"Science Powers Commerce": Mapping the Language, Justifications, and Perceptions of the Drive to Commercialize in the Context of Canadian Research

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The push to commercialize publicly funded, academy-driven scientific research has emerged as a significant science policy challenge. In this article, we investigate whether evidence of this push exists in Canadian scientific research policies through a comprehensive review of legislation, government policy instruments, funding agencies' program and awards guides and policy statements, political commentary, and university policies. The study maps and discusses the language and justifications used to promote this commercialization push, and examines possible impacts on the Canadian research environment. The article also presents the views of some members of Canadian scientific research community regarding the push or pressure to commercialize their work.

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I. Introduction

The push to commercialize publicly funded, academy-driven scientific research has emerged as a significant science policy challenge.[1] Advocates of this push include Prime Minister Stephen Harper of Canada, who recently declared that "science powers commerce,"[2] and President Barack Obama, who has urged Americans to "win the future" and claim "our generation's Sputnik moment" by supporting government investment in scientific research that will create new industries and "countless new jobs" and make the US economy more competitive.[3] Likewise, Prime Minister David Cameron, announcing a £180m "catalyst" grant for "new British ideas," referred to the life sciences as "a jewel in the crown of [the

1. Timothy Caulfield, "Talking Science – Commercialization Creep" (2012) 34:1 Policy Options 20 [Caulfield, "Commercialization Creep"]; Timothy Caulfield, "Patents or Commercialization Pressure?: A (Speculative) Search for the Right Target" (2012) 22:1 Journal of Law, Information and Science 122; Timothy Caulfield & Ubaka Ogbogu, "Biomedical Research and the Commercialization Agenda: A Review of Main Considerations for Neuroscience" (2008) 15:4 Accountability in Research 303; Timothy Caulfield, "Stem Cell Research and Economic Promises" (2010) 38:2 JL Med & Ethics 303 [Caulfield, "Economic Promises"]; Jocelyn Downie & Matthew Herder, "Reflections on the Commercialization of Research Conducted in Public Institutions in Canada" (2007) 1:1 McGill JL & Health 23.
2. Stephen Harper, "PM Announces Banting Postdoctoral Fellowships, Support for Next Einstein Initiative" (6 July 2010), online: Office of the Prime Minister <http://pm.gc.ca/eng/news/2010/07/06/pm-announces-banting-postdoctoral-fellowships-support-next-einstein-initiative-0>.
3. Barack Obama, "Remarks by the President in State of Union Address" (25 January 2011), online: The White House <http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address>.

UK] economy" and called for a new model of research and development focused on "getting the best ideas through the proof of concept stage so we can get them into clinical development and get our entrepreneurs selling them around the world."[4] In the European Union, member states have announced reforms aimed at linking research innovation with "entrepreneurship, the business environment and the labour market, with a strong focus on better commercialization of research results."[5] These claims and statements have generated some concern, especially regarding whether this "ever-intensifying pressure to commercialize research" overstates what scientific research can actually or realistically deliver.[6] As one critic has observed, key features of the commercialization trend, such as biotech start-ups and activities of university technology transfer offices, resemble Ponzi schemes because they purport by "all appearances to be a success when careful measurement reveals … failure[s]."[7]

There are, of course, arguments that can be put forward in support of both perspectives. Contemporary commercialization initiatives are chiefly characterized by academy-industry partnerships, and public funding support for research projects that are able to obtain matching private sector funds, or that can show evidence of near-term commercializable outcomes (or at a minimum, a clear route to commercial exploitation).[8] These initiatives can and have produced beneficial outcomes, including useful products, jobs, increased research funding and public-private sector linkages.[9] However, these initiatives have also been linked with

4. David Cameron, "PM Speech on Life Sciences and Opening Up the NHS" (6 December 2011), online: GOV.UK <https://www.gov.uk/government/speeches/pm-speech-on-life-sciences-and-opening-up-the-nhs>.
5. European Commission, "State of the Innovation Union 2012: Accelerating change" (21 March 2013), online: Innovation Union <http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2012/state_of_the_innovation_union_report_2012.pdf> at 10.
6. Caulfield, "Commercialization Creep", *supra* note 1 at 20.
7. Philip Mirowski, "The Modern Commercialization of Science is a Passel of Ponzi Schemes" (2012) 26:3-4 Social Epistemology 285 at 296.
8. Ubaka Ogbogu, "A Review of Pressing Ethical Issues Relevant to Stem Cell Translational Research" (2006) 14:3 Health Law Review 39.
9. Caulfield, "Commercialization Creep", *supra* note 1; Ogbogu, *ibid*; Commission on the Future of Health Care in Canada, *Building on Values:*

adverse impacts on the integrity of scientific processes,[10] scientific collaborations, exchanges and "open science" initiatives,[11] loss of public trust,[12] hyped representations of research realities and outcomes

The Future of Health Care in Canada (Saskatoon: Commission on the Future of Health Care in Canada, 2002).

10. Vincent Mangematin, Paul O'Reilly & James Cunningham, "PIs as Boundary Spanners, Science and Market Shapers" (2014) 39:1 The Journal of Technology Transfer 1; Riccardo Fini & Nicola Lacetera, "Different Yokes for Different Folks: Individual Preferences, Institutional Logics, and the Commercialization of Academic Research" in Gary D Libecap, Marie Thursby & Sherry Hoskinson, eds, *Spanning Boundaries and Disciplines: University Technology Commercialization in the Idea Age* (Bingley, UK: Emerald Group, 2010) 1; Bertrand R Jordan & Daniel Fu Chang Tsai, "Whole-Genome Association Studies for Multigenic Diseases: Ethical Dilemmas Arising from Commercialization – The Case of Genetic Testing for Autism" (2010) 36:7 Journal of Medical Ethics 440; Philip Morowski, *Science-Mart: Privatizing American Science* (Cambridge, MA: Harvard University Press, 2011); Francesco Rentocchini et al, "Working Paper No. 2011/03:The Effect of Academic Consulting on Research Performance: Evidence from Five Spanish Universities" (2011), online: Ingenio Working Paper Series <http://www.ingenio.upv.es/sites/default/files/working-paper/2011-03_-_the_effect_of_academic_consulting_on_research_performance_evidence_from_five_spanish_universities.pdf>.
11. Timothy Caulfield, Shawn HE Harmon & Yann Joly, "Open Science Versus Commercialization: A Modern Research Conflict?" (2012) 4:2 Genome Medicine 17; Tania Bubela et al, "Commercialization and Collaboration: Competing Policies in Publicly Funded Stem Cell Research?" (2010) 7:1 Cell Stem Cell 25 [Bubela et al, "Commercialization and Collaboration"]; Sotaro Shibayama, John P Walsh & Yasunori Baba, "Academic Entrepreneurship and Exchange of Scientific Resources: Material Transfer in Life and Materials Sciences in Japanese Universities" (2012) 77:5 American Sociological Review 804; Shawn HE Harmon, Timothy Caulfield & Yann Joly, "Commercialization Versus Open Science: Making Sense of the Message(s) in the Bottle" (2012) 12:1 Medical Law International 3.
12. Christine R Critchley, Gordana Burce & Matthew Farrugia, "The Impact of Commercialization on Public Perceptions of Stem Cell Research: Exploring Differences Across the Use of Induced Pluripotent Cells, Human and Animal Embryos" (2013) 9:5 Stem Cell Reviews & Reports 541; Christine R Critchley & Dianne Nicol, "Understanding the Impact of Commercialization on Public Support for Scientific Research: Is it about the Funding Source or the Organization Conducting the Research?" (2011) 20:3 Public Understanding of Science 347; M Norton Wise, "Thoughts on the Politicization of Science through Commercialization" (2006) 73:4 Social Research 1253; Ubaka Ogbogu &

(especially in innovative fields that have captured public attention and purse strings, such as genetics and stem cell research),[13] and neglect of basic research programs.[14] The latter concern has generated some push

Amy Zarzeczny, "Ethical, Legal and Social Implications of Translational Stem Cell Research: Effects of Commercialization on Public Opinion and Trust of Stem Cell Research" in Kristina Hug & Göran Hermerén, eds, *Translational Stem Cell Research: Issues Beyond the Debate on the Moral Status of the Human Embryo* (New York: Humana Press, 2011) 341; Deborah Zucker, "Ethics and Technology Transfer: Patients, Patents, and Public Trust" (2011) 59:5 Journal of Investigative Medicine 762; Christine R Critchley, "Public Opinion and Trust in Scientists: The Role of the Research Context, and the Perceived Motivation of Stem Cell Researchers" (2008) 17:3 Public Understanding of Science 309.

13. Caulfield, "Economic Promises", *supra* note 1; Tania Bubela et al, "Is Belief Larger than Fact: Expectations, Optimism and Reality for Translational Stem Cell Research" (2012) 10:1 BMC Medicine 133; Zubin Master & David B Resnik, "Hype and Public Trust in Science" (2013) 19:2 Science and Engineering Ethics 321; Zubin Master & David B Resnik, "Promoting Public Trust: ESCROs Won't Fix the Problem of Stem Cell Tourism" (2013) 13:1 American Journal of Bioethics 53; James Porter et al, "On Being a (Modern) Scientist: Risks of Public Engagement in the UK Interspecies Embryo Debate" (2013) 31:4 New Genetics and Society 408; T Caulfield & C Condit, "Science and the Sources of Hype" (2009) 15:3-4 Public Health Genomics 209; Cong Cao, Richard P Appelbaum & Rachel Parker, "'Research is High and the Market is Far Away': Commercialization of Nanotechnology in China" (2013) 35:1 Technology in Society 55; Michael P Messenger & Paul E Tomlins, "Regenerative Medicine: A Snapshot of the Current Regulatory Environment and Standards" (2011) 23:12 Advanced Materials H10.

14. Laura Eggertson, "Scientists, Supporters Rally in Canadian Cities to Support Basic Research" (2013) 185:15 Canadian Medical Association Journal E707; Shirley Leitch et al, "The Fall of Research and Rise of Innovation: Changes in New Zealand Science Policy Discourse" (2014) 41:1 Science and Public Policy 119; Gürol Irzik, "Why Should Philosophers of Science Pay Attention to the Commercialization of Academic Science?" in Mauricio Suárez, Mauro Dorato & Miklós Rédei, eds, *EPSA Epistemology and Methodology of Science* (Dordrecht: Springer Netherlands, 2010) 129; Leland L Glenna et al, "Commercial Science, Scientists' Values, and University Biotechnology Research Agendas" (2011) 40:7 Research Policy 957; Lee Davis, Maria Theresa Larsen & Peter Lotz, "Scientists' Perspectives Concerning the Effects of University Patenting on the Conduct of Academic Research in the Life Sciences" (2011) 36:1 Journal of Technology Transfer 14; Hanna Hottenrott & Susanne Thorwarth, "Industry Funding of University Research and Scientific Productivity" (2011) 64:4 Kyklos 534; Dominique Foray &

back from the scientific community. For example, this past September, over 200 Canadian university researchers rallied at the nation's capital in Ottawa to express dismay over government neglect of basic research in favour of applied research programs and grants "that specify industrial partnerships or are directed at solving applied research problems or at increasing innovation and commercialization."[15]

As the debate rages on, there remains a considerable lack of clarity regarding the true nature and scope of this "commercialization creep,"[16] where the *pressure* comes from and the nature of the pressure it supposedly exerts on scientists and the scientific research environment. No studies have explored, for instance, the actual sources of the commercialization ethos or the language employed to express or justify the push or pressure to commercialize science. Similarly, with the exception of studies that have investigated the impact of commercialization trends on the scientific research environment, much remains unknown about how the scientific research community views this trend or pressure or about the impact of existing commercialization programs on the conduct or culture of scientific research.[17]

Francesco Lissoni, "University Research and Public-Private Interaction" in Bronwyn H Hall & Nathan Rosenberg, eds, *Handbook of The Economics of Innovation,* vol 1 (Amsterdam: Elsevier, 2010) 275; James A Evans, "Industry Induces Academic Science to Know Less about More" (2010) 116:2 Americal Journal of Sociology 389; Ferric C Fang & Arturo Casadevall, "Lost in Translation – Basic Science in the Era of Translational Research" (2010) 78:2 Infection and Immunity 563; Martin Carrier, "Knowledge, Politics, and Commerce: Science Under the Pressure of Practice" in Martin Carrier & Alfred Nordmann, eds, *Science in the Context of Application* (Amsterdam: Springer Netherlands, 2011) 11; Daniel H Nickolai, Steve G Hoffman & Mary Nell Trautner, "Can a Knowledge Sanctuary also be an Economic Engine? The Marketization of Higher Education as Institutional Boundary Work" (2012) 6:3 Sociology Compass 205.

15. Eggertson, *ibid* at E708.
16. Caulfield, "Commercialization Creep", *supra* note 1.
17. Bubela et al, "Commercialization and Collaboration", *supra* note 11; Glenna et al, *supra* note 14; Timothy Caulfield et al, "Patents, Commercialization and the Canadian Stem Cell Research Community" (2008) 3:4 Regenerative Medicine 483 [Caulfield et al, "Patents"]; CJ Murdoch & Timothy Caulfield, "Commercialization, patenting and genomics: researcher perspectives" (2009) 1:2 Genome Medicine 22;

In Canada, there are several well-known examples of the degree to which the political rhetoric has translated into tangible changes in the way research is funded, such as the Alberta Government's decision to create the commercialization-focused Alberta Innovates (which replaced the more research oriented Alberta Heritage Foundation for Medical Research), and the federal government's recent push to more closely align the work of National Research Council with the needs of industry.[18] However, despite the high profile nature of these examples, much remains unclear, such as the degree to which political commentary about the commercialization imperative has penetrated formal research funding requirements and expectations and, if it has, how that change is explicitly justified.[19]

In this article, we seek to address some of these gaps through a comprehensive review of over one hundred relevant Canadian documents identified through database searches, including legislation; government policy instruments; funding agencies' program and awards guides and policy statements; political commentary; and university policies. We seek

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Yann Joly et al, "The Commercialization of Genomic Research in Canada" (2010) 6:2 Health Policy 24; Valentina Tartari & Stefano Breschi, "Set Them Free: Scientists' Evaluations of the Benefits and Costs of University-Industry Research Collaboration" (2012) 21:5 Industrial and Corporate Change 1117.

18. Eggertson, *supra* note 14; Carol Goar, "How to Modernize Canada's Science Policy; Report sees National Research Council as a Bridge between Science and Industry", *Toronto Star* (17 June 2013) A15; Peter Howitt, "Let Curiosity Drive Commerce", *The Globe and Mail* (6 June 2013) A17; Ivan Semeniuk, "Budget Ignites Science Debate; Questions Arise over Merits of Basic and Applied Research as Government Tables Funding Allocations", *The Globe and Mail* (25 March 2013) A4; National Research Council Canada, News Release, "Open for Business: Refocused NRC will Benefit Canadian Industries; The Government of Canada Launches Refocused National Research Council" (7 May 2013) online: National Research Council Canada <http://www.nrc-cnrc.gc.ca/eng/news/releases/2013/nrc_business.html>.

19. Eggertson, *supra* note 14; Goar, *ibid*; Howitt, *ibid*; Semeniuk, *ibid*; C Scott Findlay, "Big Boasts, Little Proof; Ottawa Claims it has Provided Unprecedented Support for Science. The Evidence says Otherwise", *National Post* (8 April 2013) A14; Mia Rabson, "Federal Cuts Dubbed 'Attack on Acience' – Researchers to Protest with 'Funeral Procession'", *Winnipeg Free Press* (10 July 2012) B3.

to identify and thematically assess concrete sources of and justifications for the commercialization push in the context of the Canadian research environment. However, we also briefly highlight emerging empirical evidence on the impact of existing commercialization programs on the conduct or culture of scientific research and on the views of the Canadian scientific research community regarding the push or pressure to commercialize their work.

II. Sources of and Justifications for the Commercialization Imperative

We explored documents from Canada's federal and provincial research funding agencies, from relevant publicly funded research non-profit organizations (*e.g.* Genome Canada), and from relevant research institutions (*e.g.* universities). In short, we sought to identify and analyze any language that could be interpreted as creating commercialization pressure within the Canadian research environment. We found that this ethos was ubiquitous. References to the imperative need to commercialize scientific research and justifications for doing so exist in most of the documents we reviewed, and permeate virtually all sources of governmental and institutional science and funding policy.

Specifically, the pursuit of commercialization is mandated by federal and provincial legislation governing Canada's research funding agencies. For example, the Canadian Institutes for Health Research (CIHR), the primary health research funding agency, is directed by legislation to "facilitat[e] the commercialization of health research … and promot[e] economic development through health research."[20] Similarly, legislation governing National Research Council Canada (Canada's premier organization for research and development) and key provincial research policy and funding institutions such as Alberta Innovates; British Columbia's Innovation Council; Nova Scotia's Innovation Corporation; and New Brunswick's Research and Innovation Council variously mandate a focus on the following objectives: translating research knowledge into clinical applications; promoting research that

20. *Canadian Institutes of Health Research Act*, SC 2000, c 6, s 4(i).

will result in the formation of new industries or expansion of existing ones; establishment of funding programs specifically aimed at applied research; job creation; "promot[ing] industrial, economic and social development"; and translating research knowledge into lofty goals such as improving Canadians' quality of life and creating value for Canadians (see Table A for more examples).[21]

Beyond the realm of law and high-level policy, similar references and justification abound in the other sources reviewed, notably in research funding documents, granting peer review policies, and university policies (see Table B for specific examples of funding and institutional statements). CIHR's Grant and Awards Guide, for instance, includes a provision that requires applicants for research funding to "endeavour to obtain the greatest possible economic benefit to Canada from any commercial activity resulting from research findings."[22] Genome Canada's Guidelines for Funding Research Projects states that grant applicants "must describe, with supporting evidence, the deliverable(s) that will be realized by the end of the project that will lead to social and/or economic benefits for Canada."[23] Similar language is present in the advertised funding opportunities included in our review, with some opportunities requiring applicants to demonstrate that their research will "accelerate commercialization"; "foster an entrepreneurial culture within and around the health research community";[24] and facilitate "commercial

21. *British Columbia Innovation Council Act*, RSBC 1997, c 415, s 3; *National Research Council Act*, RSC 1985, c N-15; *Alberta Research and Innovation Act*, SA 2009, c A-31.7; *Innovation Corporation Act*, SNS 1994-95, c 5; *New Brunswick Research and Innovation Council Act*, SNB 2013, c 5.
22. Canadian Institutes of Health Research, "CIHR Grants and Awards Guide" (1 April 2013), online: Canadian Institutes of Health Research <http://www.cihr-irsc.gc.ca/e/805.html>.
23. Genome Canada, "Guidelines for Funding Research Projects" (June 2012), online: Genome Canada <http://www.genomecanada.ca/medias/PDF/en/2012-bcb-competition-guidelines.pdf> at 6.
24. Canadian Institutes of Health Research, "Proof of Principle: Phase I (Fall 2013 Competition)" (19 June 2013), online: ResearchNet <https://www.researchnet-recherchenet.ca/rnr16/vwOpprtntyDtls.do?prog=1858&view=currentOpps&type=EXACT&resultCount=25&sort=program&all=1&masterList=true>.

development of products"[25] (see List A for more examples).

On the institutional side, universities in the Province of Alberta are required to allocate institutional resources in a manner that ensures "excellence in research, innovation, and commercialization" and that the province's economy "is competitive and sustainable,"[26] while the University of Toronto views research commercialization, specifically, translating research results "into products and processes with economic and social benefit" as "an important measure of impact beyond the University"[27] (see List B for more examples). These statements and policies express and govern the granting and institutional requirements and expectations facing researchers, and operate informally as indicators of successful research careers.

Viewed as a whole, our review confirms the presence of systemic and systematic pressure on Canadian researchers to commercialize research outcomes. The overall message appears to be that commercialization is now a central element and goal of the scientific research enterprise. Indeed, in the past decade, the federal and provincial governments have allocated significant public resources to shifting the focus of Canadian science towards this commercialization ethos.[28] At the federal level, several initiatives and programs specifically devoted entirely to research commercialization have emerged in recent years, including the Centres of Excellence for Commercialization and Research program (annual budget: $30m) and the Business-Led Networks of Centres of Excellence

25. Alberta Innovates – Health Solutions, "AIHS Knowledge-to-Action Grant" (2013), online: Alberta Innovates – Health Solutions <http://www.aihealthsolutions.ca/rtna/grant.php>.
26. Government of Alberta, "Draft Letter of Expectation between the Minister of Alberta Enterprise and Advanced Education and the Board of Governors of the University of Alberta", online: Change@UAlberta <http://change.ualberta.ca/-/media/change/letter-of-expectation---u-of-a/letter-of-expectation---u-of-a.pdf>.
27. University of Toronto, "University of Toronto Performance Indicators 2012: Our Research Excellence – Innovation and Commercialization", online: University of Toronto <http://www.utoronto.ca/__shared/assets/A_05_a-c_Innovation_Commercialization4920.pdf>.
28. Einar Rasmussen, "Government Instruments to Support the Commercialization of University Research: Lessons from Canada" (2008) 28:8 Technovation 506.

program (annual budget: $12m), both of which channel publicly funded university research towards the commercialization pipeline and to responding to challenges identified by industry. The provinces have established similar programs, including Alberta Innovates – Health Solutions, which supports research activities that "create … health related social and economic benefits for Albertans,"[29] and Fonds de recherche Santé Québec, a Québec government-backed funding initiative designed to support scientific and technological research that will "contribute to Québec's economic growth,"[30] among other things.

Our review also revealed a number of justifications for the push to commercialize, including enabling improved health care and quality of life; making the innovation system more sustainable (economically); faster product development; creation of new industries and expansion of existing ones; realizing returns on research investments; accountability to taxpayers; promoting economic growth and social development; job creation; and creating value for Canadians. These justifications were typically expressed in broad, aspirational language, with little or no explanation regarding meaning, scope or how they can be achieved in practical terms. Put differently, the justifications are presented in a manner that suggests they are obvious endpoints. The presentation also does not provide any evidence to support the suggested link between research commercialization and the stated justifications (this is a topic for further research), nor are there, in most cases, identified metrics for measuring successful outcomes for each of the stated justifications.[31] Also worrisome, from a policymaking perspective, there is no mention of the potential downsides or risks of commercialization. This side of the policy debate is completely absent from national, provincial and institutional science funding policy. Given the evidence of possible risks, this is a troubling absence as one would hope that emerging policy would

29. Alberta Innovates – Health Solutions, "Mandate and Roles Document" (April 2010), online: Alberta Innovates – Health Solutions <http://www.aihealthsolutions.ca/docs/mandate%20and%20roles.pdf> at 1.
30. Fonds du recherche du Québec – Santé, "FRQS Mission" (25 November 2004), online: FRQS <http://www.frsq.gouv.qc.ca/en/a_propos/popup/mission_integrale.html>.
31. Rasmussen, *supra* note 28.

explicitly recognize and balance both potential benefits and risks.

III. Brief Highlights of Emerging Evidence on Community Reaction and Impacts on Research Environment

Existing studies from Canada and elsewhere have observed a disconnect between policy and practice with respect to commercialization of publicly funded research. For example, a recent study found that professionals working in Canadian Technology Transfer Offices (TTOs) view their practical role as supporting the social and academic missions of their universities rather than their primary mandate, which is to promote and achieve research commercialization targets.[32] Another study found that commercialization activities (chiefly patenting) by members of the Stem Cell Network impact negatively on their collaborative behaviour (specifically, co-authorship), which is, arguably, an incidental outcome of the Network's commercialization-driven research approach and mandate.[33] Similarly, a study of technology commercialization via licensing contracts between US universities and the life sciences industry found evidence of the so-called "anticommons" effect;[34] specifically, that exclusive licensing of patented technologies to single firms had a "dampening effect" on "innovation diffusion" by reducing researchers' propensity to publish or collaborate with others.[35] The pressure to commercialize has also been linked to secretive behaviour among academic scientists and with creating disincentives to information sharing,[36] and with having undesirable

32. Tania M Bubela & Timothy Caulfield, "Role and Reality: Technology Transfer at Canadian Universities" (2010) 28:9 Trends in Biotechnology 447.
33. Bubela et al, "Commercialization and Collaboration", *supra* note 11.
34. Michael A Heller & Rebecca S Eisenberg, "Can Patents Deter Innovation? The Anticommons in Biomedical Research" (1998) 280:5364 Science 698.
35. Joshua B Powers & Eric G Campbell, "Technology Commercialization Effects on the Conduct of Research in Higher Education" (2011) 52:3 Research in Higher Education 245.
36. Wei Hong & John P Walsh, "For Money or Glory? Commercialization, Competition, and Secrecy in the Entrepreneurial University" (2009) 50:1 The Sociological Quarterly 145.

effects on the quantity and quality of research outputs.[37]

Regarding community reaction, a number of published studies have shed some light on the views and perspectives of the scientific research community on the push to commercialize research.[38] A recent nation-wide study of US biotechnology scientists found a "strong positive association" between market-driven views and values and the tendency to pursue applied research programs, and that this association directly affects industry funding, the proprietary nature of research outputs, and the degree of focus on basic research programs.[39] Similarly, surveys of Canadian genomics and stem cell researchers reveal that while views regarding commercialization and patenting pressure are sharply divided between supportive and critical, such pressures are correlated with an increased tendency to engage in data withholding practices and publication delays.[40]

A recent informal sampling of the views of members of the Canadian Stem Cell Network regarding commercialization pressure – conducted by our research team for the primary purpose of informing proposed semi-structured interviews – adds some colour to the existing evidence.[41] The Network is one of Canada's Networks of Centres of Excellence (NCEs), a funding initiative established in 1989 by Canada's three major research funding agencies (CIHR; the National Sciences and Engineering Research Council, which funds research in the natural sciences and engineering; and the Social Sciences and Humanities Research Council, which funds research in the social sciences and humanities) in collaboration with Health Canada and Industry Canada.[42] NCEs unite

37. Hottenrott & Thorwarth, *supra* note 14.
38. Glenna et al, *supra* note 14; Caulfield et al, "Patents", *supra* note 17; Murdoch & Caulfield, *supra* note 17; Joly et al, *supra* note 17; Tartari & Breschi, *supra* note 17.
39. Glenna et al, *supra* note 14.
40. Caulfield et al, "Patents", *supra* note 17; Murdoch & Caulfield, *supra* note 17.
41. Ubaka Ogbogu, Amir Reshef & Timothy Caulfield, "Under Pressure? Stem Cell Research and the Commercialization Imperative" (Poster presentation delivered at the Canadian Stem Cell Network Till and McCulloch Meetings, Banff Springs Hotel, Banff, 23-25 October 2013) [unpublished].
42. Ogbogu, *supra* note 8; Donald Fisher, Janet Atkinson-Grosjean & Dawn

Canada's leading researchers in a field of common interest, with the aim and mandate to "commercialize and apply … homegrown research breakthroughs, increase private-sector R&D, and train highly qualified people."[43] SCN is one of the program's success stories, and has received over $82m since it was created in 2001. The Network's primary mandate is to "be a catalyst for enabling translation of stem cell research into clinical applications, commercial products or public policy."[44]

We learned that many in the community are wary of current commercialization trends and are concerned about its effects on the scientific research environment. Specifically, most members reported that they face considerable pressure to commercialize and/or translate their research in the near term and that it would be more difficult to secure research funding without proposing a commercialization and/or translation plan. They identified main sources of pressure to commercialize as including granting agencies, patient/disease advocacy groups, their universities, and the government. Members expressed concern that commercialization trends will adversely affect research funding and opportunities for pursuing basic research, and that public trust in research will be compromised if the promised benefits of commercialization do not materialize in the near term or at all. They felt that commercialization and/or research translation targets were more likely to materialize in the longer rather than short term, and that the most important outcome they expect from their research are scholarly publications. These observations, which we caution are neither representative of the views of this community nor intended to serve as robust evidence of such views, do suggest the possibility that research communities primed for commercialization may hold an unfavourable or unenthusiastic view of their commercialization mandate, and may perceive this mandate to be associated with undesirable

House, "Changes in Academy/Industry/State Relations in Canada: The Creation and Development of the Networks of Centres of Excellence" (2001) 39:3 Minerva 299.

43. Networks of Centres of Excellence, "About the Networks of Centres of Excellence" (17 October 2013), online: Networks of Centres of Excellence <http://www.nce-rce.gc.ca/About-APropos/Index_eng.asp>.

44. Networks of Centres of Excellence, "Stem Cell Network – SCN" (4 April 2013), online: Networks of Centres of Excellence <http://www.nce-rce.gc.ca/NetworksCentres-CentresReseaux/NCE-RCE/SCN-RCS_eng.asp>.

social and research-related costs, such as loss of public trust in research and loss of opportunities for research funding and basic research. They also prompt questions about whether scientists' expectations are aligned with policies urging aggressive commercialization of the research.

IV. Conclusion

Our analysis illustrates the degree to which the commercialization imperative has become near universal. There is almost no place within the Canadian research-funding environment that is not touched by the commercialization ethos. And there is, at least within the policy documents themselves, very little substantive justification for this shift. Indeed, its value is presented as axiomatic and universally accepted – which, given the recent protests in Canada by researchers, is clearly not the case. More worrisome, at least from the perspective of transparent policymaking, there is virtually no explicit mention of the potential costs and harms associated with the push to commercialize. Few would argue that there are not benefits to the commercialization of research or with links to industry. But research tells us there are trade-offs, including a loss of public trust, decreased collaborative behaviour and, possibly, the premature implementation of technologies.

Given these downsides, one would hope that there would be explicit reference to evidence regarding the purported social benefits of this trend, but this too, as noted, is missing. Regardless of how one views such ambitious and unsubstantiated promotion of research commercialization, it should prompt serious questions about whether scientists and the scientific research infrastructure can presently deliver the promised benefits, and whether achieving such benefits is justified in light of the possible social costs of the trend. That said, interesting questions remain, including whether this pressure *actually* changes researcher behaviour and the direction of research. Perceptions and fears aside, scientists may simply adapt to the new environment in nimble fashion, and realign their research agendas accordingly.

Table A: Examples of Commercialization Language in Legislation
(continued on next page)

Source	Reference
Canadian Institutes of Health Research Act	"The objective of the CIHR is to excel … in the creation of new knowledge and its translation into improved health for Canadians, more effective health services and products … by … facilitating the commercialization of health research in Canada and promoting economic development through health research in Canada"[45]
National Research Council Act	"Council may … undertake, assist or promote scientific and industrial research, including … researches with the object of improving the technical processes and methods used in the industries of Canada, and of discovering processes and methods that may promote the expansion of existing or the development of new industries"[46]
Alberta Research and Innovation Act	"The purpose of this Act is to promote and provide for the strategic and effective use of funding and other resources to meet the research and innovation priorities of the Government, including fostering the development and growth of new and existing industries"[47]
New Brunswick Research and Innovation Council Act	"Council shall advise and make recommendations to the Executive Council on all aspects of research and innovation and on the development and commercialization of technology in order to advance these activities in New Brunswick and to foster … increased collaboration between government and the business, industry, post secondary education and research communities"[48]
Innovation Corporation Act (Nova Scotia)	"The objects of the Corporation are to … mobilize the necessary resources, nationally and internationally, to allow for technological development and commercialization in priority technology areas defined by the Corporation"[49]

45. *Supra* note 20, s 4.
46. *Supra* note 21, s 5(c).
47. *Supra* note 21, s 2.
48. *Supra* note 21, s 7.
49. *Supra* note 21, s 5(a).

Economic Innovation and Technology Council Act (Manitoba)	"The objects of the council are to foster economic development and to support economic restructuring through innovation and the development and commercialization of technology so as to enable Manitoba to compete effectively in a global market economy"[50]

List A: Examples of Commercialization Requirements in Funding Opportunities *(continued on next page)*

- CIHR Open Operating Grant, 2013-2014: Grants are expected to "[c]ontribute to commercialization/ knowledge translation"[51]
- Alberta Innovates – Alberta/Pfizer Translational Research Fund Opportunity (June 2013): "The funding opportunity will focus on the development and commercialization of innovations in health that support the interests and priorities of Alberta and Pfizer and serve as a catalyst for innovative research in Alberta"[52]
- Alberta Innovates – Knowledge-to-Action Grant (2013): "Grant opportunity is intended to support the uptake of research evidence into health policy, practice and commercial development of products"[53]
- Ontario Research Fund – Early Researcher Awards Program Guidelines (March 2013): Applications must demonstrate "potential for strategic value for Ontario based on … economic benefits [and] entrepreneurial focus"[54]
- Innovation PEI – Pilot and Discovery Fund Program Guidelines (2013): Proposed project must "[d]evelop a product or service that demonstrates a high level of innovation, commercial viability, and market potential … [and] [c]reate a positive economic impact for the Province (jobs, economic spin-offs, etc.)"[55]

50. *The Economic Innovation and Technology Council Act*, CCSM c E7, s 3.
51. Canadian Institutes of Health Research, "CIHR Open Operating Grant" (19 June 2013), online: ResearchNet <https://www.researchnet-recherchenet.ca/rnr16/vwOpprtntyDtls.do?prog=1873&view=search&terms=commercialization&org=CIHR&type=EXACT&resultCount=25>.
52. Alberta Innovates – Health Solutions, "Alberta/Pfzer Translational Research Fund Opportunity" (June 2013), online: Alberta Innovates – Health Solutions <http://www.aihealthsolutions.ca/grants/industry-partnered-translational-fund/pfizer/docs/AB-Pfizer-Program-Guide%202013-07.pdf>.
53. Alberta Innovates – Health Solutions, "AIHS Knowledge-to-Action Grant" (2013), online: Alberta Innovates – Health Solutions <http://www.aihealthsolutions.ca/rtna/grant.php>.
54. Ontario Research Fund, "Early Researcher Awards Program Guidelines" (March 2013), online: <http://docs.files.ontario.ca/documents/275/medi-era-round-9-program-guidelines.pdf>.
55. Innovation PEI, "Pilot and Discovery Fund: Program Guidelines" (2013),

- Ontario Genomics Institute – Pre-Commercialization Business Development Fund (2013): "[U]nique and useful investment fund that is helping to enable the economic impact of outcomes of genomics and proteomics research projects and technology development. Specifically, it aims to provide early-stage funding as researchers move towards commercial applications and to speed up transfer of products from lab to marketplace"[56]
- CIHR Operating Grant – Industry-Partnered Collaborative Research (Fall 2013): Objective of funding opportunity includes to "promote economic development through health research in Canada" and "encourage and facilitate mutually beneficial university-industry collaborations in health research"[57]
- Canadian Foundation for Innovation – 2012 Leading Edge and New Initiatives Funds Competition: "The research or technology development enabled by CFI funding creates the necessary conditions for sustainable, long-term economic growth, including the creation of spin-off ventures and the commercialization of discoveries. It supports improvements to society, quality of life, health, the environment, and public policy"[58]

List B: Examples of Commercialization Language in University Documents *(continued on next page)*

- University of Toronto (2013): "U of T is a leading university in Canada for commercialization and entrepreneurship and is a global leader in turning ideas and innovations into products, services, companies and jobs."[59]
- University of Alberta (2013): "UAlberta benefits society by transferring research, knowledge and discoveries out of the institution and into the community. One way to ensure UAlberta research solutions have the greatest

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online: Innovation PEI <http://www.gov.pe.ca/photos/original/IPEI-Pilot-Guid.pdf>.

56. Ontario Genomics Institute, "Pre-commercialization Business Development Fund" (2013), online: Ontario Genomics Institute <http://www.ontariogenomics.ca/business-development/pre-commercialization-business-development-fund>.
57. Canadian Institutes of Health Research, "Operating Grant: Industry-Part nered Collaborative Research" (Fall 2013), online: ResearchNet <https://www.research net-recherchenet.ca/rnr16/vwOpprtntyDtlsdo?prog=1871&view=search&terms=commercialization&org=CIHR&type=EXACT&result Count=25>.
58. Canada Foundation for Innovation, "2012 Leading Edge and New Initiatives Funds Competition" (September 2011), online: Canada Foundation for Innovation <http://www.innovation.ca/sites/default/files/Funds/Call-LEFNIF2012_EN.pdf>.
59. University of Toronto Research and Innovation, "Commercialization at U of T" (2013), online: University of Toronto <http://www.research.utoronto.ca/industry-and-partners/commercialization-at-u-of-t/#top>.

reach and impact on both society and the economy is commercialization."[60]

- University of Alberta (2013): "The University actively transfers new knowledge and creative works to Alberta, Canada and the world for community benefit, including commercial development of intellectual property when appropriate and feasible"[61]
- University of British Columbia: "For transformational research discoveries with the potential to generate significant impacts, whether financial, economic, or societal, the traditional technology transfer approach of IP-protection, development and commercialization will frequently remain essential."[62]
- McGill University (2013): "The commercialization of research outcomes is an important objective not just of researchers, but of most public and private funding programs as well. It can also be very rewarding, with potential impact on society, the economy and the environment at large"[63]
- University of Saskatchewan (2011): "We want to ensure that the relationships created through the commercialization of a technology continue to add value for all partners; leading to ongoing research projects for the inventor and the industry partner and to the commercialization of complementary technologies"[64]
- Queen's University (2013): "The role of Innovation Park is to foster interaction among the participants in the research and innovation system and thus stimulate commercialization and economic development in the South Eastern Ontario region."[65]
- University of Calgary (1994): "The nature and scope of University scholarly activity is such that industrially useful and/or commercially valuable

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60. University of Alberta Research, "Commercialization" (2013), online: University of Alberta <http://www.research.ualberta.ca/MobilizingKnowledge/Commercialization.aspx>.
61. University of Alberta Board of Governors, "Mandate and Roles Document" (2013), online: University of Alberta <http://www.governance.ualberta.ca/~/media/Governance/Documents/GO09/MAN/Mandates_and_Roles-_Approved_October_2011.pdf>.
62. University of British Columbia University-Industry Liaison Office, "Technology Transfer/Commercialization", online: University of British Columbia <http://www.uilo.ubc.ca/uilo/knowledge-mobilization/channels/commercialization>.
63. McGill Research and International Relations, "Managing Your Intellectual Property" (2013), online: McGill <http://www.mcgill.ca/research/researchers/ip>.
64. University of Saskatchewan, "Industry Liaison – Who Are We?" (2013), online: University of Saskatchewan <http://www.usask.ca/research/ilo/whoweare.php>.
65. Queen's University, "Innovation Park – Who We Are", online: Queen's University <http://www.innovationpark.com/content/who-we-are>.

Intellectual Property is sometimes the result. Indeed, there is a societal expectation that University scholarly activities will include activities which, applied, lead to useful outcomes."[66]

Table B: Examples of Commercialization Language in Political/ Institutional Commentary *(continued on next two pages)*

Source	Reference
National Research Council (2013)	"We are committed to being a strong partner for innovation, and focused on achieving the concrete outcomes that will contribute to a stronger and more prosperous Canada. We will measure our success by the success of our clients."[67]
Minister of State Gary Goodyear (Industry Canada 2013)	"Capitalizing on the momentum generated by … investments [in research], we will continue to improve commercialization performance by transforming research outcomes into economic benefits for Canadians"[68]
Canadian Institutes of Health Research (2009)	"Through its commercialization and innovation strategy, CIHR will continue to catalyze collaborations between industry and the research community to translate health research into improved health products, technologies, tools and services"[69]
Networks of Centres of Excellence (2011)	"The goal of the NCE Program is to mobilize Canada's research talent in the academic, private, public, and not-for-profit sectors and apply it to the task of developing the economy and improving the quality of life of Canadians."[70]

66. University of Calgary, "Intellectual Property Policy" (2014), online: University of Calgary <http://www.ucalgary.ca/policies/files/policies/Intellectual%20Property%20Policy.pdf>.
67. National Research Council Canada, *supra* note 18.
68. Industry Canada, News Release, "Minister of State Goodyear Promotes Commercialization of Canadian Research at International Forum" (19 March 2013) online: Government of Canada <http://news.gc.ca/web/article-en.do?nid=727519>.
69. Canadian Institutes of Health Research, "Health Research Roadmap: Creating Innovative Research for Better Health and Health Care", online: Canadian Institutes of Health Research <http://www.cihr-irsc.gc.ca/e/40490.html>.
70. Networks of Centres of Excellence of Canada, "Program Guide" (2011),

Centres of Excellence for Commercialization and Research Program (2013)	"The innovative … program bridges the challenging gap between innovation and commercialization. The program matches clusters of research expertise with the business community to share the knowledge and resources that bring innovations to market faster."[71]
Centre for Commercialization of Regenerative Medicine (2011)	"CCRM represents a tremendous opportunity for Canadians to lead RM commercialization … CCRM engages industry partners, making CCRM a global hub of RM commercialization and attracting investment to Ontario, leading to new jobs and economic growth."[72]
Government of Canada (2007); **2009**	"Canada must translate knowledge into commercial applications that generate wealth for Canadians and support the quality of life we all want in order to create an Entrepreneurial Advantage."[73] *"Canada's ability to gain a competitive advantage in the modern economy increasingly depends on our ability to translate knowledge and ideas into commercial products."*[74]
Innovate Nova Scotia (2009)	"The Innovate Nova Scotia policy framework has been developed to stimulate awareness of and discussion on the importance of maximizing the impact of innovation to enhance economic growth and employment in this province."[75]

online: Networks of Centres of Excellence <http://www.nce-rce.gc.ca/ReportsPublications-RapportsPublications/NCE-RCE/ProgramGuide-GuideProgramme_eng.asp>.

71. Networks of Centres of Excellence of Canada, "Centres of Excellence for Commercialization and Research Program" (2013), online: Networks of Centres of Excellence <http://www.nce-rce.gc.ca/Programs-Programmes/CECR-CECR/Index_eng.asp>.
72. Centre for Commercialization of Regenerative Medicine, "Mission" (2011), online: CCRM <http://ccrm.ca/mission>.
73. Industry Canada, "Mobilizing Science and Technology to Canada's Advantage" (2007), online: Industry Canada <http://www.ic.gc.ca/eic/site/icgc.nsf/eng/00871.html>.
74. Industry Canada, "Mobilizing Science and Technology to Canada's Advantage: Progress Report" (2009) online: Industry Canada <http://www.ic.gc.ca/eic/site/icgc.nsf/vwapj/STProgressReport2009.pdf/$file/STProgressReport2009.pdf> at 13 [emphasis added].
75. Nova Scotia Economic Development, "Innovate Nova Scotia: An Innovation Policy for the Nova Scotia Economy", online: Nova Scotia <http://www.novascotia.ca/econ/innovativenovascotia/docs/

Genome Canada (2013)	"Genome Canada is a catalyst for developing and applying genomic sciences that create economic wealth and social benefit for Canadians. We work in partnership to invest in and manage large-scale research and translate discoveries into commercial opportunities."[76]
British Columbia Research and Innovation Strategy	"Research and innovation creates and activates the knowledge that British Columbia needs to compete in the global economy. It leads to new, exciting products and processes that help British Columbia prosper and raise our standard of living. It fosters social and economic development, creates jobs and supports our efforts to address climate change and clean energy."[77]
MaRS Innovation "How We Work"	"MaRS Innovation collaborates with its 16 Toronto -based member institutions … to commercialize market-disruptive intellectual property … Our mandate includes seeking opportunities to increase the social, health and economic benefits of our activities to Canadians and others around the world."[78]
Vision and Mission	*"To monetize the research assets found within its member institutions, thereby converting great science into commercially viable products and services"*[79]

InnovativeNovaScotia.pdf>.

76. Genome Canada, "About Genome Canada", online: Genome Canada <http://www.genomecanada.ca/en/about/>.
77. British Columbia Ministry of Advanced Education and Ministry Responsible for Research and Technology, "Local Excellence – Global Impact: BC Research and Innovation Strategy", online: Ministry of Advanced Education <http://www.aved.gov.bc.ca/researchandinnovation/Documents/strategy.pdf>.
78. MaRS Innovation, "How We Work", online: MaRS <http://marsinnovation.com/how-we-work/>.
79. MaRS Innovation, "Vision and Mission", online: MaRS <http://marsinnovation.com/about/vision/> [emphasis added].