A BRIEF to the HOUSE OF COMMONS STANDING COMMITTEE on FINANCE

Who We Are. The Canadian Consortium for Research (CCR) is the largest umbrella advocacy organization in Canada whose primary concerns are the funding of research in all disciplines and support for post-secondary education. CCR consists of 19 organizations that represent more than 50,000 researchers and 500,000 students in a wide range of disciplines across Canada.

Executive Summary. Job growth and continued prosperity depend increasingly on a nation's success in innovation. *Basic* research is widely agreed to play an essential role in innovation, and thus in ensuring a country's future economic and social prosperity. This is especially true in Canada, where industry's low level of R&D has meant a greater reliance on the expertise and knowledge development of university and college researchers. In-house government research plays a critical role too. Even in times of stringency, a continued commitment to publicly-funded research is essential, to provide the fuel to grow Canada out of austerity: in a continuing climate of global economic uncertainty, even temporary reductions would cause damage that could take decades to repair. Understanding this, the European Union recently proposed a 45% increase (plus inflation) for research and innovation for its next 7-year period! CCR recommends:

1. ***That the federal government augment the Granting Councils' budgets by 7% (roughly matching the 7-year 45%-plus-inflation EU proposal), with the whole increase being directed to the portion of their budgets that supports basic research. Cost about $165 M p.a.***
2. ***That the base Canada Graduate Scholarships program return to roughly its pre-stimulus growth rate. First-year cost: $25M, sufficient to fund 700 additional doctoral or 1400 masters students each year.***
3. ***That, in the face of government spending cuts, the government classify public science-related programs as part of "core" services and exempt them from further spending reductions.***

The Big Question. In its call for Briefs, the HCFC asked 'in particular' for *thoughts and suggestions of Canadians about how to attain high levels of job growth and business investment in order to ensure shared prosperity and a high standard of living for all.* This will not be easy. 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 Essential. Innovation is critical to a high-performing economy, to environmental protection, to a high-performing education system, to a well-functioning system of health care, and to an inclusive society.[2] Technological innovation probably accounts for more than 50% of economic growth in advanced countries.[3,4] Unfortunately, studies[5] repeatedly give Canada failing grades for innovation. Moreover, major new innovation-based competition is coming from the emerging nations. In 2008, the company filing the most international patents was Chinese. In 2006, Brazil, Russia, India and China together trained half as many doctoral graduates as the entire OECD.[6] China will soon have more researchers than either the USA or the EU.[7] Two Indian IT companies are amongst the world's biggest. "*A wave of low-cost...innovation will shake many [rich world] industries to their foundations*."[8]

Unless we get smarter, we'll get poorer.
The UK Royal Society

Can our resource sector save us? Even here, we are not safe from major foreign competition. For example, China has developed an innovative, low-cost alternative to Canadian refined nickel: production is already greater than Sudbury's.[9]

One answer: economists call for *basic* research. In 2010, the leading editorial in the prestigious *Economist* magazine asked a similar question about securing the jobs of the future. It made just three recommendations;[10] the second was that "governments should invest in the infrastructure that supports

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innovation, from modernized electricity grids (a smarter way to help green energy) to basic research and university education."

Others agree. Last year, the U.S. Congress Joint Economic Committee stated:[11] "The innovations that have improved the country's productivity and quality of life are ultimately grounded in the results of basic research. Now, more than ever, basic research is needed to chart the way forward." Writing in the Globe and Mail,[12] Neil Reynolds went even further: "scientific advances represent the world's best chance ..... for human survival".

But what is 'basic research'? Basic research is research (usually in the natural, medical or social sciences) undertaken, typically in universities, without an *immediate* application in mind. It is also sometimes referred to as 'curiosity-driven research' or 'non-targeted research'.

Why not focus on solving our practical problems, and cut basic research? Applied research, of course, is essential. But the most significant breakthroughs come from basic research. By its very nature, basic research creates entirely unanticipated advances. These produce truly new opportunities for applied research in universities and industry, and enable product and process innovation based on today's breakthroughs, not yesterday's! A recent example is the spin-off of the World Wide Web from basic research.[13] Basic research underlies all modern computers and electronics, modern communication technologies, all other laser-based technologies and medical treatments, X-rays, MRIs, PET scans, 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.[14]

Then why doesn't industry do it? The unpredictability of basic research makes it hard for industry. Advances may not fit the company's capabilities, and a successful program requires long-term work in a wide variety of disciplines. More important, the benefits of basic breakthroughs accrue primarily to the general economy and to society, rather than to the researcher's organization.

Why not just let other countries do it? While the benefits of basic research do spread well beyond the researcher's country, the evidence is that no country can free-ride on the world scientific system. World-leading research in a wide range of disciplines solves problems and creates major opportunities that industry and governments exploit, typically in the same country as the original research.[15] Within Canada, it directly spins-off major new Canadian companies. It plays a key role in producing vibrant, creative cities such as Waterloo, Ontario, and thus, indirectly, the resulting companies like Research in Motion. Crucially, it ensures Canadian access to the personal international networks by which much foreign technology, know-how, and ideas are transferred. It plays a critical role in educating and inspiring the next generation of researchers and other leaders, and in attracting foreign students to Canada (who alone contribute $6.5B p.a. to our economy.)[16]

Recent evidence. There is strong evidence[17] 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.* A detailed study[18] estimates the direct economic impact of just one outcome of basic research: completely new companies spun-off over a nearly 40-year period (by a faculty member or student) directly from Canadian academic natural science and engineering research. With very conservative assumptions, it found the impact to be 3 – 4 times the total federal/provincial research funding, direct and indirect, over the whole period, even allowing for the time value of money. Governments will also receive more in additional tax than they spent. NSERC reports the companies' 2004 revenues as $3.5B, very largely from exports.[19]

Don't we spend enough already? Canadian spending on academic research, as a % of GDP, is about 6th in the OECD.[20] But in-house *industrial* R&D spending[21] remains low, despite generous government incentives over many decades, suggesting that the low spending may have structural, permanent roots.[22] However, the proportion of Canadian *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.[20] To an important extent, then, industry seems to fund applied R&D at the universities (building on the universities' earlier basic work) rather than doing it in-house. As a UNESCO report[23] remarks, Canadian "academic research often appears to be a surrogate for industrial R&D". As a result, the health of academic research is especially important in Canada and a continuing well-above-average investment by government is essential to help offset poor industrial performance.

Scientific output (primarily academic basic research) is the one bright spot in Canada's poor international innovation rankings.[5] So, while addressing the problems, we must continue to nurture and grow the bright spot, our basic research. The recommendations[24] of a blue-ribbon, business-based committee advising Industry Canada 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 ....."

Social sciences and humanities research (SSHR) 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, SSHR provides critical evidence to support sound policy-making. SSHR provides essential information on key social, cultural, psychological, economic and health-related issues[25] and also plays a key role in technological advances and the digital economy.[26]

What about the government's own research? When it comes to protecting Canadians' health and welfare and contributing to economic prosperity, government research also plays a unique and indispensible role, quite different from universities or industry. Over Canada's history, government research has been at the centre of the development of scientific knowledge and innovation. It is responsible for many of Canada's greatest scientific and technological achievements, with major social and economic impacts.

Some examples? The products of federal basic and applied research range from hundreds of new wheat varieties to a vaccine for meningitis C (reducing the disease's incidence in millions of children worldwide), and from corrosion resistant concrete to a brain-surgery simulator that will make surgery safer for countless patients. And canola (primarily developed by NRC) contributes more than $2B p.a. to the Canadian economy alone.

What else does government research do? It supports: public policy development, regulations and decision-making; programs to ensure public health, safety and security; and development and management of national and international standards. It provides the long-term research and monitoring capacity needed to respond to the complex challenges to Canadians' physical, environmental and economic security – climate change, alien invasive species, human pandemic disease. From SARS to the mountain pine beetle, from water and air quality to fish stocks, Canadians' health, environment and economic prosperity depend on the federal government's ability to effectively monitor serious problems and directly contribute to solutions. Government science also provides an independent yardstick, establishing a standard for unbiased and authoritative advice to government policy-makers against which competing claims can be measured.

Why suggest an increase in spending during a time of austerity? When times are tough, the last thing we should do is to 'eat our seed-corn'. Research and innovation are the engines needed to grow us out of austerity. The European Union, facing difficulties far worse than Canada's, recently proposed to increase

spending on research and innovation by 45% plus inflation over a seven year period, leaving most other major areas flat.

In summary: Our future depends on greatly improving Canadian innovation. Basic 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 an essential bright spot in Canadian innovation: we must continue to nurture and grow it, at the same time as encouraging more applied efforts! We must also take great care not to lose critically important research capabilities, built-up over decades, within government itself.

Recommendations

1. The Granting Councils are widely admired internationally and form the bedrock of support for basic research in Canada. While funding for the Councils' *applied* programs has increased significantly in recent years, increased support for *basic* research is also widely agreed to be essential to a country's future prosperity. Recognizing this, Budgets 2010 and 2011 did increase the Councils' basic research with small increases roughly equal to inflation (1.7% in Budget 2011). Yet very many researchers rated highly by international standards of excellence (i.e. fully worthy of funding) still cannot be funded; in health research for example, only about 25% of their research proposals are typically funded. Talented individuals' contribution to Canada's innovation and wealth-creating potential is thereby much reduced. Moreover, *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 Granting Councils' budgets by 7% (roughly matching the 7-year 45%-plus-inflation EU proposal), with the whole increase being directed to the portion of their budgets that supports basic research. Cost about $165 M p.a.

2. A key role of basic research is to educate, inspire, and unleash the creativity of the next generation of highly qualified people. By doing so, we make a vital long-term contribution to our future innovative and competitive advantage, and we encourage some of our brightest minds to remain in Canada. Relative to our population, however, Canada produces 35% fewer graduates at the crucial doctoral level than the OECD average or the U.S.[27] This has been recognized by the federal government with, for example, the expansion of the Canada Graduate Scholarships (CGS) program. Yet after 2011-2012, the end of special stimulus funding will reduce the CGS budget for doctoral students by $17.5M p.a., even without any new cuts. Prior to stimulus, the program had grown at an average rate of about $25M p.a. CCR therefore recommends:

That the base Canada Graduate Scholarships program return to roughly its pre-stimulus growth rate. First-year cost: $25M, sufficient to fund 700 additional doctoral or 1400 masters students each year.

3. Even though the federal government is aggressively pursuing reductions in spending, many functions can still only be undertaken by governments. In-house government science programs are essential services for the protection of the health, safety and well-being of Canadians. It is therefore critically important that in-house government science be adequately funded. Science-based departments and agencies have already been cut by 5% between 2007 and 2011. Moreover, for many years, Canada has badly trailed the G7 and OECD average for government in-house R&D as a fraction of GDP.[20] CCR therefore recommends:

That, in the face of government spending cuts, the government classify public science-related programs as part of "core" services and exempt them from further spending reductions.

FOOTNOTES AND SOURCES

[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.

[2] *A Report Card on Canada, Innovation* (The Conference Board of Canada, February 2010).

[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] See reference 2, for example. 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, it scores 'D' on 9 indicators and 'C' on 2 indicators. Its sole 'B' rating is in Scientific Articles, an area driven largely by the academic community's basic research.

[6] *OECD Science, Technology and Industry Scoreboard* (OECD, 2009), pp .17 and 135.

[7] Hugo Hollanders and Luc Soete, UNESCO Science Report 2010, p. 10.

[8] 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).

[9] A. Hoffman, "*A breakthrough in China, another blow for Sudbury*," Globe and Mail Report on Business, pp. 1, 4 (June 11, 2010).

[10] The Economist (August 7, 2010), p. 9. The other recommendations were to improve the environment for business, and to encourage winners to emerge by themselves instead of trying to pick them.

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

[12] Neil Reynolds, The Globe and Mail Report on Business (December 4, 2009), p. B2.

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

[14] L. Lederman, *The God Particle. If the Universe is the Answer, What is the Question*? Houghton Mifflin, Boston, (1993).

[15] Many success stories can be found on the Granting Council's web-sites. We give one example per Council: (i) NSERC. Domtar and FPInnovations are building a $32M demonstration plant to produce commercial-scale nanocrystalline cellulose (NCC). NCC, produced from wood fibre, will give the forestry industry major new high-value-added opportunities in a variety of sectors. Canada is the world leader in NCC, largely due to basic research going back to 1961. For an industry facing major challenges, new, world-leading, high-value products are critically important. (ii) SSHRC. 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. (iii) CIHR. A team of Canadian CIHR-supported researchers has created 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.

[16] Roslyn Kunin & Associates. *Economic Impact of International Education in Canada*. Final Report to Foreign Affairs and International Trade Canada (2009). http://www.international.gc.ca/education/assets/pdfs/RKA_IntEd_Report_eng.pdf .

[17] "*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).

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

[19] NSERC, *Research Means Business* (October, 2005).

[20] OECD, *Main Science and Technology Indicators, Volume 2011/1* (2011), pages 69, 71 and 76.

[21] J. Niosi, *Choices. Connecting the Dots between University Research and Industrial Innovation,* IRPP (2008), p. 9.

[22] Reasons for this could include the branch-plant nature of many Canadian firms, the nature of many resource industries, etc.

[23] Hugo Hollanders and Luc Soete, UNESCO Science Report 2010, p. 22.

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

[25] 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.

[26] D.P. O'Donnell, *Edmonton Journal* (July 21, 2010), for example, points out that Larry Sanger, 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.

[27] *OECD Science, Technology and Industry Scoreboard* (OECD, 2009), pp. 17 and 135. The Economist (footnote 10) points out that China and India alone graduate 135,000 people annually with higher degrees in engineering or computer science.