A BRIEF to the HOUSE OF COMMONS STANDING COMMITTEE on FINANCE

The Canadian Consortium for Research (CCR) is the largest umbrella organization in Canada whose primary concerns are the funding of research in all disciplines and support for post-secondary education. Established in 1976, CCR consists of 15 organizations that represent more than 50,000 researchers and 500,000 students in a wide range of disciplines across Canada.

Conscious of the severe time constraints faced by members of the HCFC, we limit our arguments and recommendations to 3 pages, giving further details in footnotes. Recommendations are on page 3.

The Big Question. Can Canada maintain, or even improve, its current standard of living - its prosperity, its social programs, its environment - in coming years and decades? Or will we face a slow decline into mediocrity? Already, as a result of poor productivity growth, median real earnings in Canada have not advanced since 1980, and are sliding relative to other nations.[1]

Innovation is Key. Looking beyond current challenges, most economists agree[2] that a nation's place in the world depends increasingly on its ability to innovate -- to nurture and develop creative, educated people, and to excel across the whole innovation spectrum: knowledge creation, downstream R&D, and generating world-class products, processes, medical treatments, and government policies. Technological innovation probably accounts for more than 50% of economic growth in advanced countries.[3,4]

Canada's innovation performance is poor. Studies[5] repeatedly give Canada failing grades for innovation. (The only bright spots are primarily academic: scientific output[5], and research-based academic spin-off companies, where we are a world leader.[6])

Competing will get far tougher. We often assume that our competition in the innovation race is the rest of the 'rich' world. No more! A special 2010 report[7] in *The Economist* describes the ferment of innovation now occurring in emerging nations. In 2008, for example, the company filing the most international patents was Chinese.[8] The world leader in money transfer by mobile phone is Kenya.[7] In 2006, the BRIC[9] countries trained half as many doctoral graduates as all OECD countries put together.[10] Infosys and TCS (Indian) are amongst the world's biggest IT companies. "*A wave of low-cost...innovation will shake many [rich world] industries to their foundations*."[7]

Even our resource sector is not safe! For example, China has developed an innovative, low-cost alternative to Canadian refined nickel: production is already greater than Sudbury's.[11]

The low spending on in-house R&D by much of Canadian industry[12] is a key barrier to Canadian innovation. Generous government programs have tried to address this issue for decades. They have not solved the problem, which suggests that it may be structural and permanent.[13]

But Canadian industry does support targeted academic research, presumably reflecting its high quality. The proportion of academic research supported by Canadian industry (while small compared with government support) is second only to Germany in the G7, and 50% more than the G7 average.[14] To a significant extent, then, industry seems to fund targeted R&D at the universities rather than doing it in-house.

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So, if industry does little in-house R&D, but does utilize universities, then the health of academic research is especially important in Canada. World-leading research in a wide range of disciplines creates opportunities that industry and governments can exploit.[15] It also plays a key role in creating vibrant and creative cities such as Waterloo, Ontario, and it can solve critical practical problems. There are many examples. [18] It also ensures Canadian access to the personal international networks by which much foreign technology, know-how, and ideas are transferred.

Government Science: While we focus on academic research, government science also plays a key role in our health, well-being and prosperity.[16] Yet as a share of GDP, our in-house government R&D spending is well below the G7 average and falling.[17] Government R&D plays a unique and indispensable role, which a balanced approach to research funding must recognize.

Targeted research is very important, but the most significant breakthroughs[19] depend on basic (or curiosity-driven) research, i.e. research not directed at an immediate, specific application. Basic research, by its very nature, creates entirely unanticipated advances (and so is rarely supported by industry). These advances produce truly new opportunities for targeted research in universities and industry, and enable innovation based on today's breakthroughs, not yesterday's! A recent major example is the spin-off of the World Wide Web from basic research. [20]

So, while addressing the problems in Canadian innovation, we must continue to nurture and grow the bright spot, our basic research. The recommendations[21] of a blue-ribbon, business-based committee asked by Industry Canada to advise on R&D *commercialization* were "based on one key premise: continuing government commitment to publicly funded research carried out with little or no expectation of [immediate] commercial application....The challenge for government is to increase - not merely maintain - its investments in publicly funded research, while encouraging private sector R&D."

The Obama administration has proposed to substantially increase spending on basic research, towards doubling the budgets of the key funding agencies for such research by 2017. [22] The U.S. proposals tend to *reduce* targeted research budgets and *increase* those for basic research.[23] The U.S. Congress Joint Economic Committee[24] recently stated: "The innovations that have improved the country's productivity and quality of life are ultimately grounded in the results of basic research...some studies have shown that it is the form of R&D that generates the greatest economy-wide returns...Now, more than ever, basic research is needed to chart the way forward."

Two economic studies published this year underline the case for basic research. There is strong new evidence[25] of high returns to the broad economy from U.K. Research Council spending, even within a couple of years; *the returns are much higher than those from R&D tax credits for the private sector*. And here in Canada, a new peer-reviewed study[26] estimates the direct economic impact of new companies spun-off from 1960 to 1998 (by a faculty member or student) directly from Canadian academic natural science and engineering research. It compares this with all federal/provincial government research funding, direct and indirect, over the same period. With very conservative assumptions, and allowing for the time-value of money, *the impact of this one outcome of basic research is 3 – 4 times the government funding*; governments will also receive more in additional tax than they spent.

Social sciences and humanities research is an integral element of a successful innovation strategy. By advancing our understanding of the world and helping us gain insight into behaviours, relationships and society, social sciences and humanities research provides critical evidence to support sound policy-making. Research in these disciplines provides essential information on key

social, cultural, psychological, economic and health-related issues. [27] Social sciences also play a key role in technological advances, informing many aspects of the digital economy.[28]

In summary: Our future depends on greatly improving Canadian innovation. Basic, curiosity-driven academic research (necessarily funded by government) is a crucial driver of innovation, particularly as industry in-house R&D spending is modest in Canada. Canadian and foreign experts agree on the importance of increasing support for basic research. On its own, a single by-product of Canadian basic research (academic spin-off companies) much more than repays the government funding. Basic research is one of the bright spots in Canadian innovation: we must continue to nurture and grow it, at the same time as encouraging more targeted efforts!

Recommendations

1. The Granting Councils are the best mechanism to fund basic (curiosity-driven) research in Canada. While funding for the Councils' *targeted* programs has increased significantly in recent years, the consensus among our community and our partners in every sector is that increased support for *basic* research is also essential to a healthy national innovation capacity. Recognizing this, Budget 2010 did increase the Councils' funding for basic research -- a small but much appreciated increase. Much more remains to be done, however, particularly given that the *cuts* to the Councils mandated in 2009 will reduce their budgets by $87M p.a. in 2011-12 and beyond. CCR therefore recommends:

That the federal government augment the basic (curiosity-driven) research portion of the Granting Councils' budgets by 5%.

2. A key role of basic research is to educate, inspire, and unleash the creativity of the next generation of highly qualified people. Relative to our population, however, Canada produces 35% fewer graduates at the crucial doctoral level than the OECD average or the U.S.[10] This has been recognized by the federal government with the creation of, for example, the Vanier Canada Graduate Scholarships. CCR therefore recommends:

That additional graduate level scholarship programs be developed and sustained over the long term to support emerging researchers, as current stimulus programs expire.

3. Adding at least 40% to the direct costs of conducting research in Canada, indirect costs[29] are reimbursed by the federal Indirect Costs Program at only about 25%.[30] The shortfall is borne by the research institutions, forcing them to forego other investments that would improve the quality of teaching and research. The U.S., U.K. and the EU recognize the impact of such a burden and reimburse 40-60% of the direct costs of research. Maintaining world-class research infrastructures and facilities in Canada requires increased support to cover these costs. However, CCR recognizes the current financial situation and therefore recommends:

That the funding for the indirect costs of university research rise over the course of the next 5 years to represent 40 percent of the direct costs funded by the granting councils.

FOOTNOTES AND SOURCES OF DATA.

1. TD Financial Group, *Post-secondary Education is a Smart Route to a Brighter Future for Canadians. Standard of Living and Education Linked to High Degree* (May 17, 2010), based on OECD data. TD Finance continues: "...median real earnings of individuals within the lowest income quintile have actually been falling. Moreover, Canada is slipping lower in the international living standard benchmarks. Canada's per capita GDP expressed in purchasing power parity terms (PPP), which ranked 5th highest for the most part of the 1980s and the 1990s, has slipped to 11th highest in 2008..."
2. The Conference Board of Canada summarizes it well: "Innovation is essential to a high-performing economy. It is also critical to environmental protection, a high-performing education system, a well-functioning system of health promotion and health care, and an inclusive society. Without innovation, all these systems stagnate and Canada's performance deteriorates relative to that of its peers." http://www.conferenceboard.ca/HCP/Details/Innovation.aspx
3. M. Pianta, *Technology and Growth in OECD Countries, 1970-1990*. Cambridge J. of Economics 19 (1) 175-187 (1995).
4. C. Jones, *Sources of U.S Economic Growth in a World of Ideas*, American Economic Review 92 (1) 220-239 (2002). This study (and the 50% estimate) included five nations: the U.S., W. Germany, Japan, France, and the U.K.
5. The Conference Board of Canada, for example, has for many years given Canada low grades on innovation, versus many other nations. In the most recent report (*A Report Card on Canada, Innovation*, February 2010), Canada ranks 14th out of 17 countries and receives a 'D' grade (the lowest ranking) overall, as it has for decades. Out of 12 individual innovation indicators, Canada scores 'D' on 9 indicators and 'C' on 2. Its sole 'B' rating is in Scientific Articles, an area driven largely by the academic community. http://www.conferenceboard.ca/HCP/Details/Innovation.aspx
6. By 'academic spin-off companies', we mean new companies spun-off directly (usually by a faculty member) from Canadian university research. In the definitive survey of the field (S. Shane, *Academic Entrepreneurship: University Spinoffs and Wealth Creation*, Edward Elgar, 2004), index entries and mentions in the text clearly place Canada in the leading group of four countries (the U.S., U.K., Sweden and Canada). See also the work cited in footnote 26.
7. The Economist, "*The new masters of management*" p. 11 and "*A Special Report on Innovation in Emerging Markets*" in the same issue (April 17, 2010).
8. The company was Huawei, a Chinese telecommunications giant.
9. BRIC= Brazil, the Russian Federation, India, and China.
10. *OECD Science, Technology and Industry Scoreboard* (OECD, 2009), pp.17 and 135. The Economist (footnote 7) points out that China and India alone graduate 135,000 people annually with higher degrees in engineering or computer science.
11. Andy Hoffman, "*A breakthrough in China, another blow for Sudbury*," The Globe and Mail Report on Business, pages 1 and 4 (June 11, 2010).
12. J. Niosi, *Choices. Connecting the Dots between University Research and Industrial Innovation*, IRPP (2008), p. 9.
13. There may be various reasons for this, including the branch-plant nature of many Canadian firms, the nature of many resource industries, etc.
14. OECD, *Main Science and Technology Indicators, Volume 2010/1* (2010), pages 69 and 71. This latest data also shows that Canada has fallen (as of 2008) to a triple-tie for sixth in the OECD for total spending on academic research as a percentage of GDP.
15. There are many transfer mechanisms, of which formal publication is but one. Nevertheless, we support current efforts to create more open access to research publications (http://www.carl-abrc.ca/projects/open_access/open_access-e.html).
16. Federal government research is vital to the welfare and livelihood of Canadians, addressing the quality of the air they breathe, the food and water they ingest, the safety of their consumer products, and their physical security in the course of their daily lives. The research is necessary to approve safe food and drugs, develop vaccines and other medications, and adapt to a changing climate. The Canadian public expects that government will maintain the scientific capacity necessary to understand, anticipate and respond to new technologies and emerging public health threats.
17. *Canada's Science, Technology and Innovation System: State of the Nation 2008*, Government of Canada: Science, Technology and Innovation Council (2009), page 8.
18. For example: (i) On July 16, 2010, Domtar and FPInnovations announced that they will build a $32M demonstration plant to produce commercial-scale nanocrystalline cellulose (NCC). NCC, produced from wood fibre, will provide the forestry industry with major new high-value-added opportunities in a variety of sectors. Propelling the industry's enthusiasm is Canada's unequivocal world leadership in NCC technology. This coveted stature is largely due to the fundamental discoveries of university researchers, generated by basic Canadian research going back to 1961. For an industry facing

major challenges, the ability to create high-value products based on world leadership could be critically important. Other NSERC impact stories are at http://www.nserc-crsng.gc.ca/Media-Media/ImpactStories-ArticlesPercutants_eng.asp (ii) Studies show that the University of Waterloo's spin-off companies (based largely on Granting Council-funded research) were essential to the development of the well-known entrepreneurial ferment in Waterloo. Without this environment, it is unlikely that a University of Waterloo student would have founded Research in Motion, the maker of the Blackberry. (iii) NSERC has documented that new companies spun-off directly (usually by a faculty member) from Canadian university research supported by NSERC had annual revenues of roughly $3.5B in 2004, very largely from exports. (iv) By analyzing a well-known novelist's changing writing style while she apparently succumbed to Alzheimer's, a Professor of English may have created the basis for an early test for the disease. Other SSHRC impact stories are at http://www.sshrc.ca/society-societe/stories-histoires/index-eng.aspx. (v) A team of Canadian CIHR-supported researchers has come up with a new approach to treating diabetes. They have discovered a way to engineer cells lining the gut to take over insulin production from the pancreas. Other CIHR impact stories are at http://www.cihr-irsc.gc.ca/e/35235.html .

19. Academic research has been enormously important to economic growth. Basic scientific understanding was essential to the development of all modern computers and electronics, lasers (and thus modern communications, laser printers, many medical treatments, etc.), X-rays, cathode ray tubes, and a host of other advances whose economic and social impacts have changed our world. Inventions based on the understanding of quantum physics alone may account for over 25% of the GDP of all the industrial powers (L. Lederman, *The God Particle. If the Universe is the Answer, What is the Question?* Houghton Mifflin, Boston, 1993), and are essential for the existence of the global economy itself (D. Kleppner and R. Jackiw, *One Hundred Years of Quantum Physics*, Science 289, 893-898, 2000). Almost as important are the major instrumentation and methodology advances that have spun off from academic research, such as MRIs, electron microscopy, ion implantation (essential for making integrated circuits), PET scans, materials characterization by neutron scattering, and recently the WWW.

20. See, for example, S. Avery, *Idea finally spins gold for Web's inventor*, The Globe and Mail, Toronto (June 15, 2004). Tim Berners-Lee invented the World Wide Web while at CERN, the European international particle physics laboratory, in 1989. It arose from the need to allow the worldwide subatomic physics community to easily share and update information. Canadians have been very active at CERN for many years.

21. *People and Excellence: The Heart of Successful Commercialization: Final Report of the Expert Panel on Commercialization*, Industry Canada (2006).

22. For example, the National Science Foundation's research budget was slated to increase by 9.4% for FY 2011: see the February 4, 2010 *Policy Alert* of the American Association for the Advancement of Science. Even if these proposals are changed by Congress, the trend seems clear.

23. Valerie La Traverse, S&T Counselor at the Canadian Embassy in Washington, reporting on the 2010 Policy Forum of the American Association for the Advancement of Science (May 2010).

24. U.S. Congress Joint Economic Committee, *The Pivotal Role of Government Investment in Basic Research* (May 2010).

25. "*Value-Adding Enterprise*", Nature (editorial) 466 p. 296 (July 15, 2010), referring to J. Haskel and G. Wallis, Centre for Economic Policy Research, Discussion Paper 7725 (March, 2010).

26. P.S. Vincett, *The economic impacts of academic spin-off companies, and their implications for public policy*, Research Policy 39 736-747 (2010).

27. Examples where Canadian researchers have recently made significant contributions to our understanding include: (i) the influence of parental actions, children's leisure activities, and community design on child obesity, (ii) the individual, family, school and neighbourhood factors influencing mental health, (iii) actions that can reduce youth suicide, substance abuse, and crime, and (iv) the factors that may cause homelessness.

28. See, for example, D.P. O'Donnell, *Edmonton Journal* (July 21, 2010). The article points out that Larry Sanger, the co-founder of Wikipedia, has a Ph.D. in philosophy, the founder and CEO of Facebook initially applied to Harvard to study classics, while the lead developer of Unicode (the technology used to transmit the different alphabets on the web) did doctoral research in Celtic studies. The digital economy emphasizes problems humanists and social scientists have always studied: organization and communication, and the balance between the group and the individual.

29. Indirect costs include buildings and laboratories, specialized equipment and other facilities, power, information networks and other consumables, archives, libraries and other knowledge resources, and a variety of support services.

30. *Building a Competitive Advantage for Canada*, AUCC, November 18, 2009.