Canada Foundation for Innovation
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Research Infrastructure and the Economy:

An exploratory study on the link between CFI investments and Canadian university spin-off company growth

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Executive Summary

The Canada Foundation for Innovation (CFI) was established to build the capacity for innovation at Canadian institutions – universities, research hospitals, colleges and non-profit research institutes – through investments in research infrastructure. Such investments are expected to generate social and economic benefits for Canada at least partly through knowledge translation and commercialization activities conducted at regional, national and international levels.

A topic of interest for the CFI is the role of research infrastructure investments in contributing to institutional-societal linkages and knowledge translation in Canada. The CFI recognizes that it is one of many investors in higher education institutions and research hospitals, and additionally, the challenge of measuring knowledge translation and commercialization is a steep one. However, where there are concrete data, and reasonably accepted indicators, some measurement can take place.

One component of the knowledge translation and commercialization measurement agenda is that of university spin-off companies. For this exploratory study, the CFI collaborated with Dr. Denys Cooper, Guest Worker at National Research Council's Industrial Research Assistance Program (NRC/IRAP). Cooper has an extensive database on Canadian university spin-off companies, and possibly the most long-lived internationally, with data going back to 1962. His database assembles the standard economic indicators: revenue, employment and investment.

The exploratory study revealed the following:

- Of the 155 CFI-funded projects reporting positive in 2006 that their research infrastructure was of benefit to spin-off companies, 94 university/hospital spin-off corporations could be independently confirmed as spin-offs.

- The impact of CFI funding at Canadian institutions started to become significant after 2000, as funded projects became fully developed. Of the 313 Canadian university spin-offs that were incorporated between 2000-2006 (revealed by the Cooper database), 61 (19.4%) have been identified by the exploratory study as CFI-linked.

- CFI-linked spin-off companies incorporated before 2000 numbered 33 (4.7% of the sample university spin-offs incorporated during 1988-99). For these pre-existing companies, researchers cited the infrastructure investment as significant for their development.

- While the 94 CFI-linked spin-off companies comprise only 7% of the total sample of known university spin-offs created in Canada since 1962, they have attracted 16% of the known private sector investment - $1.1B – since 1997.

- The CFI-linked spin-offs tend to be in new, knowledge-intensive niche areas where industrial receptor capacity is low: life sciences (including biotechnology, pharmaceuticals and medical devices), ICT, and electronics – consistent with Canadian spin-offs generally.

- There is a high degree of sectoral convergence between the private and CFI public funding of the projects and spin-offs, with life sciences leading the way.

- About 18% of the CFI-linked spin-offs are fast-growing "gazelles", that is, they have doubled their employment within 5 years to at least 20 people.

- Most of the CFI-linked spin-offs (69%) are in Montreal, Toronto and Vancouver.

1. Introduction

The Canada Foundation for Innovation (www.innovation.ca) supports Canadian institutions in their efforts to contribute to the knowledge economy. Through investments in research infrastructure, the CFI enables Canadian universities, colleges, research hospitals, and non-profit research institutions to carry out cutting edge research and development (R&D), and attract and equip students with the latest research tools and approaches. These forms of investment – in knowledge production and students - bring about long-term social and economic benefit to Canada through their uptake and employment in the public and private sectors. Efforts are committed within the Canadian public policy machinery to understand and measure these resource flows. For its part, the CFI prepares its annual Report on Results: An Analysis of Investments in Research Infrastructure, program evaluations and outcome measurement studies, along with occasional special studies, which are made available as input into the larger work.

The CFI believes that investments in research infrastructure also assist with more direct institutional-societal linkages, and that these forms of relationships give rise to accelerated knowledge translation. Knowledge translation includes not only commercialization by for-profit companies, but also the transfer of research findings and models to the public and non-profit sectors. The latter process leads to efficiencies and improved effectiveness of these sectors, resulting in improved systems and services aimed at raising quality of life and sustaining the environment, while keeping costs down.

In essence, by providing a high-technology, capital resource that is of benefit for the forging of R&D partnerships with the public and private sectors, the CFI contributes to the knowledge translation agenda of Canadian institutions.

2. Purpose of the study

The CFI is interested in understanding how it contributes to the knowledge translation and commercialization agenda in Canada, as one important player among a range of agencies. With its specific mandate to invest in research infrastructure, the CFI provides a key foundational resource upon and around which partnerships with other societal partners are built at regional and other levels. Research infrastructure is one component of the Canadian system of innovation, and given its renewal and world-class quality at institutions across Canada, likely a very important one.

Knowledge translation and commercialization processes are driven by people and organizations: researchers, students, graduates and institutions, usually on the supply side, and (employees of) companies, government departments, non-government organizations (NGOs) and other non-profit organizations, usually on the demand side. A great deal of scholarly and public sector attention is focussed on the topic.[1]

[1] For example, within Canada work is ongoing or has been conducted or collected at key organizations such as Industry Canada, Statistics Canada, NRC Clusters studies, Department of Foreign Affairs and International Trade, Canadian Health Services Research Foundation (CHSRF), Federal Partners in Technology Transfer, the Innovation Systems Research Network (a network of academic researchers funded by the Social Sciences and Humanities Research Council), the Association of Canadian Academic Healthcare Organizations (ACAHO), provincial government departments, and consulting companies. Abroad, standard setters include the Organization of Economic Cooperation and Development (OECD) and the European Union (EU).

A problem for such studies is the availability of quality data. The CFI possesses a repository of basic, survey-type research and development (R&D) data that can be used to explore certain issues of interest. The data are derived from the annual project progress reports that are prepared by researchers and submitted by institutions. From time to time the CFI partners with other agencies or contracts with experts to share quantitative data for evaluation and special studies oriented at locating evidence and planning for the future. University spin-off companies are an area of interest for the knowledge translation agenda in Canada and one for which there are sufficient data. For this study, the CFI collaborated with Denys Cooper of the National Research Council (NRC) Industrial Research Assistance Program (IRAP). Cooper is the custodian of an extensive database on Canadian university spin-off companies (details are furnished below).

3. Context for spin-offs

3A. EXISTING POLICY AND PROGRAMS

According to the 2007 federal government strategy *Mobilizing Science and Technology to Canada's Advantage*, "more can be done" to encourage technology transfer from Canadian universities to the private sector, including spin-offs. University and other public research sector spin-offs are a significant component of the knowledge translation policy agenda in Canada. This is due to the nature of the Canadian market and the character of the industrial R&D and innovation landscape. "More can be done", but as the strategy acknowledges, it is a complex undertaking for a small trading nation in a globalizing world.

In Canada, university spin-off companies are often established where industrial "receptor capacity" does not exist or is minimal; that is, where there are no or few R&D-aware companies with the ability to discern and appropriate the commercial opportunity. According to a report on commercialization prepared for the CFI in 2004, Canada was estimated to create about twice as many university spin-off companies as the U.S., per $1 million dollars of research expenditure invested, but generate about half the amount of licensing revenue.[2]

Having passed the Bayh-Dole Act in 1980, which was a framework that awarded rights to universities and non-profit organizations for intellectual property that they generate, the US federal administration appears satisfied that this policy intervention was sufficient to ensure that maximum commercial advantage was derived from public sector research. There is no mention of the need for policy attention to spin-off companies in recent pronouncements related to competitiveness and innovation.[3] Market mechanisms are believed to be sufficient, given the size and dynamic character of this advanced and productive economy.

The European Union (EU) however, maintains a policy interest in university spin-offs, stating, in a 2006 communiqué stressing continued development of an EU innovation strategy that:

> Structured and strategic partnerships between business and universities need to be strengthened… (including) the establishment of science parks around universities, with adequate finance available to support research spin-offs…Development of links between universities and local civil society would also be conducive to a better uptake of innovation at local and regional

[2] Bruce Clayman and Adam Holbrook, *Third Annual Commercialization Report*, March 2004. The report uses time series data for 1991-2002 from the Association of University Technology Managers (AUTM) licensing surveys. More up-to-date basic survey data is available through AUTM at http://www.autm.net/, and detailed data for a cost. The Alliance for the Commercialization of Canadian Technology (ACCT) is committed to develop further metrics in the future. See http://www.acctcanada.ca/

[3] For example, no mention of spin-offs is made in the *American Competitiveness Initiative 2006*.

> levels…Mobility of researchers…must be enhanced…structural mobility between academia and industry are essential.[4]

At an EU policy benchmarking workshop on spin-offs held in 2002, the discussants noted that, while spin-offs from public research institutions represent only a small proportion of new firm creation, they are critical to innovation. Spin-offs contribute to rapid diffusion of new technologies and approaches that provide flexibility to segments of the productive sector which absorb them, and help them to change trajectories of the past.[5]

Cooper and other long-time Canadian experts on spin-off companies in Canada note that they often fall into the biotechnology, medical devices, information and communications technology (ICT)and advanced materials sectors where niche opportunities exist, and where there are few existing firms in a position to license and develop the intellectual property.[6] A Statistics Canada study revealed that more than one-third (36%) of the total sample of Canadian university spin-off companies surveyed in 2004 (n=968) fell into a health science technology field, with information and engineering/applied sciences forming the next two important technology fields.[7] Life sciences, ICT and advanced materials are also the main fields for spin-off company development in the US, UK and France. Such companies are helping to spearhead brand new areas of the knowledge economy.

The range of schemes (see Appendix 1) to support knowledge translation in Canada, including support to spin-off companies from publicly-funded research organizations, is consistent with the overall importance that Canada assigns to spin-off companies. However, it is also indicative of pluralistic traditions, federalism, and a certain confidence in the market to provide the key financing. Disputes, debate and dialogue are a continuing feature of the innovation policy areas in Canada that attempt to address these areas.

3B. A ROLE FOR RESEARCH INFRASTRUCTURE?

When the CFI was created in 1997 to fund research infrastructure at Canadian institutions, its mandate was to build the *capacity* for innovation, a mandate that remains to this day. No specific role was articulated for knowledge translation, although the output "increased links to users" was included in its 2002 Evaluation Framework. This inclusion suggested that links to users were expected to result from the activities of the CFI and that indicators would be devised to measure them. This became one of the tasks of the evaluation and outcome assessment work at the CFI, and ultimately the measurement of "increased links to users" was incorporated into its Outcome Measurement Study (OMS) approach. In the years to come, as the OMS rolls out, the significance CFI-funded infrastructure for spin-off companies, along with other areas of knowledge translation, will become clearer on an institutional, thematic basis.

Scholarly investigation and debate suggests that research infrastructure has a key role to play in the forging of institutional-societal linkages, and that these linkages are a key feature of successful regional and national systems of innovation. An report on the Boston biotechnology community cites a 2002 study suggesting that "…the sharing of resources and equipment and

[4] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Putting knowledge into practice: A broad-based innovation strategy for the EU. Sept. 13, 2006. http://icttoolkit.infodev.org/en/Publication.2923.html

[5] European Commission, Enterprise Directorate-General Innovation/SMEs Programme, Policy Benchmarking Workshop 19-20 February 2002, "The changing role of public support to academic spin-offs". http://www.trendchart.org/tc_newsitem.cfm?ID=126

[6] Denys Cooper, personal communication; and Denzil Doyle, for example, in *National Capital Scan,* "Enough sophistication already just measure economic returns", March 2008, p.2.

[7] Cathy Read, "Survey of Intellectual Property Commercialization in the Higher Education Sector, 2004", Statistics Canada, (Science, Innovation and Electronic Information Division), October 2006, Catalogue Number 88F0006XIE, no.011, p.22.

collective access to a larger scientific group (are) key features of knowledge communities.[8] An investigation in the European context notes that the "…existence of a critical mass of spin-offs in a region and the development of networks between them and with the surrounding environment is one of the key success factors for the… "ecosystem".[9] As for the Canadian view, scholars of the SSHRC-funded Innovation Systems Research Network, collaborating with the NRC clusters study group, report that:

> The needs and concerns of cluster players differ depending on the stage of development …in early stage clusters, salient issues include the development of specialized R&D infrastructure, the fostering of linkages, the development of firm capabilities, access to talent, and the elaboration of a shared vision.[10]

Drawing together the different strands laid out above, it seems reasonable for the CFI to heighten and speed its exploration on how its investments have contributed to knowledge translation, and use this information for the development of future directions. As discussed earlier, due to the availability of data, university spin-off companies appear as a good place to start.[11]

4. Definitions, Data and Methods

Different regions and agencies use definitions of "university spin-off companies" that are not precisely the same, which can affect the results and comparability of data, especially in an international context. For the purposes of this study, and to take advantage of the Cooper database and expertise, the CFI uses the same operational definition as Cooper to decide what is a spin-off company and what is not. However we make small semantic modifications on the Cooper terminology so as to be consistent with the latest studies on spin-offs by the Association of Canadian Academic Healthcare Organizations (ACAHO)[12] and EU language.

For our study, the term **"university spin-off company"** refers to either a Canadian university or hospital source of the intellectual property (IP). The company has been created to commercialize IP that is owned either by the university/hospital or by the researcher(s) within these institutions, or the IP is owned by both of these actors. The critical point is that the relevant researchers who are the source of the IP are employees of, or hold full-time appointments in the institution when the company is formed.

In Canada, IP ownership policies vary across institutions, and the policy architecture for IP remains under the remit of these institutions. In some cases, IP is entirely owned by the university / hospital, or by the researchers; in others, partly owned by the researchers with the institutions taking some of the ownership. Many stakeholders and other interested parties

[8] Murray, F. 2002. "Innovation as the co-evolution of scientific and and technological networks: Exploring tissue engineering.," cited in J. Owen-Smith and W.W. Powell, "Knowledge Networks as Channels and Conduits: The Effects of Spillovers in the Boston Biotechnology Community", *Organization Science* 15 (1) Jan-Feb 2004, pp. 6-7.
[9] Clarysse, B. A. Heirman and J Degroof, Het fenomeen spin-off in België, IWT Observatorium No.36, Brussels, 2001, cited in European Commission, Ibid.
[10] David Arthurs, Erin Cassidy, Charles Davis and David Wolfe, Manuscript prepared for a Special Issue of the *International Journal of Technology Management* "Innovation Networks and Knowledge Clusters in the Global Knowledge Economy and Society: Insights and Implications for Theory and Practice", November 2006, p.10.
[11] Additional useful studies could focus on university licensing revenues and on spin-out companies that are linked to research infrastructure.
[12] See ACAHO, *From Microscope to Marketplace, Spin-off Companies from ACAHO Member Institutions*, May 2008.

such as business have views on this constellation. Debates continue as to whether framework legislation such as the US Bayh-Dole Act might be appropriate for Canada.[13]

In contrast, a company created by (a) graduate(s) of the institution, usually with its own rights to the IP, is not a university spin-off company. This type of firm is often referred to as a spin-out company, though precise nomenclature is still under debate.[14] Most spin-outs originate from business, and some define these as equity carve-outs that allow a new business to form around a market opportunity that cannot be accommodated within an existing company. In any event, a spin-out formed by a university or college graduate may retain links with the institution, or a parent university spin-off company, but the graduate was not, and is not, an employee of the institution at the time the spin-out was created. The topic of higher education-related spin-outs is a fascinating one, and possibly quite significant. However these higher education spin-outs have not been tracked in the Cooper database, nor, to the authors' knowledge, have data been systematically collected at Canadian institutions. In contrast, some of the federal laboratories, such as the Communications Research Centre (CRC), have collected substantial data on their technology transfer activities, including spin-outs.[15] There could be merit in exploring further work in this area.

Cooper's database of university spin-offs is based on data from NRC/IRAP and other sources, including the internet, and is a leading tool for this work. The database can be used to generate valuable information at the aggregate level. Internationally it is one of the largest such databases and it appears to be the one with the most extensive longitudinal data, according to an OECD study.[16] The definition of university spin-off has remained consistent, and the data followed are core economic measures such as jobs, investment, and sales that together track company growth.[17] The economic data is continually cross-verified with lists of spin-offs available at University Industry Liaison Offices (UILOs, or technology transfer offices), the Globe and Mail "Top 1000 Firms", the Re$earch Money list of R&D-intensive companies that is published annually, and Web searches. As of April, 2008, the database included information on **1288 university spin-off companies in Canada**. A database of similar proportions has been created by Jorge Niosi of the Université du Québec à Montréal, with input by Cooper, but it apparently does not contain the same in-depth information. Based on periodic surveys of the commercialization activity of Canadian universities and hospitals, StatsCan also has a database on spin-off companies, with 968 entries as of 2004.[18]

The CFI has its own database of project progress reports which can be used, within limits, to investigate issues. The project progress reports are submitted for the first five years after the finalization of the Award Agreement with the CFI. Project leaders and institutions are asked to respond to a set of questions, and among these is one that asks how the infrastructure

[13] For example, see the stakeholder submissions to the 2005 *Expert Panel on Commercialization*, which was appointed by the Canadian federal government for the production of a report at http://strategis.gc.ca/epic/site/epc-gdc.nsf/en/tq00039e.html

[14] For example, see the discussion on Wikipedia and a recent paper prepared in Germany in 2007 on business spin-outs, strategies and two case studies. http://en.wikipedia.org/wiki/Spin_out

[15] For example, Denzil Doyle, "Measuring Knowledge Commercialization", presented at the Federal Partners in Technology Transfer (FPTT) Annual General Meeting June, 2007 in Halifax.

[16] OECD, *STI Review No. 26, Vol 2000*, "Special Issue on Fostering High-tech Spin-offs: A Public Strategy for Innovation". July 2001, especially pp. 24, 34, 45, 48 Available at http://www.ingentaconnect.com/content/oecd/10105247/2000/00002000/00000001/9000261e

[17] Some argue that this basic approach remains the best,[17] while others seek to explain the rationale and conditions for university spin-offs so as to better design policy interventions. For example, Taran Thune, "University-Industry Collaboration: The Network Embeddedness Approach", *Science and Public Policy*, 34 (3), April 2007, pp. 158-168, though there are countless other studies. The ISRN has undertaken extensive cluster analysis and this is relevant to this study, and discussed later.

[18] Cathy Read, Statistics Canada, Ibid.

investment was important for socio-economic benefits, including spin-off companies, if any.[19] Not all of the respondents answering "yes" to this question provide details, but many do, pointing out how the infrastructure was significant.

For this study, CFI project report data for 2006 – that is, data submitted in 2006 - were used as the baseline, augmented by data submitted in 2007 to clarify, if possible, uncertainties in 2006 data. For this sample, there were 155 positives for the question on spin-off companies. Of these, a total of 5 were approved by the CFI in 1999, 35 in 2000 and the remaining 115 approved between 2001 and 2005. Most infrastructure awards *approved* in a given year take time to negotiate, procure and to be developed – sometimes this can take well over a year. Thus the great majority of projects had their start within the 5-year time period of 2000-2005. To eliminate double entries (different researchers may cite the same spin-off company if more than one researcher is involved) and verify if these were actually spin-offs according to the definition above, the Cooper database was used. After this cross-verification was complete, it was determined that, for the period 1999-2006:

- **94** university spin-off companies were identified citing research infrastructure as significant. Of these,
    - 57 companies were already documented in the Cooper database
    - 37 companies from the CFI data were independently verified
- 89 researchers were involved (some with >1 company)

It is worth emphasizing that there could be more spin-off companies where CFI infrastructure was significant in their development, however, researchers were silent on the details in many cases. Hence our estimate of the proportion of Canadian university spin-offs that are linked with CFI research infrastructure is likely on the conservative side.

As an exploration, the resources committed to the study were modest, and it was not feasible to undertake detailed study of all of the university spin-off companies identified within the available timeframe. From Cooper's database significant quantitative data were provided for the sample, though sales and jobs metrics could not be tracked down for all of them. Consequently it was decided to extract key data for the three most important urban centres in terms of numbers of CFI-linked spin-offs. Attention was focused on **Montreal, Toronto** and **Vancouver,** to reveal the basic economic metrics, and to gain insight on their sectoral differences as measured by investment capital inflows.

5. Results

5A. AGGREGATE SAMPLE

To place the findings of our study into an overall Canadian context, Table 1 summarizes the significance of university spin-offs in terms of overall company figures. As expected, university spin-offs form only a very small proportion of start ups in Canada – most Canadian business start ups are not based around R&D.[20] The formation of university spin-offs experienced a

[19] CFI Project leaders were asked the following in 2006: "Please comment on how CFI investments in infrastructure for your research have helped to generate social and economic benefits for Canada since the beginning of the project. Benefits may be generated directly by activities of researchers and trainees, by other users of the research infrastructure or the users of the research enabled by it. The following list provides some examples of social and economic benefits. Check those that apply, and provide further details in the (comments) box below.

- Spin-off companies (provide number(s) and business line(s))"

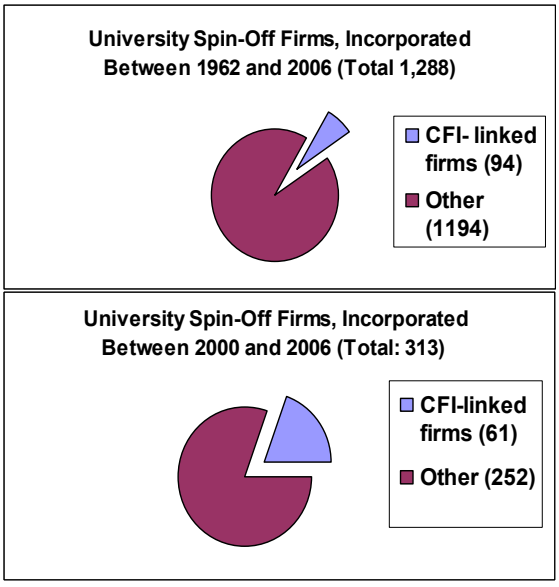
[20] A review of 1.6 million start ups in 6 European countries led to 228,000 spin outs from existing business – or 14%. A similar proportion for Canada might suggest that, of the 150,000 companies created per year,

Table 1 - Proportion of university spin-offs among companies in Canada

Total # of small companies with employees – 2007[1]	>1M
Approximate # new companies created /y[2]	139,000
Approximate # R&D-based companies (2003)[3]	12,000
Average # new university spin-offs created per year in Canada – 2000-2006[4]	52

Notes
1. Industry Canada, Small Business Policy Branch. *Key Small Business Statistics July 2008*. (Drawn from Statistics Canada data)[21] More than half of these businesses have less than 5 employees. Pp.5-7.
2. Ibid. This is the current calculation, based on data gathered over 1991-92 to 2002-03. It points out that 1000's of businesses enter and exit the marketplace every year, and net entries averaged approximately 8,800 per year. Pp.3,6, 10-11.
3. Ibid. pp.38-39. These figures are based on a Statistics Canada investigation, Personal communication between Cooper and Stats Can suggests that this number increased to about 17,000 by the end of December 2007.
4. Cooper data.

Figure 1- Proportions of CFI-linked University Spin-Offs



10,000 could be spin outs. Some of these would be R&D or technology-based, such as after the Nortel contraction in 2001. European Commission 'Corporate and Research-based Spin-Offs: Drivers for Knowledge-based Innovation and Entrepreneurship", Proceedings of the Expert Workshop 2001, Brussels (EUR 19903 EN). ftp://ftp.jrc.es/pub/EURdoc/eur19903en.pdf
[21] http://www.ic.gc.ca/epic/site/sbrp-rppe.nsf/vwapj/KSBS_July2008_Eng.pdf/$FILE/KSBS_July2008_Eng.pdf

growth spurt in the 1990's[22] and early in the millennium, but presently the number of new university spin-off companies formed per year has fallen to less than 50.

As illustrated above in Figure 1:

- The 94 university spin-off companies identified as "linked" to CFI infrastructure comprise 7.3% of the total university spin-offs in Cooper's comprehensive database covering all university spin-offs formed since 1962.
- For the period 2000-2006, 313 university spin-offs were formed. In this time period, research infrastructure investments began to transform the Canadian S&T landscape. For this time period, 61, or 19.4% of Canadian university spin-offs were "linked" to CFI-funded infrastructure, that is, researchers considered that the research infrastructure investment was beneficial for nearly a 5th of the new or existing Canadian spin-off company pool.

CFI-linked spin-off companies incorporating before 2000 numbered 33, and for these, researchers cited the infrastructure investment as significant for their development.

The metrics provided in Table 2 show that, at the moment, CFI-linked spin-offs are not generating the same degree of employment or sales as the total sample, which contains many mature companies. However, the CFI-linked spin-offs have been, or are, attracting a large proportion of the total private sector investment that is going into university spin-off companies in Canada - an estimated **$1.1 billion or 16%.** It is likely that most of the CFI-linked companies are at a conceptual or early stage, primarily engaged in R&D, but clearly they have the confidence of investors.

Table 2 – Economic metrics for NRC/IRAP and CFI-linked university spin-off companies

Data source	# Spin-offs	Jobs (2006)	Sales (2006)	Capital raised (since 1997)[1]	Gazelles[2]	
					#	%
NRC/IRAP/Cooper	1288	30,000	$6.4 Billion	$6.7 Billion	178	13%
CFI-linked	94	1,227	$36 Million	$1.1 Billion	17	18%
% CFI-linked	7%	4%	0.6%	16%		

Notes
1. Data sources for capital inflows include: Thomson MacDonald, SEDAR, WWW
2. "Gazelles" refer to spin-off companies that double employment within 5 years to at least 20 people

Further analysis reveals that the sample of CFI-linked spin-offs include a significant proportion of fast-growing "gazelles", namely 18%, a proportion higher than the overall average for Canadian start-ups and also for the overall sample of university spin-offs, as detailed in Table 3.

[22] Cooper data, confirmed by data in Cathy Read, Statistics Canada, Ibid.

Table 3 – Proportion of high-growth companies – gazelles – among Canadian start-ups

Data source	Time period	# of entries	Est. % Gazelles
StatsCan / IRAP company start-ups	1995-2005	1M	1-4
NRC/IRAP/Cooper data on university spin-offs	As of April 2008	1288	12-18
CFI-linked university spin-offs	As of April 2008	94	18

It appears that the entry of the CFI investment into the university environment is helping both to support spin-off companies that already existed, and those that have been recently established. For the sample of 94 CFI-linked companies, about one-third existed before 2000. After 2000, when CFI funding for research infrastructure investments was approved and started to flow to institutions, there was a jump in the number of spin-offs, with about two-thirds of the sample being formed. About half of these companies, before and after 2000, received NRC/IRAP funding. The data for the two sources of funding are shown in Table 4.

Table 4 – Currently "CFI-linked" university spin-offs founded before and after the CFI

Timeframe	# Incorporated	Funded by IRAP[1]	
		#	%
Pre-CFI - 1988-99	33	15	45
Post-CFI - 2000-06	61	28	46
Total	94	43	

Note
1. A funded IRAP company is defined as one which received >$15,000 within 5 years of its incorporation.

Figure 2 presents the breakdown, by sector, of the investment into CFI-linked university spin-offs since 1997. The data indicate that CFI-linked university spin-offs predominate in new knowledge and niche areas of the economy: biotech, pharmaceuticals, medical, and ICT.

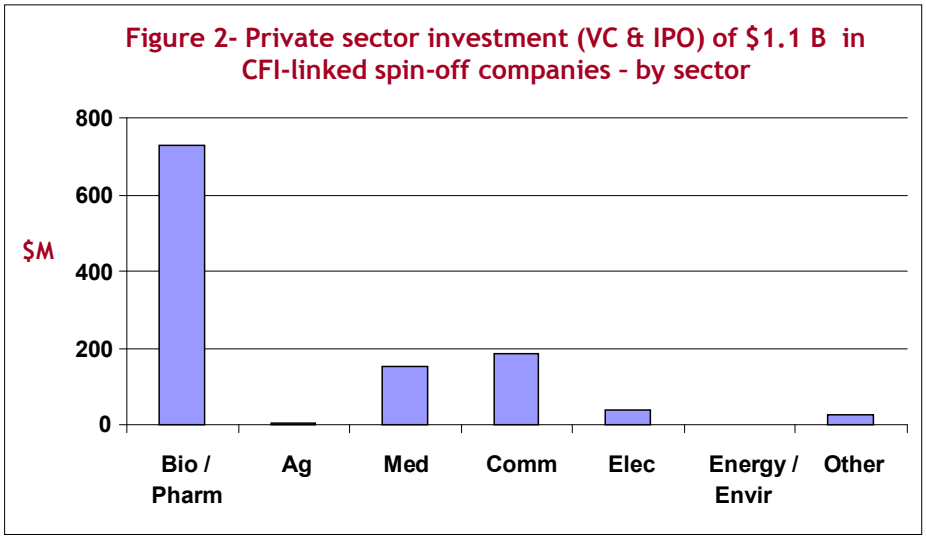
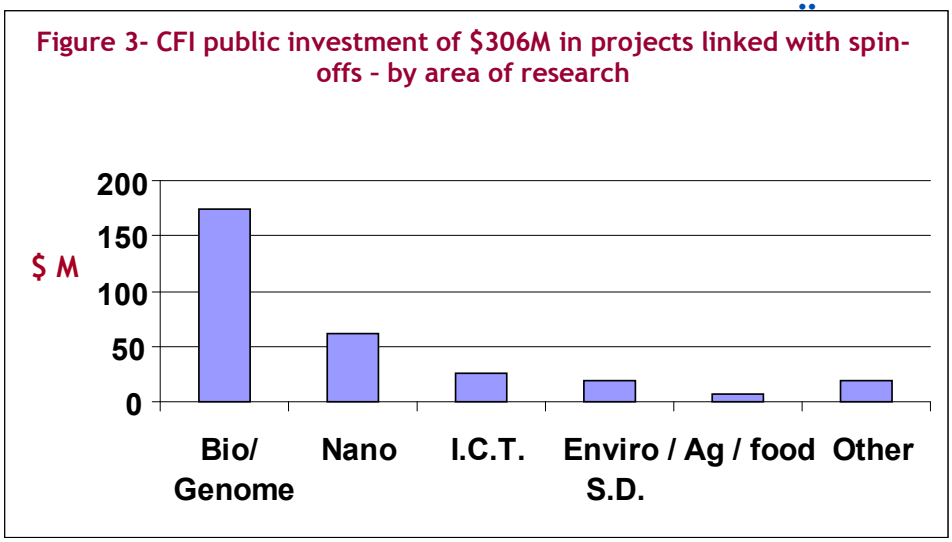


Figure 3 provides a breakdown of the $306 million of CFI capital investment into the 94 projects with links to spin-offs in 2006. Project leaders identify which "area of research" their project falls into, according to categories provided by the CFI.



Comparison of Figures 2 and 3 indicate that the two sets of investment inputs (private and public) into these institutionally-based projects converge.

5B. BY CITY

To gain insight into regional differences for university spin-offs across Canada, we examined data for Montreal, Toronto and Vancouver in more detail. These three centres produced 65 (69%) of the total sample of 94 CFI-linked spin-off companies (Table 5).

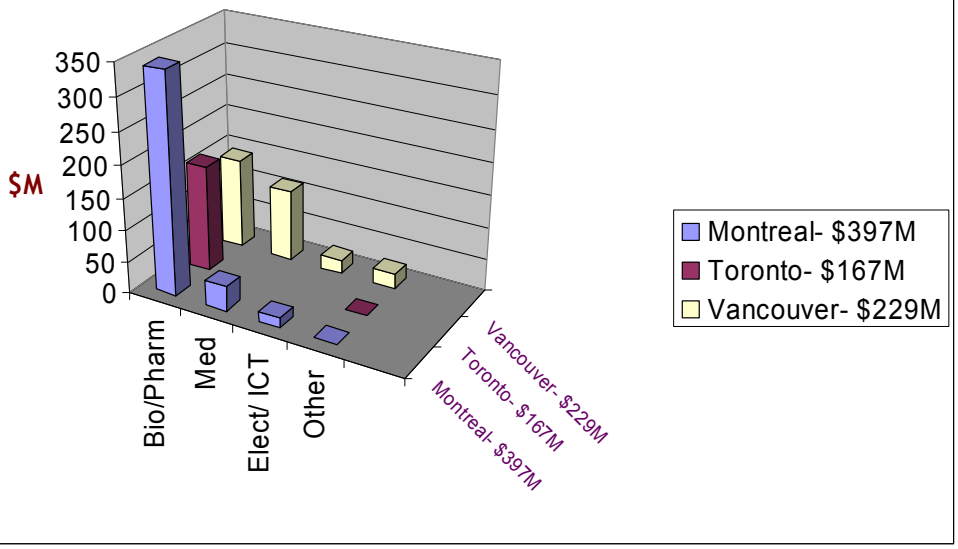
Table 5 - Economic metrics for CFI-linked university spin-off companies in Montreal, Toronto and Vancouver

City	Spin-offs		Sales		Jobs	Capital raised (since 1997) $M
	#	%	#[1]	$M		
Montreal	28	30	11	6	486	397
Toronto	16	17	6	2	164	166
Vancouver	21	22	6	28	281	300
Elsewhere	29	31	3	1	296	270
Total	94	100	26	37	1227	1133

Note 1. Refers to number of firms with known sales.

In Figure 4 private sector investment made since 1997 in the identified CFI-linked spin-offs is provided by sector, for each city. Montreal was the leading destination for life sciences investment in university spin-off companies, followed by Vancouver. Vancouver university spin-offs, on the hand, appear to attract private sector investment across a number of sectors.

Figure 4 -Private sector investment in Montreal-,Toronto-, and Vancouver-based CFI-linked spin-off companies- by sector



6. In Conclusion

The results of this exploratory study on university spin-off companies appear quite striking. The trend detected in the CFI project progress reports of 2006 points to an upsurge of spin-off formation, and quite substantial inflows of private sector investments. The areas of private sector investment correspond with that observed by Cooper and others: new, niche, knowledge-intensive sectors of the Canadian economy including pharmaceuticals, biotechnology and medical devices, ICT, and electronics. Montreal leads in the attraction of private sector capital for this sample of 94 identified spin-off companies, followed by Vancouver and Toronto. These investment trends have been observed elsewhere.[23]

This study identified 33 research infrastructure projects which already had linkages with spin-off companies before the infusion of public investment from the CFI, but which were said to benefit from the new infrastructure. Another 61 spin-off companies formed since CFI investments started to flow were clearly linked with the infrastructure funded by CFI. Importantly, the overall CFI-linked sample of 94 companies comprised only 7% of known Canadian university spin-offs, yet they have attracted an estimated 16% - $1.1B - of known private sector investment in such companies in the last 10 years.

These results are likely a conservative estimate of the impact of CFI investments for the formation and growth of university spin-off companies in Canada. The review of submitted progress reports indicated that there were more spin-offs than were actually identified by name, so these could not be included in the sample.

Finally, the measurement of university spin-off companies in no way comprises the totality of the socio-economic impact of CFI investments and institutional activity in knowledge translation and commercialization. University spin-offs are one component of this activity – but they are reasonably easy to measure given the existence of the Cooper and other databases. Studies on university *spin-out* companies could be helpful to fill out another part of the picture, however the authors are not aware of any studies or data collection processes within Canada at the current time. As always, more research is called for.

[23] Department of Foreign Affairs and International Trade – Global Innovation Strategy (draft).

Appendix 1- Program Directory

Below is a brief typology of the types of national Canadian programs, financial incentives and sources, and organizations that currently, directly or indirectly, assist the development of spin-off companies in Canada. Program and scheme detailed descriptions follow in a list. Note that this list excludes provincial, regional and local programs in Canada, many of which actively support spin-off company formation with a range of innovative investment and other schemes.

- Federal level competitive funding schemes
  - IRAP
  - Granting Council Programs
    - Idea to Innovation (I2I) Program of the Natural Sciences and Engineering Research Council (NSERC)
    - Proof of Principle Program (POP) of the Canadian Institutes of Health Research (CIHR)
    - Networks of Centres of Excellence (NCE), Centres of Excellence in Commercialization and Research (CECR), and Business-led NCE programs governed jointly by the three granting councils (NSERC, CIHR, Social Sciences and Humanities Research Council (SSHRC)) and Industry Canada.
- Facilitation, information
  - NRC's Cluster Strategy (14 clusters)
  - Industry Canada Innovation Portal
- Finance
  - "Angels", 3F (Family, Friends, Fools), Venture Capital , Canadian Business Development
  - Scientific Research and Experimental Development (SR&ED) Tax Credits (at $3.4 B / year at the federal and at least $700 M at the provincial level)
- Management expertise
  - Venture Capital
- Networking, support
  - A range of bottom-up member-driven associations, service companies, and "4th pillar" organizations.

NRC Industrial Research Assistance Program (NRC-IRAP): NRC-IRAP provides advisory and financial assistance to growth-oriented Canadian small and medium enterprises (SMEs), as well as supporting research, innovation and commercialization of new ideas. Each year, NRC-IRAP helps over **12,000** SMEs (including university spin-offs) turn innovative ideas into profitable products. IRAP combines market advice, financial support, access to important information, and world-class networking capabilities to produce solutions that are unique to the needs of each specific firm. See: http://irap-pari.nrc-cnrc.gc.ca/main_e.html

Idea to Innovation (I2I) Program (NSERC): This program's objective is to accelerate the development of new technologies and promote their transfer to new and/or existing Canadian companies. The program provides funding to university and college faculty members through a number of stages, with the overall goal being eventual technology transfer. In the first stage of funding, NSERC covers all direct research costs; in the second, a commercial partner (a spin-off or pre-existing company) begins sharing the funding responsibilities. There will be four rounds of competition in 2008. See: http://www.nserc.gc.ca/professors_e.asp?nav=profnav &lbi=b4.

Proof of Principle Program (CIHR): Part of CIHR's Commercialization and Innovation Strategy, the Proof of Principle program promotes academic health research and technology transfer

activities that support the commercialization of intellectual property.
The competition operates on a two-phase basis. In the first phase, a new idea is developed into a commercializable technology, with the aim of attracting investment and creating a new science-based company. In phase II, the discovery is moved further down the "innovation pipeline," with the researcher being required to secure a partnership with a non-academic investor. In 2008, the CIHR funded 19 phase I and 2 phase II projects, for a total of over $2.5 million. The two phase II projects were able to secure additional, private funding of nearly $800k. See the archived program description at: http://www.cihr-irsc.gc.ca/e/25487.html, and funding results at: http://www.cihr-irsc.gc.ca/e/35656.html

Networks of Centres of Excellence (NCE) Program: The NCE Program is administered jointly by the three federal granting councils: NSERC, CIHR, and SSHRC. "NCE bring together researchers and partners from the academic, private, public and non profit sectors in areas of strategic importance for Canada: Information and Communication Technologies; Engineering and Manufacturing; Environment and Natural Resources; and the Health and Life Sciences" (http://www.nce.gc.ca/). The program has existed for over 15 years, becoming a permanent government program in 1997. Since 2004, the NCE federal budget has been $82.4M annually. This program has helped to support spinoffs by forging lasting collaboration between academia, the private sector and government. According to the NCE website, in 2005-2006, NCE stimulated outside cash and in-kind investments totalling almost $70 million, ($27M of which came from the private sector). Combined with the program's own investment of over $80M, the total dedicated to research, commercialization and knowledge transfer was almost $150M. See: http://www.nce.gc.ca/about_e.htm

Centres of Excellence in Commercialization and Research (CECRs): Administered by the NCE program, the CECRs are intended to promote research and commercialization at Canadian institutions. In February 2008, eleven new CECRs were introduced, receiving over $160M in funding. For more information, see the Competitions section of the NCE website: http://www.nce.gc.ca/comp/CECR/cecr_e.htm

Business-led NCES - Business-Led Networks of Centres of Excellence (BL-NCEs): As a part of Budget 2007, the BL-NCE initiative was designed to support Canadian private sector competitiveness and innovation by funding large-scale collaborative networks. For a four-year period which begins in 2009, $46M will go towards the creation and support of up to five new not-for-profit consortia that represent the interests of Canadian private sector companies. According to the NCE website, "The BL-NCEs will differ from existing NCEs in that they will be for a shorter term, Business-Led and focused on solving business research needs that have been identified by the private sector. The intention is to increase private sector investments in research in Canada, support the training of skilled researchers, and optimize the timeline between research and commercialization." For further information, see: http://www.nce.gc.ca/comp/BLNCE/blnce_e.htm

Industry Canada Innovation Portal: The online portal was created in 2003 as one of many responses to the government's new innovation mandate. The portal is targeted to SMEs, entrepreneurs and others interested in improving productivity, and is designed to "demonstrate Canada's commitment to creating a culture of innovation and knowledge, while encouraging provinces, private sector and research institutions to work together to improve Canada's innovation performance". (http://www.marketaccess.ca/portfolio/project.asp?bid=3&pid=66). With a database of over 17,000 links, the portal is "a growing inventory of research, public input and links to government and private sector resources that can help [innovators] turn [their] ideas into commercial reality." See: http://innovation.gc.ca/gol/innovation/site.nsf/en/index.html

Scientific Research and Experimental Development (SR&ED) Tax Credits: This incentive designed by the Canada Revenue Agency (CRA) is designed to encourage R&D by business enterprise in Canada. Eligible companies, typically small, can receive investment tax credits on up to $3 million in R&D per year as an incentive to invest heavily in new innovative ideas. See: http://www.cra-arc.gc.ca/taxcredit/sred/

ACCT: The Alliance for Commercialization of Canadian Technology: Created to bring together the four regional higher education commercialization networks— ARCN, Les BLEUs, OnSeTT and Westlink— ACCT forms a national "network of networks" intended to "enhance Canada's technology commercialization infrastructure, capacity, and collaboration". ACCT was created in 2005 by Canadian AUTM members (see entry below) and now comprises a total of 84 members nationwide. See: http://www.stmarys.ca/academic/fgsr/documents/ACCT.pdf

Canadian Association of Business Incubation (CABI): CABI is a national organization composed of over 70 member organizations. CABI defines business incubation as "dynamic business strategies to help build up strong, viable, companies from an idea and determination." The association supports the development and growth of small and medium enterprises (SMEs) throughout Canada by providing information, training, networking opportunities and strategic alliances between members and stakeholders. See:http://www.cabi.ca/about-cabi.php

Association of University Research Parks (AURP): The mission of the AURP is to promote the development and operations of university research parks, with the larger goal of increasing technology transfer and commercialization. A research park is defined as a research/science-based facility either owned by or formally in collaboration with a university. To fit the AURP's definition, the facility must in some way promote the associated university's R&D through industry partnerships and the creation of new companies. The association was created in 1986, and renamed the AURP in 2001. See: http://www.aurp.net/index.cfm

Association of University Technology Managers (AUTM): Based mostly in the US, but with many international participants, the AUTM is, according to their website, "a living, dynamic, global network of more than 3,500 technology transfer professionals who work in academic, research, government, legal and commercial settings." AUTM works with universities and business leaders to support technology transfer through education, advocacy, networking and communication. See: http://www.autm.net/index.cfm