, 2001; Australian Bureau of Statistics, *Research and Experimental Development, All Sector Summary, 2000–01*, Australian Bureau of Statistics, Canberra, 2002.

governments perform the least research. The key differences are the higher level of business R&D in Canada and the lower expenditure on R&D in the provincial government sector in Canada.

Over the last decade or so, both Australia and Canada have experienced a significant and parallel structural change in research carried out by business, government and the universities. The common features are a strong increase in business R&D, a moderate (Australia) or strong (Canada) increase in university research and a substantial decline in the R&D carried out by federal government agencies. R&D expenditures within the Canadian provincial governments also declined between 1990 and 2001, whereas comparable expenditure by state governments in Australia remained fairly static.

Federal government expenditures (in their own laboratories) have fallen substantially in both countries over the last decade. At the provincial level, however, R&D expenditure within Canadian provincial agencies declined more rapidly, and from a lower base, than in equivalent state government laboratories in Australia. In summary, the relative importance of business and university research has grown in both countries, at the expense of R&D carried out by the government sector.

These changes have several implications for regional cooperation in knowledge and research. Governments (federal, or state/provincial) seeking to influence knowledge-based regional development now operate in a very different environment than they faced in the early 1990s. Specifically:

- the growth of business R&D spending means that local firms and industries potentially command a stronger say in regional innovation policies;
- as a research performer, the influence of central government has declined. In Australia, one could add that the influence of the federal government R&D has declined relative to state R&D. In Canada this is not the case. Between 1990 and 2001 the provincial performance of R&D declined at a greater rate than federal R&D expenditure;
- the salience of business and university research implies that states/provinces are now more likely to engage directly with these sectors than with the federal research agencies;
- government influence on research is more likely to be felt through its *funding* of university research and through intermediary agencies rather than through direct support for government research laboratories.

This last proposition presumes that, over the last decade or so, government expenditures on R&D have been redirected from government laboratories to support research in other sectors like universities, firms or other non-government organisations. The proliferation of government schemes to encourage cross-sector research, the privatisation of government laboratories, and direct support for R&D carried out by industry are mechanisms for effecting such a transfer. Could this be an explanation for the marked decline in government performed R&D in both countries?

Table 2 shows the contributions of the various sectors to R&D *funding* in Canada. A comparison with Table 1 provides evidence that the R&D substitution mentioned above is indeed occurring. Although government *financing* of R&D carried out in all sectors (Table 2) fell between 1990 and 2001, the decline is less than that in government expenditures on its own R&D facilities (in Table 1).

Table 2. Government funding of R&D in Canada, 1990 and 2001

(a) Percent of GDP	1990	2001 (est.)	% change
Business enterprises	0.58	0.80	38.2%
Higher education	0.24	0.33	39.1%
Federal government	0.42	0.34	–18.6%
Provincial government	0.09	0.09	–7.1%
Total	1.51	1.91	26.9%
(b) Percent of GERD	**1990**	**2001 (est.)**	**% change**
Business enterprises	38.6%	42.0%	8.9%
Higher education	15.8%	17.3%	9.7%
Federal government	27.9%	17.9%	–35.8%
Provincial government	6.2%	4.6%	–26.8%
Total	100.0%	100.0%	–

Note: Private non-profit and foreign funding sources are omitted.
Source: Statistics Canada, *Science Statistics: Total Spending on Research and Development in Canada, 1990 to 2001, and Provinces, 1990 to 1999*, Statistics Canada, Ottawa, 2001.

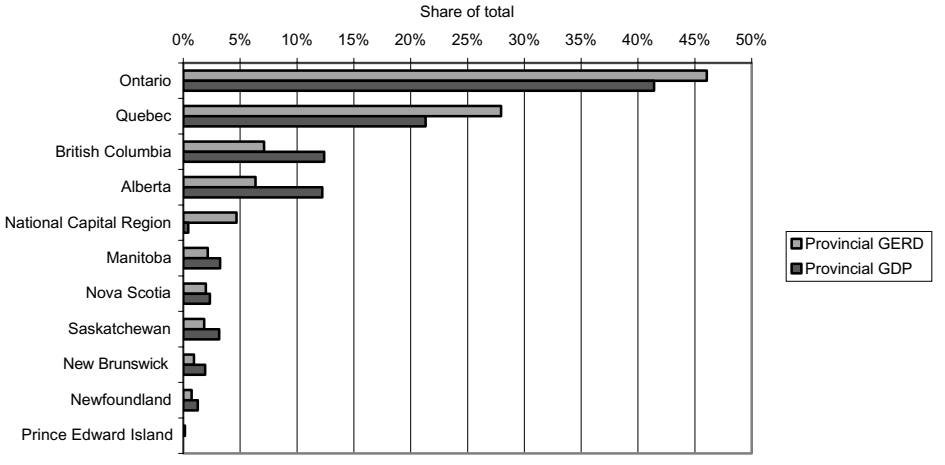
Federal R&D *funding* (as a proportion of GDP) fell by around 19%, compared with a reduction of 26% in federally *performed* research.

For the Canadian provincial governments the difference is even more marked. Provincial government performed R&D fell by over 47% during the period; by comparison, *funding* of research by the provinces declined by merely 7% over the period. This is a clear indication that the provinces have changed their investment strategy over the last decade or so, away from research performed directly by government agencies and towards mechanisms that support research performed by other sectors and cross-sector R&D. In 1999, around two-thirds of provincial R&D funds went to higher education, less than a quarter to provincial government institutions and around 7% direct to business.[6]

Provincial Economies and Innovation

Both in Canada and Australia, economic power and capacity for research are strongly concentrated in the most populous provinces. However the concentration is more marked in the Canadian provinces than in Australia. As Figure 1 shows, Quebec and Ontario dominate the Canadian economy, accounting for nearly 63% of GDP in 1999. With the addition of British Columbia and Alberta, these four largest provinces accounted for over 87% of GDP.

Expenditure on R&D is even more concentrated in the richest provinces. Ontario and Quebec (excluding the National Capital Region) contributed 74% of GERD in 1999. Expressed in terms of R&D intensity (PGERD/PGDP), only Ontario, Quebec and the National Capital Region exceeded the Canadian average of 1.8%. The R&D expenditure in most other provinces, including British Columbia and Alberta, at around 1% of PGDP, was less than half the R&D intensity in the two largest provinces. Business is by far the largest R&D sector in Quebec, Ontario and British Columbia and it is also strong in Alberta and Manitoba. In the other provinces, business contributes a much smaller proportion of PGERD.[7]



Source: Statistics Canada, *Science Statistics: Total Spending on Research and Development in Canada, 1990 to 2001, and Provinces, 1990 to 1999*, Statistics Canada, Ottawa, 2001.

Figure 1. Canada: provincial GDP and GERD, 1999.

These gross economic and research indicators reflect the broad industrial differentiation in Canada and set the environment for federal and regional innovation policy. To make a broad generalisation, in the smallest provinces, the policy agenda is to gain *any* niche in new knowledge based industries and to build up the social and knowledge infrastructure to attract them. In Alberta and British Columbia, the goal is to value-add and 'knowledge-add' activities onto existing resource-based industries, as well as to develop or attract new knowledge-based industries. In Quebec and Ontario, the challenge for public policy is to support the innovation capabilities of established industrial strengths (largely manufacturing) and to build new industries, capitalising on the strong research and innovation expertise of both the public and private sectors. Thus the focus of regional innovation policies is likely to be different in different provinces and sub-provincial regions. However, as the paper later shows, the *mechanisms* and *organisations* developed to support regional innovation have been remarkably similar across Canada.

Federal Policies

Overview

The 2002 federal innovation strategy document *Achieving Excellence* recognises that the sources of competitive advantage are localised and sees a challenge for government in promoting more innovative communities.[8] It sets targets for internationally recognised technology clusters, for 'innovative performance' and communications infrastructure, but commits little funding.

The federal government faces several constraints in trying to support regional innovation. First is a steady devolution of responsibilities to the provinces and municipalities, and the consequent problem of dealing first hand with municipalities and local government. As one federal manager put it, 'Federal dollars are welcome for regional development, but federal control is not!'.[9] There are three

main federal regional development agencies: Western (Canada) Economic Diversification (WD), Canada Economic Development for Quebec Regions (CED), and the Atlantic Canada Opportunities Agency (ACOA). They engage with but do not necessarily reflect provincial priorities. A sensitive point is the federal requirement for matching funds from the provinces. A second constraint is the federal government's limited ability to steer research in the provincial universities (see below).

Federal initiatives and policy interventions may thus take a 'back door' approach. The National Research Council (NRC) can establish or expand research institutes at various locales. NRC in partnership with the University of Alberta and the provincial government set up a National Institute for Nanotechnology (NINT) in Edmonton, and NRC Genome Canada (a non-profit corporation) is establishing five genomics centres across Canada with funding from Industry Canada.

Federal initiatives on 'strengthening communities' and funding for decaying urban infrastructure are being used to help communities to develop innovation strategies. Industry Canada, for example, funded cluster analyses in some Canadian cities and is considering doing the same for smaller communities. The larger cities have funded cluster studies, and knowledge focused economic development. The Smart Community programme is a federal government funded demonstration programme for initiatives like 'e-government' in cities. But the question is how to support communities that have developed regional innovation strategies?

The more significant federal policies and programmes that support university research and promote cross sector interactions in R&D and innovation are shown in Table 3.

University Research and Innovation

Although Canada's public universities are a provincial responsibility, the federal government has contributed to their funding since at least the 1950s. This tendency accelerated in subsequent decades especially through loans during the expansion of higher education during the 1960s. By about 1977, the federal government was providing around half of the operating costs under a complex block funding formula. However, these funds were by way of a tax sharing arrangement with the provinces and were not specifically tied to higher education. The value of the federal block funding for tertiary education declined in the 1980s.

In 1973, a federal university research funding system was created independent of the NRC and other federal councils that had provided research funds. This comprised the research councils for the natural sciences, social sciences and medicine (see Table 3). Much of the research council money is earmarked for research training: around 70% of the value of SSHRC grants goes to postgraduate scholarships.

From 1997 to 1998 the federal government initiated three highly visible grant schemes for direct support of university research. The Canada Foundation for Innovation provides funds for academic research infrastructure. The costs are shared, with 40% from the federal government, a similar amount from the provincial government, and 20% from the university and corporate sponsors. These provisions were waived in the case of the Atlantic provinces where the federal contribution is around 80%. The Canadian Millennium Scholarships primarily supported undergraduates, with doctoral scholarships through the research councils. Perhaps the most visible of the schemes has been the more than 2,000 Canada Research Chairs created, each with funding of up to C$200,000 a year. The Chairs

Table 3. Selected federal programs in support of research and innovation

Programs	Indicative budget (2001)
Research Councils:	
Canada Institutes for Health Research (CIHR) Est. 2000—formerly Medical Research Council	$480 mill.
Natural Sciences and Engineering Research Council of Canada (NSERC), Est. 1977	$540 mill.
Social Sciences and Humanities Research Council of Canada (SSHRC) Est. 1977–78	$130 mill.
Canada Foundation for Innovation (CFI)	$300 mill.
Est. 1997 to fund research infrastructures in universities, research hospitals and non-profit organisations	
Canada Millennium Scholarships (see text)	
Canada Research Chairs (see text)	
Networks of Centres of Excellence (NCE)	$78 mill. (1999)
Est. from 1988; 22 research partnerships, focusing on 'large problems' and involving universities, the private sector and government	
Science, Research and Experimental Development Tax Credit (SRED)	–
20% for all R&D; 35% for smaller, Canadian-controlled private corporations	
Precompetitive Applied Research Network (PRECARN)	$7 mill.
Industry-led consortium for collaboration with universities in intelligent systems technologies	
National Research Council of Canada (NRC)	$600 mill.
Regional Initiatives and Technology Clusters	
Ottawa (information communications technologies, photonics)	
Saskatoon (agri-biotechnology)	
Montréal (aerospace, biopharmaceutical, materials)	
Atlantic Canada (life sciences, information technology, etc.)	
Vancouver (Fuel Cells Technologies Centre)	
NRC's Industrial Research Assistance Program (IRAP)	
Est. 1962; aimed at SMEs, IRAP helps close to 12,000 firms and attracts an average of 3,000 new clients each year	
IRAP Canadian Technology Network (CTN)	
Est. 1996; a network of industry associations, SMEs, universities and government, CTN has increased its membership from 300 to more than 1,000 members, and it answers nearly 3,000 queries per year	

are allocated on a formula according the value of grants received from the federal research funding councils. A large research university, the University of Toronto, received about 270 Chairs from the fund. One effect is that they relieve the provincial governments of having to fund these academic salaries.

These three programmes then represent a 'new federalism' (or, to the critics, centralism) in academic research funding by direct transfer, but run by agencies that are at 'arm's length' from the federal ministries. Some are clearly designed to entice matching funding either from the provinces, the universities themselves or their industry partners. A continuing issue is the failure on the part of the federal schemes (notably the research councils) to pay for the indirect costs of research. In the 2001 budget the federal government made a one-off payment of around C$200 million to the universities and hospitals for this purpose. Even so, deficiencies are still perceived in the base level of funding for universities, which has not kept pace with the US public universities over the last 5–10 years. The universities see themselves as part of the North American labour market for academics, and also in competition with US institutions for corporate funding from Canada and the US.

Federal research policies then do not have an explicit goal of promoting innovation clusters. Cluster members may however be supported by federal funds. In the case of the photonics clusters in Ontario (Ottawa and Southern Ontario), for example, a mix of federal, provincial and industry funding contributes. Photonics Research Ontario (PRO) at the University of Toronto is a provincially funded centre, while Laval hosts one of the federal (NCE) centres, and photonics manufacturing is run by the federal NRC. The cumulative effect of policies is to support cluster development but, critics claim, without any overall strategy and with only weak coordination between federal and provincial schemes and objectives, and thus potentially wasteful overlap. Coordination is coming from the clusters themselves. A Canadian Photonics Consortium was established to provide a forum for the five photonics clusters in Canada.

Other federal support for universities has promoted innovation clustering. Gurstein reports on the effect of NSERC/SSHRC sponsorship of a Chair in the Management of Technology Change programme at the University College of Cape Breton in Atlantic Canada.[10] The Chair played a central role in supporting and gaining acceptance for innovation and training and the development of IT based firms in a community formerly dependent on traditional extractive industries. The Chair acted as a catalyst, provided needed resources for change, leadership in local committees (such as the local branch of the federal ACOA) and linkages to global networks.

University–Industry Linkages

Two federal programmes were commonly cited as most effective in promoting interaction between the research and productive sectors. These are the NRC's Industrial Research Assistance Program (IRAP) and the Networks of Centres of Excellence (NCE) (see Table 3). A recent review describes 'the NRC–IRAP and NCE programs as contrast cases of hybrid organisational forms that attempt, with some success, to occupy a shifting third space between public and private science, and between academic and industrial values'.[11]

Industrial Research Assistance Program (IRAP). Canada's National Research Council was established in 1916, as part of the push for science organisation in the British dominions that led to the establishment of Australia's CSIR. From the outset, the NRC sponsored research and training in the universities, and was the main source of academic research grants until this responsibility was devolved to the newly established NSERC in 1977.[12] The Industrial Research Assistance Program was set up in 1962, as one of the first programmes that provided public funding for private research. It owes its innovative structure to Keith Glegg, an industry scientist, who took over the programme in 1977.

IRAP has the goal of providing technological advice and assistance to SMEs. It works through field agents called Industrial Technology Advisors (or 'ITAs') who have a strong regional connection—IRAP itself has offices in every province. In Calgary, for example, the ITAs work out of the (provincial) Alberta Research Council office. About two-thirds of IRAP's agents come from local universities and industry and only one-third from NRC itself. ITAs enjoy considerable autonomy, being able to commit funding of up to C$100,000 on behalf of a client firm. Over its several decades of operation, IRAP has gained a strong reputation in Canada as a model programme for the successful delivery of innovation support to firms.

Because of this, the concepts of regional devolution, networking, autonomy, and investing in people rather than infrastructure, which IRAP embodies, have found their way into subsequent programmes, such as the NCEs.[13]

Networks of Centres of Excellence (NCEs). The NCEs were set up by the federal MOSST from 1988, both independent of the powerful NRC and 'enabling the federal government to circumvent university power and autonomy, and provincial jurisdiction'.[14] Like Australia's Cooperative Research Centres, the NCEs are ephemeral (with funding for a maximum of 14 years) and largely virtual. While well regarded as a successful model for university–industry collaboration, they face the same issues as hybrid cross-sector research centres elsewhere. They are, as Atkinson-Grosjean *et al.* term it, 'parasitic' on universities for much of their resources, with argument about appropriate sources and control of funding, the balance of between fundamental and directly commercial research goals, and organisational and intellectual sustainability.[15]

Provincial and Regional Policies

Ottawa Region

The Ottawa region of Ontario, including the National Capital Region which crosses into Gatineau, Quebec, comprises around one million people. It is a 'research intensive' region with a high concentration of public research agencies and research universities. Ottawa's technological growth dates to the Second World War with an influx of British scientists working on radar and like projects. The NRC was the research workplace of choice for postdoctoral fellows. In the private sector, the low R&D-intensive forestry, and forest products (pulp and paper) industries have made a strong economic contribution to the region.

Since about 1990, successive Ontario governments have adopted explicit strategies for regional innovation and economic development. The tenor of these policies was influenced by the political colour of the government—a consultative, bottom up strategy of 'social partnerships for learning' by a social democratic government in the early 1990s, followed by the neo-liberal policies of a conservative government later in the decade.[16] In the latter period, policies focused on the 'city-region', through devolution of responsibilities (and the financing of them) from the provincial government to the municipalities. As Bradford notes, this 'offloading' of responsibilities and related amalgamation of local governments were driven by economic rationalist motives, but had the effect of focusing attention on urban economic clusters and innovation at the local level.

Current Ontario government research and innovation programmes include the following, several of which are tied in some way to federal initiatives:

- provincial Centres of Excellence;
- a Challenge Fund to promote university–industry links;
- Ontario Innovation Trusts—these provide matching funds to the federal Canada Foundation for Innovation programme;
- Premier's Research Excellence Awards;
- tax credits for companies conducting research in universities; and
- provincial top-up for the federal Science, Research and Experimental Development Tax Credit.

The advantage of the Ottawa region now lies in its amalgamated City of Ottawa government (allowing for a municipal innovation strategy), its research and innovation intensity, and the effectiveness of regional networking and coordination. The latter has been facilitated to a large degree through the Ottawa Centre for Research and Innovation (OCRI), an apparently effective institutional model that is being emulated elsewhere in Canada. In the words of one interviewee, the development of the Ottawa region has been 'impressive' and OCRI has had 'wide influence'.

The Ottawa Centre for Research and Innovation is a fully incorporated (but non-profit, non-shareholder) company, focused on the Ottawa region, and engaging in a broad range of activities aimed at fostering research, technology and industrial innovation. The Centre evolved from the Ottawa–Carleton Research Institute, set up in 1983 as collaboration between industry partners, the regional municipality (which provided half the budget), education institutions and government laboratories. Its original role was to maintain contact between government laboratories and their spin-off companies and industry.

OCRI is strongly supported by its 700 or so members including large firms, research laboratories, SMEs, post-secondary education institutions, local school boards, and private individuals. Some professional organisations (computer consultants, electrical engineers, etc.) are members. OCRI has a total budget of around C$12–15 million annually. It receives no direct core federal funding although it has specific contracts and arrangements with federal agencies like Industry Canada and NRC–IRAP. Provincial funding is gained on a project basis, while some core funding flows from the municipal government. Its programmes are largely self-sustaining: over C$9 million a year is paid to attend OCRI events.

In 2001, OCRI merged with the Ottawa Economic Development (OED) corporation, and carries out broad economic development activities on contract from the city government. Whilst OED received 80% of its funds from government, OCRI received only 10% of funds from government. Combined, OCRI receives less than 15% of funds from the municipal government.

OCRI has a 20 person Board of Directors from key 'stakeholder communities' mainly from business and education, the City of Ottawa, and NRC. OCRI is driven by the private sector, engages local business leaders and rides on their trust and 'social capital'. But, part of the secret of its success is that it is not an exclusive high tech or business club, even though its governance is strongly business/research/education dominated. For example, several sporting groups are members. A broad community feels 'ownership' of OCRI, and initiates activities which are then run under the OCRI umbrella. OCRI is all 'bottom up' not 'top down'.

Its activities include:

- investing in R&D (Chaired by University of Ottawa and Carleton University);
- TalentWorks, a city initiative to undertake an analysis of gaps in the workforce, looking at vocational/trade skills, with nine partners, including vocational colleges;
- economic development activities: global marketing of Ottawa;
- for the last five years, marrying *big business* with the universities, to provide research chairs (C$500k from industry over four years);
- 'Sm@rtCapital', a demonstration project funded by Industry Canada on how to use technology, though community demonstration sites;
- broadband vision for Ottawa: two demonstrations in rural communities;

- partner with industries on courseware: engaging SMEs into research, through 'Research Days' at universities; a database of R&D within government labs and universities; and fellowship programmes—business to academia which produces long-term partnership;
- extra funding for existing research chairs, e.g. to bring in international experts (business encouraged to top up costs);
- technology 'breakfasts' and other forums for business and community leaders.

About one-third of OCRI's resources are devoted to education, having merged with the Ottawa–Carleton Learning Foundation in 1998. It has 30 teachers on staff, and contracts with school boards in Ottawa for the technology coach programme—with one coach for between two and three schools. OCRI CEO's philosophy is that you 'can't have economic development without social development', an approach that I was told sits well with its members, although other interviewees noted that the education and technology streams 'represent two cultures'. As well as its more formal research and innovation support activities aimed at 'putting Ottawa on the high tech map', the Centre has a definite community development agenda and runs a wide range of community awareness and education programmes. These include:

- educational programmes from primary to post-secondary level;
- sponsoring 'community technology' events, such as the July 2002 'OCRI Tech Rocks' rock band competition;
- providing school breakfasts paid for through community fund raising activities, as an important talent-building activity;
- improving Internet access for schools;
- running a large cadre of community volunteers (e.g. 'technology coaches' in schools), donating around 140,000 hours a year.

The innovation cluster strategy in Ottawa emerged, as one interviewee commented, 'completely by accident', but is now coming on to the policy agenda of both the federal and provincial agencies in Ottawa, including Industry Canada, and the Ontario Office of Urban Economic Development (Ministry of Enterprise and Innovation), which is carrying out regional cluster studies. Consultancy studies on 'Choosing a Future: A New Economic Vision for Ottawa' in 2000 and a regional innovation roundtable in 2002 have fuelled the policy debate on clustering policies.

The studies identified strategies for seven industry/technology clusters: telecommunications equipment, microelectronics software and communications services, professional services, tourism, life sciences and photonics, some of which lacked supporting industry associations. OCRI in 2002 sought money from the City to provide minimal support (e.g. secretariat functions) for five of the clusters.

The Ottawa region provides an instructive example of a municipality's learning process in supporting regional knowledge based industrial, economic and social development. OCRI in particular is regarded as a shining success by many. On the other hand, as another interviewee commented, OCRI may have become so all encompassing as to have 'outlived its usefulness'. The 'models' for OCRI apparently were Joint Venture Silicon Valley (USA) and similar initiatives in Glasgow, Scotland. Not surprisingly, given this successful borrowing of foreign organisational models, enthusiastic attempts are being made to replicate the achievements

of OCRI elsewhere in Canada, notably in Calgary and Vancouver. The following sections show how some of the federal and Ontario policy initiatives are being echoed in Alberta and British Columbia.

Alberta

Alberta sees itself as falling behind the other large provinces in terms of R&D investments, human capital, venture capital and the development of knowledge-based industries.[17] Heavy economic reliance on the oil industry has given way to a push for industry diversification. In the 1980s, much like several Australian state governments, the province embarked on a series of innovation policies involving large scale public investment in 'monolithic' technology programmes (notably the telecommunications corporation, NovAtel) which were financially unsuccessful, but produced valuable technology networks and spin-offs. This experience led to a policy hiatus which has only been broken in the last six or seven years, recently under the banner of 'Alberta Ingenuity'. In part this has also been driven by competition between the provinces for major national research faculties, such as the new nanotechnology institute, mentioned above, established at Edmonton. Some recent initiatives are described below.

Alberta Science and Research Authority. The Alberta Science and Research Authority (ASRA) is a group of 'independent leaders in S&T' to advise the provincial government on its own R&D expenditures. It is intended as a science and engineering counterpart to the Alberta Heritage Foundation for Medical Research that has a large endowment budget and has been spectacularly successful in attracting scholars and federal research money to Alberta.

The Alberta Research Council (ARC), which was established over 80 years ago, is, with its counterpart in Quebec, 'one of the last Provincial Research Councils'. ARC nominally reports through ASRA. ARC made the transition by about 1998 from a basic research and testing agency to one that functions far more as an intermediary body. This involved shedding/privatising some 'governmental' functions such as soil surveys. ARC sponsors projects in research institutes, industry research consortia (telecommunications, wireless technologies and photonics) and specific projects within the universities. It is funding 'star professors' by creating Chairs in, for example, quantum computing. ARC Calgary supports manufacturing engineering and information technology. This gives a rather strong 'research push' to Alberta's innovation and cluster development policies.

The 'matching funds' requirement of the federal Canada Foundation for Innovation has forced Alberta, like Ontario, to set up a parallel fund. With the Canada Chairs programme these funds have changed the climate for university research.

Clusters and Community Innovation. The Calgary region has a range of industry clusters in different stages of development:[18]

- transforming: oil and gas;
- expanding: information technology, wireless-telecommunications, tourism, arts and entertainment, and transportation, warehousing and logistics;
- emerging: geomatics (geographical information systems and remote sensing);
- seed: health and agricultural biotechnology.

Municipal involvement in innovation and industry development can be seen in both Calgary and Edmonton. Unitary municipal governments help this. History shows strong local support for the establishment of the University of Calgary, for example, and the university's continuing strong local roots, perhaps more so than most Canadian universities. Academic research and innovation strengths build on local industry; and education programmes support local industry.

Calgary Technologies Inc. (formerly the Calgary Research and Development Corporation) is a partnership between the city, university and chamber of commerce. It has two main roles: as a promotion and networking body, and as the manager of a technology incubator (Calgary Technology Centre) and Innovation Centre sponsored by the federal NRC.[19] The CTI incubator in particular is highly rated for its inter-firm informal communications, being in physical proximity to ARC, and the University of Calgary's Faculty of Engineering. CTI is seen as a modest counterpart to OCRI, while other local groups including the Centre for Innovation Studies (THECIS) have recently sprung up to take on 'innovation club' functions.

British Columbia

As noted earlier, the situation in the Western Canadian provinces can be roughly characterised as 'relatively strong, low-technology industries, relatively weak research sector and knowledge-based industries'. Like Alberta, British Columbia (BC) is aiming to move from resource based to high technology based industries. The technology based industries association notes recent improvements in the tax environment which are advantageous to R&D (SREDC) and in the education environment. Venture capital is less of a problem than it used to be, while demand for senior talent is now the biggest inhibitor to the development of knowledge based firms. However, the election of a Liberal government in 2001 which is rather antithetical to public support for industrial innovation has led to the re-evaluation of many established programmes. The BC government in 2002 pushed for a doubling in the numbers of science and engineering graduates from provincial universities, to be funded by increased tuition fees. In contrast to the situation in Alberta, municipal governments 'have come to the party late' and do not seem to have been particularly effective.

Two common strands in Canadian regional innovation policy can be identified. The first is the development of local initiatives that ride on federal government programmes, while the second is the adaptation and reinvention of longstanding local institutions so that they can better serve as networking organisations. In British Columbia, these trends can be seen in the extensions made to the federal NRC–IRAP programme, and in the evolution of the responsibilities and structure of the Science Council of British Columbia (SCBC).

Regional Extension of NRC–IRAP. The Canadian Technology Network (CTN), started in 1994, is part of IRAP nationally and in western Canada. While IRAP concentrates on technical assistance, CTN aims to give both business and technical support to SMEs and will refer businesses to IRAP's ITAs. Its strength is as a people/electronic network of public sector service providers, which can be achieved with minimal funding, such as by web-based listings of experts. There are around 40 members in BC. Firms are not members of the network, but clients. CTN was reorganised in 2002 to stimulate regional innovation and now supports

community innovation projects, not just ad hoc requests from firms. Perhaps the most important contribution of CTN has been in the non-metropolitan regions. Small grants (several thousand dollars) have for example supported a local innovation strategy conference in the Powell River region of BC.

CTN delivered two BC government programmes (Technology Assistance Program, Market Assessment of Research and Technology—MART) until their cancellation by the conservative provincial government in January 2002 which views such programmes as subsidies to industry. There has been little municipal involvement in CTN, but the Network enjoys strong support in BC's regions.

As Langford *et al.* note, CTN is rather ambitious in scope, covering management, marketing, and financial planning problems as well as technology management.[20] But structurally it is built on the IRAP model which has worked very effectively at the local level.

The Canadian Institute for Market Intelligence (CIMI) is a BC based extension of IRAP. CIMI takes IRAP beyond technical support to active market intelligence and cluster building. It is quite a small programme with a budget of about C$1 million, from IRAP's BC/Yukon regions. There is no direct BC government funding to CIMI. CIMI claims to have brought together the wireless technology cluster firms in BC. CIMI has identified 20 client groups (e.g. fuel cells, security), six of which are 'tier 1'. These include biotechnology, environmental technology and medical devices. In the view of its Executive Director, CIMI 'gives an agenda' to IRAP. It is 'modelled on the need' of firms and may have a role in 'gingering' the federal and provincial governments to become more actively involved in cluster development.

CIMI is not universally applauded; one interviewee saw it as a 'travesty' of IRAP's mandate. It is certainly more ambitious even than CTN and takes on a role that elsewhere would be handled by the private sector. Ottawa's OCRI, with its strong business support, has trodden carefully in active cluster promotion.

CIMI's potential local competitors include the BC Technology Industries Association (although this has more of a policy role) and the provincial government's Advanced Systems Institute (ASI), a virtual organisation. The federal and provincial governments originally jointly funded ASI. ASI is rather like OCRI in that it is advised by business and sponsors' activities like technology workshops. ASI can partner with or take equity in companies and represents some federal programmes in BC.

Science Council of British Columbia. The Science Council of British Columbia was established in the 1970s to counter the influence of the national Science Council of Canada, and with a mandate to link university skills with BC's strategic priorities and to promote university–industry interaction. It also had a role in advising the provincial government on research policy issues. About 70% of its funds were directed to universities, and the remainder to other sources including industry. The 1980s saw the establishment of 'Discovery Parks' which after a long period of gestation are now starting to attract transnational companies like IBM, Merck and Nokia.

While maintaining its research funding programmes, from around 1987, SCBC took a more market-pull approach, developing 20 sectoral strategic plans (forestry, food, biotechnology, alternative energy, etc.). There was more success with emerging sectors than with established sectors. The programme gave rise, for example, to the Biotechnology Industry Association in BC.

Recognising the concentration of scientific endeavour in the 'lower mainland' (Vancouver and eastwards) and Victoria regions, SCBC made a conscious effort from 1990 to establish satellite regional science councils. Seven councils were established and these became independent of SCBC in 1996, though continued to seek provincial funding through SCBC. The regional councils, such as the one at Prince George, have carried out regional inventories and are now moving into regional technology and innovation strategies. They allow a strong community input.

SCBC covers the full range of scientific research. The Council has also developed a network of volunteers, with 500–600 people involved in its various steering committees. By comparison with the federal research councils it has a higher representation of business people.

It has a complementary relationship with the federal councils and a very close relation with IRAP. Until 2001, several IRAP ITAs were based at SCBC. The Council has encouraged federal grant applications to the NCEs and CFI programmes, and claims credit for BC's high success rate in these programmes.

With the election of the conservative Campbell government in 2001, SCBC was one of the agencies hit by budget cuts. It remains as an advisory body, but has lost programmes like the Technology BC initiative. Other agencies, the Premier's Technology Council and the Progress Board, are advising the government on innovation matters.

British Columbia presents an interesting case where, despite earlier initiative in the regional science councils, the provincial government appears to be retiring from direct support for the development of innovation clusters. Municipal involvement is more limited than in the Ottawa region and in Alberta, but cluster activity is being supported by extensions of the federal NRC–IRAP programme. A strong intermediary body like OCRI has not yet emerged.

Conclusions: Key Policy Issues in Canada and Australia

The Character of Regional Innovation Policy

Recent reviews by John de la Mothe and Geoff Mallory of innovation and regional economic growth in selected cities and regions in Canada and several other countries (but not Australia) emphasise the widespread significance of local innovation initiatives in 'constructing advantage':[21]

> … new arguments about innovation policy through which local ingenuity, entrepreneurial vigour and appetites rise up and are met by regional and national government policies and programs, which are adaptive enough to in essence become customized to local needs, is now the way forward.[22]

The present paper reveals both anticipated commonalities in and unexpected differences between the Canadian and Australian innovation environments and policy approaches. Federalism, resource-based economies and sparse population have led to similar concerns and solutions.

First, a number of common features are evident. There is in both countries a strong state/provincial interest in promoting regional technology-based industry cluster development and 'building regional innovation systems'. The range of initiatives and instruments used to effect this development is remarkably similar

between and within the two countries, with the differences more likely to arise from the political philosophies of governments than from innate features of the local economy. This recognises, perhaps, that the *drivers* of clustering may be quite different in different circumstances, but that the *resources* required are closely similar (knowledge institutions, new facilitating organisations, local champions, strong innovative firms).

In particular, there is common recognition of the importance of public knowledge institutions—universities and government research facilities—as essential anchors of regional innovation. Thus much emphasis is on supporting higher education, both in its research and training activities. As in Europe[23] much effort is devoted to enhancing the contribution of universities and SMEs to regional innovation. In the least knowledge intensive regions, a lack of knowledge infrastructure is keenly felt. Federal government sponsorship of even a single university research chair has made a significant difference in Atlantic Canada.[24] A goal of regional policy is to attract, for example, major new federal research facilities—witness the nanotechnology institute in Canada, and the synchrotron facility in Australia. The importance accorded to large, primarily publicly funded, research facilities perhaps sets Australia and Canada apart from the experience in the European countries, although the EU funding of major research programmes and facilities needs to be taken into account.

Policy interest in innovation and economic development at the regional level of government has grown strongly in recent years in both countries. It has seen some resurgence in Australia of 'regionalism' as far as government support for science, technology and innovation is concerned.[25] This has been driven in both countries by recognition of the far-reaching change in industrial structure which has led to the emergence of 'knowledge-based' industries across a wide range of primary, manufacturing and service sub-sectors. But the trend has been enhanced, certainly in Australia, by a withdrawal on the part of central government from the performance of research and a redirection of funds into other sectors, notably higher education and cross-sector collaboration. A similar structural change in federal/provincial relations is evident in Canada, although the redirection of funding to higher education occurs largely at the provincial budget level.

Regional innovation policy is thus driven both by global economic developments and by changes in the structure of the national innovation system. The structure of the regional or local innovation system influences the choice of specific policy instruments, but not the fundamental form of the policy instrument. In other words, policy instruments appear fairly transferable, once the 'diagnosis' of particular failure in the local innovation system has been made.

A good example is the way both countries have gone about filling the 'new spaces' referred to above with hybrid organisations that sit between industry, the universities and the government laboratories. The Cooperative Research Centres (CRCs) in Australia and the Networks of Centres of Excellence (NCEs) in Canada are structured almost identically, have both been very successful and appear to face similar questions about their position in the system, future, governance and funding.

In both countries, aspects of state/provincial policy deliberately 'ride' upon federal government programmes and funding. Again, the CRCs are an Australian example of a wholly federal government initiative that has been embraced by the states as an effective catalyst for developing knowledge based linkages

between government research agencies (both commonwealth and state), universities, and firms or non-profit organisations that are able to benefit from the research.

Second, however, there are notable differences in detail between the two countries. Canada, perhaps through historical accident, seems in a better position to support knowledge based regional development than does Australia. The study finds greater involvement by the Canadian federal government in promotion of regional industrial innovation than is the case in Australia. This may reflect the greater regional economic disparities and entrenched political and cultural differences in Canada that mean the federal government has a longer history of accommodation with the provinces. For example, provincial and federal programmes appear better interlinked in Canada. The longstanding NRC–IRAP programme for technical assistance to companies is beautifully decentralised, devolved and integrated with provincial and municipal programmes and institutions to an extent never seen in Australia. This devolution/autonomy model is entrenched to the extent that collaboration is expected even in the absence of explicit agreement. Other programmes, like the federal CFI's requirement for matching funds, *demand* collaboration and, despite the welcome funding have been less well received by the provinces.

Canadian policies in relation to knowledge industries and research are strongly moulded by the exigencies of the North American market for labour, research contracts and industry sponsorship. As such they are often cast in terms of creating an environment that attracts *individual* skilled workers or companies to a particular region. In the positive sense this provides a real benchmark for the performance of Canadian universities, firms and other institutions, but it also leads to inevitable 'boosterism' on the part of regions. Australia, on the other hand, faces lesser competition for skilled labour, and less regional variation in economic conditions, taxation and 'lifestyle' factors.

Steering University Research

With universities as core institutions of the knowledge economy, the way that higher education research and training is managed and 'steered' by government becomes central to regional innovation policy. In Australia, university funding is centralised in the federal government and its research councils. Influence from the state and local governments is minimal. The federal government has only in recent years started to look at specific measures for 'regional' universities. In Canada, by contrast, the universities are much more strongly 'localised'. The provincial governments, often with strong municipal support, still primarily finance them. The federal government certainly has a strong influence through its research councils and funding, but not by direct *diktat* as in Australia. Canadian universities appear far more strongly embedded in their local communities and potentially able to be more responsive to local needs.

On the other hand, the decentralisation of the university system in Canada appears to have led to lesser pressure for 'academic commercialisation' and market orientation than in Australia. As an example, Canadian universities have adopted quite different approaches to the allocation of intellectual property rights (IPR), whereas in Australia the universities have promulgated a commonly agreed IPR model.

Community Innovation Organisations

Another point of difference between the two countries is in the development of what may be termed community innovation organisations—bodies that do not necessarily carry out innovation themselves, but facilitate and promote regional innovation and support and network those who do. Building local innovation systems and networks is a question of building on social capital and Canada seems rather more inventive and effective than Australia in turning social capital into sustainable organisations. Several regions of Canada have developed very strong *community* involvement in networks and institutions for improving technological skills, awareness and programmes. Notable are non-profit organisations like the Ottawa Centre for Research and Innovation and Calgary Technologies. These municipally supported, business-community innovation networks have barely begun to appear in Australia. One possible reason is the absence of the kind of structural change in state/municipal relations—local government amalgamations and the 'offloading' of programmes—that has been seen for example in Ontario. But, as de la Mothe and Mallory observe, 'sustainable communities are built on local networks and a spirit of collaboration'.[26]

In several cases, the Canadian organisations have developed by a process of dramatic organisational change from pre-existing public sector research performing or managing bodies. Examples are OCRI and to some extent the SCBC, at least until 2001. Australian governments on the other hand seem to find abolition of public organisations and programmes rather easier than their reformation. Here, the Canadian experience with the stability of core innovation programmes such as IRAP, and research councils in some provinces, the long history of federal/provincial cooperative programmes and the evolution of existing institutions from 'science councils' into community innovation organisations is of real value to an Australian policy audience.

Notes and References

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