7-3-2013

Reflections on the Commercialization of Research Conducted in Public Institutions in Canada

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REFLECTIONS ON THE COMMERCIALIZATION OF RESEARCH CONDUCTED IN PUBLIC INSTITUTIONS IN CANADA

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We are presently witnessing a remarkable emphasis upon the commercialization of research in public institutions around the world. The issue is polarizing within the academic community, but the commercialization of research in public institutions has, in itself, largely failed to capture the public imagination. Nothing suggests that a large-scale debate on this issue is forthcoming in Canada or elsewhere. The purpose of this paper is therefore to build the case for why large-scale debate is necessary and to set the stage for that debate by providing an account of all of the alleged benefits and harms of commercialization. Our review of these benefits and harms exposes the fact that there is much that we simply do not know about the impact of commercialization, which provides support for the claim that much greater caution is warranted on the part of public institutions currently embracing this phenomenon with enthusiasm. Therefore, to ensure that this social experiment proceeds safely, ethically, and democratically, we must start gathering and sharing all of the relevant information pertaining to effects of this commercialization phenomenon, engage all those with relevant expertise and those whose interests are at stake in discussions about the values involved and the relative merits of various courses of action, and then ground policies and practice in the arena of commercialization in these discussions.

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The authors would like to thank the members of the Novel Tech Ethics research team at Dalhousie, Brad Abernethy, and the anonymous reviewers for helpful comments on earlier drafts of this paper. We would also like to note that this paper is a Canadianized, updated, and revised version of Jocelyn Downie, "The Power of Money: Commercialisation of Research Conducted in Public Institutions [in Australasia]" (2006) 11:2 University of Otago Law Review 305-325.

INTRODUCTION

Against a backdrop of increased operating costs and decreased support for universities from government and other traditional non-commercial sources,[1] as well as a transition to "knowledge-based" economies, we are witnessing the remarkable commercialization of research in public institutions around the world. Academic scholarship on the topic of commercialization has begun to explode—predominantly in relation to biomedical research, although a few treatments have been more encompassing.[2] The issue is polarizing, with critics of commercialization seemingly becoming more strident on the one hand and government officials (of all political stripes) and university administrations more deeply embracing commercialization goals on the other. Yet, the commercialization of research in public institutions has, in itself, largely failed to capture the public imagination. Nothing suggests that a large-scale debate on this issue is forthcoming in Canada or elsewhere. Thus, rather than undertaking an in-depth scholarly analysis of a few specific examples of the impact of commercialization upon specific research areas, our approach in this paper is decidedly broad: we seek to build the case for why large scale debate is necessary and to set the stage for that debate by providing an account of all of the alleged benefits and harms of commercialization. Our review of these benefits and harms will, of necessity, be summary in nature but will nevertheless expose the fact that there is much that we simply do not know about the impact of commercialization. By demonstrating that the push in favour of commercialization is in turn largely responsible for this paucity of evidence, we hope that our overview will add persuasive force to more detailed critiques of discrete aspects of the commercialization phenomenon and support the claim that much greater caution is warranted on the part of public institutions currently embracing this phenomenon with enthusiasm.

There are three parts to our paper. First, we define our object of inquiry, the commercialization phenomenon, by briefly situating it in historical terms, charting current related statistical indicators, and describing some of the consequences it has already had upon places of research, research priorities, and researchers. In the second part, we present the alleged benefits and harms of the commercialization phenomenon, deferring a consideration of the relative weighting of these benefits and harms until the third and final part of the paper.

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DISSECTING THE PHENOMENON

For the purposes of this paper, we stipulate a set of definitions. First, "commercialization of research" means "the conversion of research results into products, services, and processes that can be the object of commercial transactions". "Public institutions" means "post-secondary institutions, government-funded Networks of Centres of Excellence, public hospitals, and government research organizations". In discussing the commercialization of research in public institutions, we focus on two often-related, but nonetheless distinct, features of the phenomenon: first, the harnessing of intellectual property by public institutions (through, for example, the patenting or licensing of research results); and, second, the partnering of public institutions with the private sector.

There are, of course, historical precedents for patenting, licensing, and public-private partnerships. In the early 1920s, for instance, University of Toronto researchers F.G. Banting and C.H. Best patented a method of making synthetic insulin. Donations from private corporations and individuals then helped to

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[1] "[G]overnment grants and contracts make up only 56.6% of all university revenues, down from 67% as recently as 1992". Canadian Association of University Teachers, "Public or Private? University Finances 2002-2003" 6:3 CAUT Education Review 1 at 3. "In the past two decades, government operating grants to public universities have fallen by 30 per cent per student." University of Waterloo, "Building a talent trust", online: University of Waterloo <http://www.campaign.uwaterloo.ca/brochure/building.html>. "At precisely the time when the 'knowledge-based' economy is crying out for better educated workers—people who can think and solve problems—we have seen a shocking decline in education spending." A. Charles Baillie, Chairman and Chief Executive Officer, Toronto Dominion Bank (Address to the Canadian Club, Toronto, 26 February 2001), online: <http://www.canadianclub.org/static/speeches/13.pdf>.

[2] Derek Bok, *Universities in the Marketplace: The Commercialization of Higher Education* (Princeton: Princeton University Press, 2003) [Bok]; Neil Tudiver, *Universities for Sale: Resisting Corporate Control over Canadian Higher Education* (Toronto: James Lorimer and Company Ltd., 1999) [Tudiver]; Jennifer Washburn, *University, Inc.: The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005) [Washburn]; Sheila Slaughter & Gary Rhoades, *Academic Capitalism and the New Economy: Markets, State, and Higher Education* (Baltimore: The Johns Hopkins University Press, 2004) [Slaughter & Rhoades].

create the Banting Research Foundation in 1925,[3] the same year in which Canada's first public-private research institute, the Pulp and Paper Research Institute of Canada (PAPRICAN), was founded at McGill University.[4] As we show next, however, patenting, licensing, and public-private partnerships are now occurring at unprecedented rates. In Banting and Best's era, the commercialization of research was more grass-roots and not always condoned by public institutions or well received by the academic community.[5] Today, public institutions explicitly embrace the commercialization of research as a core goal and actively attempt to steer research in that direction through a variety of mechanisms.[6] We therefore start from the position that the present commercialization phenomenon represents a fundamental shift in values and direction.

A. Harnessing Intellectual Property

Public institutions in Canada are certainly harnessing their intellectual property (IP). For example, public institutions reported the following IP harnessing activities for 1998, 1999, 2001 and 2003:[7]

TABLE 1

Harnessing Activity	**1998**	**1999**	**2001**	**2003**
# of new patent applications	379	656	932	1252
# of patents held	*	1915	2133	3047
# of spin-off companies	366	471	680	876

* An exact figure for this year is unavailable.

Earlier data about levels of patenting are difficult to obtain or simply unavailable. According to the U.S.-based Association of University Technology Managers (AUTM), whereas only 59 new U.S. patent applications were filed by 10 Canadian institutions in 1991 (i.e., an average of 5.9 applications per institution), 572 new applications were filed in 2004 by 34 institutions (i.e., an average of 16.8 applications per institution).[8] The rate of "start-up" company formation is also accelerating according to AUTM: of the 712 start-up companies accounted for in 2004, 556 were formed after 1993.[9]

Through the harnessing of IP, public institutions are generating considerable and continually increasing income. For example, public institutions reported the following income from IP harnessing in 1998, 1999, 2001 and 2003:[10]

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[3] See Banting Research Foundation, "About Us: Proud Of Our History", online: Banting Research Foundation <http://www.utoronto.ca/bantresf/>.

[4] Jorge Niosi, *Flexible Innovation: Technological Alliances in Canadian Industry* (Montreal: McGill-Queen's University Press, 1995) at 33 [Niosi].

[5] For an interesting account of early instances of patenting publicly funded inventions in the U.S. and the ensuing public controversies, see Charles Weiner, "Patenting and Academic Research: Historical Case Studies" (1987) 12:1 Science, Technology, & Human Values 50.

[6] Again, we do not mean to suggest that historical examples of government-sponsored programs to encourage university-industry collaboration do not exist. The federal government implemented the Program for the Advancement of Industrial Technology (PAIT) and the Industrial Research Institute Program in 1965 and 1966, respectively: see Janet Atkinson-Grosjean, Dawn House & Donald Fisher, "Canadian Science Policy and Public Research Organisations in the 20th Century" (2001) 14:1 Science Studies 3 at 12-13ff. [Atkinson-Grosjean]. Nevertheless, as detailed below, the number of, and emphasis placed, upon these programs have increased dramatically in recent years.

[7] Statistics Canada, *Survey of intellectual property commercialization in the higher education sector, 1998* by Michael Bordt & Cathy Read (Ottawa: Minister of Industry, 1999), online: Statistics Canada <http://www.statcan.ca/english/research/88F0006XIE/88F0006XIB1999001.pdf> [Statistics Canada, *1998 Survey*]; Statistics Canada, *Survey of intellectual property commercialization in the higher education sector, 1999* by Cathy Read (Ottawa: Minister of Industry, 2000), online: Statistics Canada <http://www.statcan.ca/english/research/88F0006XIE/88F0006XIB2000001.pdf> [Statistics Canada, *1999 Survey*]; Statistics Canada, *Survey of intellectual property commercialization in the higher education sector, 2001* by Cathy Read (Ottawa: Minister of Industry, 2003), online: Statistics Canada <http://www.statcan.ca/english/research/88F0006XIE/88F0006XIE2003012.pdf> [Statistics Canada, *2001 Survey*]; Statistics Canada, *Survey of intellectual property commercialization in the higher education sector, 2003* by Cathy Read (Ottawa: Minister of Industry, 2005), online: Statistics Canada <http://www.statcan.ca/english/research/88F0006XIE/88F0006XIE2005018.pdf> [Statistics Canada, *2003 Survey*].

[8] Association of University Technology Managers, *AUTM Canadian Licensing Survey: FY 2004, Survey Summary* (AUTM, 2006) at 10, online: AUTM <http://www.autm.net/events/File/AUTM%20PUBLICATIONS/FY04AUTMCanLicSurvSum-public.pdf>.

[9] *Ibid.* at 18.

[10] Statistics Canada, *1998 Survey*, *supra* note 7 at 22-23; Statistics Canada, *1999 Survey*, *supra* note 7 at v; Statistics Canada,

TABLE 2

Income (in millions)	**1998**	**1999**	**2001**	**2003**
Income from IP commercialization	*	*	$52.5	$55.5
Equity held in public spin-offs	$22.5	$54.6	$45.1	$52.4
Royalties from licensing	$15.6	$21.1	$47.6	$55.4

* Exact figures for these years are unavailable.

This harnessing of IP is driven, in large part, by significant financial incentives. First, and most obviously, public institutions are permitted to keep profits from the commercialization of their research (even where that research is funded by the public purse).[11] With no governmental strings attached, then, income from commercialization is becoming increasingly prized. Second, significant funding is available specifically for commercializable research, as the federal government is creating funds to support commercializable research in public institutions. Examples include:

- The NSERC Idea to Innovation Program ("provides funding to college and university Faculty members, through defined stages, for research and development activities leading to technology transfer to a new or established Canadian company");[12]
- The CIHR Proof of Principle Program ("Grants will fund proof of principle research projects of up to 12 months duration designed to advance discoveries/inventions towards commercializable technologies, with a view to attract new investment and create new science-based businesses.");[13] and
- Industry Canada's new program for "Commercialization Funds" ($75 million over the next five years: "One of the Funds will provide $50 million ... to further strengthen the commercialization capacity of universities and research hospitals. The other $25 million Fund will encourage the commercialization of research conducted in federal government labs.").[14]

Later in this paper, we will discuss additional reasons for the commercialization of research in public institutions.

B. Partnering with the Private Sector

Public institutions in Canada are also partnering with the private sector. For example, investment by business in Canadian universities is significant. "Canadian firms contract out over 6% of their R&D to universities (well above levels in other G-7 countries) and this represents 16% of university research funding."[15] "Business enterprise" R&D expenditures in the higher education sector have gone from $115.1 million in 1988–89 to $643.1 million in 2002–03, increasing by more than 500%.[16]

As with the harnessing of IP, this partnering is driven, in large part, by financial incentives. Governments clearly see partnering as beneficial:

2001 Survey, *supra* note 7 at 25, 28; Statistics Canada, *2003 Survey*, *supra* note 7 at 12-13, 23.

[11] Cathy Read, "Commercializing the results of research in Canadian universities and hospitals: an update for 2003" (2005) 7:3 Innovation Analysis Bulletin 11 at 11.

[12] National Sciences and Engineering Research Council of Canada, "Idea to Innovation (I2I) Program", online: NSERC <http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=b4>.

[13] Canadian Institutes of Health Research, "Operating Grant: Proof of Principle", online: CIHR <http://www.cihr-irsc.gc.ca/e/25487.html>.

[14] This statement previously appeared at Industry Canada, "University and Government Research Commercialization Funds", online: <http://strategis.ic.gc.ca/epic/internet/incf-fc.nsf/en/h_tg00003e.html>, but is no longer available. However, this commitment was originally made in the federal government's 2004 budget: "Budget 2004: Building an Innovative Economy for the 21st Century", online: Ministry of Finance <http://www.fin.gc.ca/budget04/pamph/paecoe.htm> at 4.

[15] Canada, "Innovation in Canada: The Canadian University Sector: Innovation Profile" (2002), online: Government of Canada <http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in02596.html> [Canada, "Innovation in Canada"].

[16] Statistics Canada, *Estimation of Research and Development Expenditures in the Higher Education Sector, 2002-2003* (Ottawa: Minister of Industry, 2004), online: Statistics Canada <http://www.statcan.ca/english/freepub/88-001-XIE/88-001-XIE2004010.pdf>.

> Universities play an important role in stimulating innovation ... but their ties to the private sector make them a particularly important player in Canada.... [U]niversities need to ... more aggressively seek out commercial applications for publicly funded research.[17]

One of the Canadian government's current priorities is to "support academic institutions in identifying intellectual property with commercial potential and forging partnerships with the private sector to commercialize research results".[18] Government programs clearly encourage industry/university collaboration. Some funding programs include:

- NSERC's Collaborative Research and Development Grants Program ("intended to give companies that operate from a Canadian base access to the unique knowledge, expertise, and educational resources available at Canadian postsecondary institutions ... the mutually beneficial collaborations are expected to result in industrial and/or economic benefits to Canada..."));[19]
- CIHR's Innovation and Industry Programs ("designed to help the academic community interact with Canadian companies with an interest in health research and development");[20]
- Networks of Centres of Excellence ("...fosters powerful partnerships between university, government and industry. Networks of Centres of Excellence funded by the program are designed to develop Canada's economy and improve the quality of life of Canadians.");[21]
- Canada Foundation for Innovation ("an independent corporation created by the Government of Canada to fund research infrastructure which consists of the state-of-the-art equipment, buildings, laboratories, and databases required to conduct research. The CFI's mandate is to strengthen the capacity of Canadian universities, colleges, research hospitals, and non-profit research institutions to carry out world-class research and technology development that benefits Canadians.... [CFI] normally funds up to 40 percent of a project's infrastructure costs which are invested in partnership with eligible institutions and their funding partners from the public, private, and voluntary sectors who provide the remainder");[22] and
- Genome Canada (provides funding to support "large-scale projects of strategic importance to Canada, which are beyond current capacities by bringing together industry, government, universities, research hospitals and the public").[23]

In addition, benchmarks of success for public institutions (and the concomitant rewards) now include commercializable and commercialized research. The total number of patent applications filed, licensing agreements secured, and spin-off companies created are closely tracked as primary indicators of commercialization by technology manager organizations such as AUTM and by governmental bodies such as Statistics Canada and the federal funding agencies alike. The metrics used by other organizations are cruder. Research Infosource, for example, rates the top 50 Canadian research universities each year based strictly on their sponsored research income. The more sponsorship a university attracts, the more favourable a rating they will receive.[24] Finally, while an awareness of the limits of all of these metrics is

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17 Canada, "Innovation in Canada: Section 5: The Knowledge Performance Challenge: Canada's Innovation Strategy", online: Government of Canada <http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in04160.html>.

18 Canada, "Executive Summary: Achieving Excellence", online: Government of Canada <http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in02425.html> [Canada, "Achieving Excellence"].

19 Natural Sciences and Engineering Research Council of Canada, "Collaborative Research and Development (CRD) Grants", online: NSERC <http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=b3>. Other collaborative funding programs from NSERC include Research Partnerships Agreements, Strategic Network Grants, and Strategic Project Grants: Natural Sciences and Engineering Research Council of Canada, "Partnerships Programs Overview", online: NSERC <http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=toc_b>.

20 Canadian Institutes of Health Research, "What We Do: CIHR Innovation and Industry Programs", online: CIHR <http://www.cihr-irsc.gc.ca/e/4569.html>. Other collaborative funding programs from CIHR include Industry Partnered Operating Grants, Industry Partnered Randomized Controlled Trials, Industry Partnered New Investigator Salary Awards, and Industry Partnered Research Chairs: Canadian Institutes of Health Research, "Master List of all CIHR Current Funding Opportunities", online: CIHR <http://www.cihr-irsc.gc.ca/e/27194.html>.

21 Networks of Centres of Excellence, "Welcome to the Networks of Centres of Excellence (NCE) Program", online: NCE <http://www.nce.gc.ca/index.htm>.

22 Canada Foundation for Innovation, "CFI Policy and Program Guide", online: CFI <http://www.innovation.ca/programs/index.cfm?websiteid=253>.

23 Genome Canada, "About Genome Canada: Mandate and Objectives", online: Genome Canada <http://www.genomecanada.ca/xcorporate/about/objectives.asp?l=e>.

24 Research Infosource Inc., "Canada's Top 50 Research Universities 2005", online: Research Infosource <http://

beginning to emerge,[25] Canadian universities have explicitly promised to treble the commercialization of research by 2010;[26] this target is based exclusively on gross financial income.[27]

C. Consequential Changes

A number of changes in the research landscape largely facilitate, maximize, and respond to this harnessing and partnering. These changes include: creating new structures; collaborating across sectors; intermingling of people across sectors; and shifting the roles, missions, and mandates for researchers, research institutions, research regulators, research funders, hospitals, and universities.

1. *New Structures*

In universities, new offices have been created. Many universities now have a Business Development Office, Technology Transfer Office, or similarly named office aimed, at least in part, at commercializing the research results of the institution.[28] The staff members of these offices include commercialization managers, as well as lawyers specializing in contracts and IP. In Australia, New Zealand and the US, titles and portfolios at the highest levels of university management have also evolved to include Pro or Deputy Vice Chancellor (Research and Innovation), Pro Vice Chancellor (Research and Development), Deputy Vice Chancellor (Research and Commercialization), and Deputy Vice Chancellor (Research, Enterprise and International).[29] We are also starting to witness this evolution in Canada through the development of positions such as the Vice-President of Research and Innovation at York University.[30]

New companies attached to universities have also been created. For example, Queen's University's PARTEQ Innovations is an independent corporation "founded in 1987 to commercialize intellectual

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www.researchinfosource.com/media/2005-top50.pdf>.

25 The Association of Universities and Colleges of Canada (AUCC), for example, has acknowledged that commercialization is but one aspect of innovation and knowledge transfer, and has attempted "to push the measurement of commercialization to a broader discussion of the economic and social benefits". Statistics Canada, "Summary: Meeting on Commercialization Measurement, Indicators, Gaps and Frameworks, Ottawa" (Working paper) (Ottawa: Minister of Industry, 2005) at 10, online: Statistics Canada <http://www.statcan.ca/english/research/88F0006XIE/88F0006XIE2005007.pdf>. Statistics Canada, too, has recognized that the goals of obtaining patents and generating licensing revenues may conflict with training highly qualified personnel. *Ibid*. at 14.

26 "Universities should seek to triple the intellectual property revenues generated by commercialization by 2010. This target has been adopted by the federal government as part of the national innovation strategy." Association of Universities and Colleges of Canada, "The Commercialization of University Research", online: AUCC <http://www.aucc.ca/_pdf/english/reports/2002/innovation/commercial_e.PDF>.

27 A 2005 report explains this tripling target:

> To measure universities' collective progress in meeting their target of tripling commercialization performance, AUCC developed an indicator called *Total Income from the Commercialization of Intellectual Property*. This measure is based on data reported every two years in the *Survey of Intellectual Property Commercialization in the Higher Education Sector* conducted by Statistics Canada. The tripling indicator is an aggregate of gross income earned as a result of royalties from licences, equity disposed of by institutions, dividends paid to institutions and reimbursement of patent costs.... In 1999, the base year for the tripling target, total income derived from the commercialization of university intellectual property was estimated at $23.4 million. To triple this income from 1999 to 2010, universities and their affiliated institutions will need to earn more than $70.2 million from their commercialization activities by 2010. Universities have made significant progress and are on track to achieve the tripling target, possibly in a shorter timeframe than initially predicted. The most recent results of the Statistics Canada survey show that between 1999 and 2003, universities more than doubled their total gross income from commercialization, from $23.4 million to $51 million.

Association of Universities and Colleges of Canada, *Momentum: The 2005 report on university research and knowledge transfer* (2005), online: AUCC <http://www.aucc.ca/momentum/en/_pdf/momentum_report.pdf> [footnotes omitted].

28 A few universities had established so-called "Research Offices" in the 1970s. Starting in the 1980s, however, the federal government's financial assistance enabled every major research institution in Canada to establish an "industry liaison office" mandated to protect and licence intellectual property, to administer research contracts, and sometimes even to create "spin-off" companies: see Donald Fisher & Janet Atkinson-Grosjean, "Brokers on the boundary: Academic-industry liaison in Canadian universities" (2002) 44 Higher Education 449 at 453.

29 Australian Vice-Chancellors' Committee, "Deputy/Pro Vice-Chancellors – Research", online: AVCC <http://www.avcc.edu.au/database/report.asp?a=show&committee=283>.

30 York University, "Vice-President Research & Innovation", online: York University <http://vpacademic.yorku.ca/directory/findadm.php?id=5001>.

property ... arising from university-generated research".[31] Univalor is an independent company whose mission is "to commercialize discoveries made by researchers at the Université de Montréal".[32]

Universities have also developed new degree and diploma programs. For example, the University of Waterloo's Masters in Business, Entrepreneurship and Technology (MBET) is described on its official website as follows:

> MBET's vision is to be recognized as an entrepreneurship program of local and international [renown], where the exceptional talents of graduates in identifying, developing and marketing breakthrough opportunities are widely recognized. By providing visionaries with a unique set of business skills and hands-on opportunities in a nurturing, real-time technological environment, the MBET program will supply the leaders who will build tomorrow's businesses.[33]

While the University of Waterloo has long taken an approach that integrates education with employment (e.g., through its co-op programs), the emphasis on identifying commercial opportunities *ex ante* rather than *ex post* in the technology development process represents a subtle but arguably significant development.

2. *New Collaborative Entities*

Groups of individuals and institutions are also collaborating on the commercialization of research. Consider, for example, the following ways in which new entities present themselves on their websites:

- TR Labs ("Creates innovative technologies and trains students to enhance ICT expertise and improve Canada's competitiveness.... Industry seasons the research program by setting direction and priorities...."); [34]
- Westlink Innovation Network ("We connect skilled professionals in academia and industry to collaborate and move Canadian expertise and innovations from the lab and minds of researchers to final products in the marketplace."); [35]
- MaRS ("is building a closely connected commercialization community that will bring together research, capital and industry to improve the productivity of technology transfer, increase capital flow and grow the number of Canadian companies achieving global success"); [36] and
- Leaders' Roundtable on Commercialization ("is a blue-ribbon panel of 46 CEOs, university presidents and deputy ministers ... with the self-declared mandate: *to establish a shared commercialization vision for Canada and an action plan that recognizes the unique challenges facing various sectors and regions*.") [37]

3. *Intermingling of People across Sectors*

Industry has long sought to have greater influence on research performed at public institutions, securing positions in university administrations and creating foundations in order to advance that goal.[38] In the past, many of these efforts sparked intense controversy and resistance from members of the academic community and from an outspoken former President of the National Research Council.[39]

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31 PARTEQ innovations, "about PARTEQ", online: PARTEQ <http://www.parteqinnovations.com/about.html>.

32 Univalor, "Home", online: Univalor <http://www.univalor.ca/researchers/home.htm>.

33 University of Waterloo, "What is the Master of Business, Entrepreneurship and Technology (MBET)?", online: University of Waterloo <http://cbet.uwaterloo.ca/Prospective_Students/MBET.html> [University of Waterloo, "What is the MBET?"]. See also University of Alberta, "MBA: Technology Commercialization", online: University of Alberta <http://mba.bus.ualberta.ca/Degrees/TC.htm>.

34 TRLabs, "A Thread in Western Canada's ICT Fabric", online: TRLabs <http://www.trlabs.ca/trlabs/about/>.

35 Westlink Innovation Network, "About Westlink", online: Westlink Innovation Network <http://www.westlink.ca/about.php>.

36 MaRS, "Explore MaRS: About MaRS", online: MaRS <http://www.marsdd.com/>.

37 The Conference Board of Canada, "Leaders' Roundtable on Commercialization", online: The Conference Board of Canada <http://www.conferenceboard.ca/CRTBL/> [emphasis in original].

38 In 1956, a national nongovernmental organization designed to foster university-industry cooperation called the Industrial Foundation on Education was formed, wholly financed by the private sector: see Tudiver, *supra* note 2 at 142. Also, industry-sponsored research chairs, research contracts and consulting arrangements with universities date as far back as the latter part of the nineteenth century: see Niosi, *supra* note 4 at 33.

39 Influential university officials' plans to build on-campus "institutes" solely for industrial research, for instance, ended when a Parliamentary subcommittee learned that faculty at the University of Toronto were "adamantly opposed to 'bargaining with manufacturers'": see Canada, *A Science Policy for Canada: Report of the Senate Special Committee on Science Policy*, vol. 1

However, following a rash of programs and measures introduced by various federal governments, reaching back as far as the 1960s and accelerated through the 1980s and 1990s,[40] the intermingling of the public and private sectors is now much more profound and less subject to comment, let alone controversy. Most Boards of Directors of Canadian universities include Directors of a variety of companies. The President of GlaxoSmithKline, a major pharmaceutical company, is on the Board of Directors at Queen's University.[41] The Chancellor of the University of Waterloo board is Mike Lazaridis, President and CEO of RIM[42] and a major donor to the university.[43] In some universities, industry even represents the majority at the board level, while at the University of Alberta, Concordia University, and the University of Calgary, nearly 50% of the members of the Boards of Directors have corporate affiliations.[44] But industry's presence also permeates the institution as a whole, with "industry scholars" appearing on peer review committees and with industry employees using space in university/hospital labs and holding appointments on university/hospital staff. At the same time, public institution researchers now commonly appear in the private sector, where they can be found serving as board members, consultants, authors, and speakers. University administrators are also serving on corporate boards. For instance, the President of Dalhousie University, Tom Traves, is a director at Clearwater Seafood, The Greater Halifax Partnership, and InNOVAcorp.[45]

This intermingling is not only in roles but also in space, through "co-location" of industry and academic researchers. Since the 1980s, several urban centres have built "science parks" near university campuses, zoning sizeable plots of land for spin-off company tenants in the hope of stimulating technology transfer.[46] In 2002, the Canadian government took this idea a step further, officially endorsing co-location of government, academia, and industry not only within the same geographical region but within the same building.[47] Consider, for example, the MaRS Centre in Toronto: "The MaRS Centre—both as a physical complex and as the hub for an extended virtual community—is designed to accelerate the commercialization of Canadian innovation by uniting the disparate worlds of science and technology with industry and capital."[48] Interestingly, the chair of the board of directors at MaRS, Dr. John Evans, is also Chair of the Torstar corporation, former vice-chair of NPS-Allelix Inc., and President *emeritus* of the University of Toronto.[49] Industry and the academy are both literally and figuratively coming together through the commercialization of research in public institutions.

(Ottawa: Queen's Printer for Canada, 1970) at 31 (Chair: Maurice Lamontagne). Under the direction of E.W.R. Steacie between 1952 and 1962, the NRC continued to see its task as developing a "critical mass" of university-based scientists. Although indirect, Steacie fervently believed that this approach was the optimal way to support industry: Atkinson-Grosjean, House & Fisher, *supra* note 6 at 10–11. Bureaucratic organization was, in his view, the "enemy" of laboratory science. Steacie once stated the following: "The important thing is that in any well run laboratory there must be a conscious and continuing effort to reduce organisation and planning to a minimum, to have as few committees as possible, to write reports as infrequently as possible, and to regard 'coordination' as a dirty word!" E.W.R. Steacie, *Science in Canada: Selections from the Speeches of E.W.R. Steacie*, ed. by J.D. Babbitt (Toronto: University of Toronto Press, 1965), cited in *ibid*. at 11.

40 See Atkinson-Grosjean, *supra* note 6.

41 Canadian Association of University Teachers, "Directory of University and College/Corporate Board Linkages 2005-2006" (2005), online: CAUT <http://www.caut.ca/en/publications/linkages/db.asp> [CAUT, "Directory"].

42 *Ibid.*

43 See University of Waterloo, Media Release, "RIM Founder increases donation to $50 million for Quantum Computing and Nanotechnology Engineering Research at UW" (2 May 2005), online: University of Waterloo <http://newsrelease.uwaterloo.ca/news.php?id=4463>.

44 CAUT, "Directory", *supra* note 41.

45 *Ibid.*

46 Various other terms are used to describe these areas, including "research parks", "technology parks", "technopoles", and "innovation centres". By the year 2000, there were 17 such areas, mostly built during the 1980s, although the Sheridan Science and Technology Park in Mississauga opened in 1965. All science parks are intended to serve essentially three sorts of objectives: "economic development objectives" (e.g., "[s]timulate the formation of start-up new-technology-based firms"); "transfer-of-technology objectives" (e.g., "[f]acilitate technology transfer from academic institution to firms on park"); and "local benefit objectives" (e.g., "[c]reate new jobs for the region"). Proponents of science parks may, however, stress different objectives when speaking to different audiences: see Richard Shearmur & David Doloreux, "Science parks: actors or reactors? Canadian science parks in their urban context" (2000) 32 Environment and Planning A 1065 at 1066–67, 1071–72 [Shearmur & Doloreux], citing, amongst others, Doreen Massey, Paul Quintas & David Wield, *High-Tech Fantasies: Science parks in society, science and space* (New York: Routledge, 1992).

47 Canada, *Achieving Excellence: Investing in People, Knowledge and Opportunity* (Ottawa: Industry Canada, 2001), online: Government of Canada <http://innovation.gc.ca/gol/innovation/site.nsf/vDownload/Page_PDF/$file/achieving.pdf>.

48 MaRS, "Explore MaRS: The MaRS Centre", online: MaRS <http://www.marsdd.com>.

49 MaRS, "Leadership: Board of Directors", online: MaRS <http://www.marsdd.com>.

4. *Shifting Roles, Missions, and Mandates*

A researcher in a public institution may now be not only a researcher but also a graduate student supervisor, teacher, clinician, consultant, peer reviewer, author, speaker, license holder, patent holder, and equity holder. Similarly, a public institution may now be not only a research institution but also an educational institution, clinical care provider, license holder, patent holder, and equity holder. The role of public universities has shifted from the provision of education and the conduct and dissemination of research to the provision of education, the conduct and dissemination of research, and entrepreneurial engagement in the market economy.[50] Universities have long struggled to balance competing demands for utilitarian, vocation-oriented education with fundamental inquiry and the pursuit of knowledge for its own sake. However, this shift towards economic entrepreneurialism signals a new era in higher education.[51]

II
THE POTENTIAL BENEFITS AND HARMS OF COMMERCIALIZATION

Quite clearly, there is significant commercialization of research in public institutions in Canada (as elsewhere in the world). The question that must be addressed is whether this phenomenon should be embraced and promoted or resisted. In order to begin to answer this question, a thorough canvass of the potential benefits and harms of commercialization is needed.[52] Potential benefits and harms of commercialization of research in public institutions can be seen for research itself as well as for individual researchers, students, public institutions, industry, and society. We will consider each in turn and, of necessity, in brief.

A. For Research

1. *What Is Researched*

The phenomenon of the commercialization of research in public institutions may result in less non-commercializable research being undertaken. Research with commercial potential may be prioritized over research with no commercial potential.[53] For example, research into the treatment of diseases disproportionately affecting the poor (in countries without government-funded drug coverage),[54] research into the treatment of diseases affecting only a small number of people, and research into prevention rather than pharmaceutical treatments may all be less likely to be undertaken.[55]

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50 The historical shifts in the university's missions or roles have been studied and variously characterized by a number of commentators. In the American context, Etzkowitz argues that universities had two primary missions, teaching and research, until the early twentieth century, when events at the Massachussets Institute of Technology, Stanford University, and a few other institutions helped legitimize a third mission, the university's role as an enterprise of economic development: see Henry Etzkowitz, "Research groups as 'quasi-firms': the invention of the entrepreneurial university" (2003) 32 Research Policy 109.

51 See Tudiver, *supra* note 2; see also Washburn, *supra* note 2.

52 It must be acknowledged here that some readers may disagree about whether some effects are potential harms or potential benefits. For example, some may find the shaping of research to be a positive rather than a negative result of commercializing research. We have deliberately chosen not to offer a justification of a normative position in relation to the effects, firstly because doing so would require far more space than we have available to us, and secondly because justification is not necessary for the point we wish to make in regard to the need for informed debate (which requires information that we do not have). Where possible, we have directed the reader to relevant literature that explores the potential benefits or harms in detail.

53 In the United Kingdom, "[a]pproximately 90% of clinical drug trials and 70% of trials reported in major medical journals are conducted or commissioned by the pharmaceutical industry. As it does most of the research, inevitably the industry not only has a major effect on what gets researched, but also how it is researched and how results are interpreted and reported." U.K., House of Commons Health Committee, *The Influence of the Pharmaceutical Industry: Fourth Report of Session 2004-2005*, vol. 1 (London: The Stationary Office Limited, 2005) at para. 160 [Pharma Industry].

54 This is especially true of diseases affecting populations in developing countries such as "tropical diseases". In fact, because the commercial model of drug development fails completely "in the developing world, where few patients can afford to pay patented prices for drugs" some advocates are actively promoting alternate models of drug development to aid those populations. Stephen M. Maurer, Arti Rai & Andrej Sali, "Finding Cures for Tropical Diseases: Is Open Source an Answer?" (2004) 1 PLoS Medicine 183 at 183.

55 Examples of industry shaping can be found in Sheldon Krimsky, *Science & the Private Interest: Has the Lure of Profits Corrupted Biomedical Research?* (Lanham, MD: Rowman & Littlefield Publishers Inc., 2003) at 223 [Krimsky]. A committee in the U.K. recently heard evidence of this fact, with people arguing that drug innovation was aimed at the affluence rather than health needs, and that it was directed at established and emerging mass markets. Also, it was claimed that there was little research into non-drug intervention. The committee received evidence that "more money is now invested in research into the prevention of

2. *How Research Is Conducted*

When the emphasis is on the commercialization of research, we may see cheaper but more dangerous methods being used. For example, a placebo-controlled trial is usually cheaper and faster than a trial using an active-control arm. Yet, a placebo-controlled trial can be more dangerous in some situations than an active control trial, as some of the participants are, by definition, on a placebo rather than on a known safe and effective, or possibly safe and effective, treatment.[56] In addition, research may be designed to achieve favourable results and avoid negative results. For example, with respect to favourable results, the following methods might be employed:

- Conducting a trial of one drug against another treatment known to be inferior;
- Testing one drug against too low a dose of a competitor drug;
- Conducting a trial of one drug against too high a dose of a competitor drug (making the former drug seem less toxic);
- Conducting trials that are too small to show differences from competitor drugs;
- Using multiple endpoints in the trial and selecting for publication those that give favourable results;
- Doing multi-centre trials and selecting for publication results from centres that are favourable;
- Conducting subgroup analyzes and selecting for publication those that are favourable; and
- Presenting results that are most likely to impress (for example, reduction in relative rather than absolute risk).[57]

With respect to avoiding negative results, for example, if a liver biopsy is not conducted in a trial of a drug for the treatment of thalassemia (a disease causing damaging iron loading in the liver), liver fibrosis may not be discovered and an unsafe drug may appear safe. [58]

3. *How Research Is Interpreted*

There may be a bias towards positive results in the interpretation of research results in research funded by industry. It has been reported that, in the U.K., "[f]ive out of six systematic reviews published in the last two years have shown that research that is sponsored by a drug manufacturer is more likely to yield a positive result for the company's product than research that is independently sponsored."[59] For example,

> one survey investigating the wide divergence of views on the health effects of passive smoke found that 74 percent of the studies finding no adverse effects were written by authors with ties to the tobacco industry. Of the authors with tobacco ties, 94 percent found that passive smoke was not harmful to health, while only 13 percent of those without tobacco ties reached the same conclusion.[60]

Similar results are being reported in meta-analyses of clinical trials.[61]

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disease, such as drugs to reduce cholesterol, than into its treatment, which serves to divert investment away from the sick towards the well, away from the old towards the young and away from the poor towards the rich." It also heard arguments that "'there is little incentive for industry to conduct research aimed at small patient populations', and that there is little industry funding for research to determine the subgroups of patients that benefit from particular therapies". Pharma Industry, *supra* note 53 at para. 165.

56 Susan S. Ellenberg & Robert Temple, "Placebo-Controlled Trials and Active-Control Trials in the Evaluation of New Treatments: Part 2: Practical Issues and Specific Cases" (2000) 133 Annals of Internal Medicine 464 at 464.

57 Richard Smith, "Medical Journals Are an Extension of the Marketing Arm of Pharmaceutical Companies" (2005) 2 Public Library of Science Medicine 364 at 365.

58 Jon Thompson, Patricia Baird & Jocelyn Downie, *The Olivieri Report: The complete text of the report of the independent inquiry commissioned by the Canadian Association of University Teachers* (Toronto: James Lorimer and Company Ltd., 2001) [*Olivieri Report*].

59 Pharma Industry, *supra* note 53 at para. 177.

60 Deborah A. Barnes & Lisa A. Bero, "Why Review Articles on the Health Effects of Passive Smoking Reach Different Conclusions" (1998) 279 Journal of the American Medical Association 1566 at 1566, cited in Bok, *supra* note 2 at 76.

61 Justin E. Bekelman, Yan Li & Cary P. Gross, "Scope and Impact of Financial Conflicts of Interest in Biomedical Research: A Systematic Review" (2003) 289 Journal of the American Medical Association 454 at 456-459; Joel Lexchin *et al.*, "Pharmaceutical industry sponsorship and research outcome and quality: systematic review" (2003) 326 British Medical Journal 1167.

4. *How Research Is Reported*

Industry sponsorship of research may affect the way that research is reported. First, research reporting may be shaped through "ghost authorship" and "ghost journalism". "Ghost authorship" describes a practice wherein an individual employed by the corporate sponsor writes up the results of research and then the company (or a second company hired by the first) casts about for an academic to sign on as the "author" or "co-author" on the paper.[62] "Ghost journalism" describes a practice wherein the corporate sponsor of the research (or a second company hired by the first) produces a video that looks like a news report. It is sent to a television or radio station complete with, for example, a report by an individual who appears to be a journalist and interviews with "experts", individuals suffering from whatever disease the new treatment is for, and a script for the local anchor to read as voiceover for the story. Yet, the entire package has been created by or paid for by the company.[63] The problem of bias is obvious.

Second, research results may be suppressed. This can occur when a sponsor or university prevents a researcher from publishing the results of research (e.g., by issuing legal threats).[64] For example, Dr. Nancy Olivieri was threatened with legal action by her research sponsor, Apotex, if she disclosed information in any manner to a third party about the negative results of her study.[65] The University of Toronto and the Hospital for Sick Children, involved in the negotiations for a substantial donation from Apotex, failed to support Dr. Olivieri in her efforts to disclose the research results.[66] More recently, the University of Manitoba prevented the release of a film made as part of a research project on genetically modified crops. The video is "explicitly critical of crop genetic modification technology as a whole and, of biotech giant, Monsanto.... Monsanto has a long and intimate relationship with the University of Manitoba...."[67]

Suppression of research results can also happen when a researcher self-censors because of the risk of harm to his own profits where, for example, he is an owner of a company holding the patent for the intervention he is testing.[68] Self-censorship can also occur because the research sponsor does not want the results reported at all or wants negative results misreported; the researcher complies in order not to compromise future research funding or other financial rewards.

As the British House of Commons Health Committee's *The Influence of the Pharmaceutical Industry, Fourth Report of Session 2004-05* notes: "Studies comparing all clinical trials have shown that, overall, pharmaceutically sponsored trials are less likely to be published than trials commissioned by other organisations."[69] While reforms directed at this problem are being implemented,[70] there is a long way to go before the problem of suppression of results is resolved.

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62 See David Healy & Dinah Cattell, "Interface between authorship, industry and science in the domain of therapeutics" (2003) 183 British Journal of Psychiatry 22; Melody Petersen, "Whistle-Blower Says Marketers Broke the Rules to Push a Drug" *New York Times* (14 March 2002) C1; Erica Johnson, "Inside the Business of Medical Ghostwriting", CBC Marketplace (25 March 2003), online: CBC.ca <http://www.cbc.ca/consumers/market/files/health/ghostwriting/>; Annette Flanagin *et al*., "Prevalence of Articles With Honorary Authors and Ghost Authors in Peer-Reviewed Medical Journals" (1998) 280 Journal of the American Medical Association 222.

63 See Daniel Price, "Doctor Doctor, Give Me the News" (2005) 12:2 PR Watch 1, online: PR Watch, <http://www.prwatch.org/files/PRW12Q2.pdf>. For an Australian example, see transcript of Liz Jackson, "A marketing breakthrough" *Media Watch* (13 June 2005), online: ABC <http://www.abc.net.au/mediawatch/transcripts/s1390967.htm>.

64 *Olivieri Report*, *supra* note 58 at 5.

65 Dr. Olivieri conducted a clinical trial for a new drug to treat patients with thalassemia. However, when she began to observe unfavourable results, her efforts to report those results both to the patients in the trial and the scientific community at large were undermined by the University of Toronto and the Hospital for Sick Children, which were in the midst of negotiating a large donation from Apotex Inc., the producer of the drug being tested in the trial. For a detailed account of this case, see *Olivieri Report*, *supra* note 58.

66 *Ibid.* at 8.

67 Seeds of Change, "University of Manitoba, Monsanto, and the Battle for Academic Freedom: Background to the controversy surrounding the *Seeds of Change* film" (2005), online: Seeds of Change <http://seedsofchangefilm.org/?p=the_film_censored>.

68 See e.g. the Tseng case described in Bok, *supra* note 2 at 67.

69 *Supra* note 53 at para. 203.

70 Clinical trials registries are being widely discussed and implemented. For example, the GSK register can be seen at GlaxoSmithKline, "Clinical trial register", online: GlaxoSmithKline <http://ctr.glaxowellcome.co.uk/welcome.asp>. ICMJE statements can be found at "Clinical Trial Registration: A Statement from the International Committee of Medical Journal Editors" (2004) 141 Annals of Internal Medicine 477. The NIH provides a registry at <http://www.clinicaltrials.gov>.

5. *Public Trust in Researchers, Research Institutions, and Research*

As the shaping of research and research results becomes public, it is possible that public trust in researchers, research institutions and the research enterprise as a whole may be eroded.[71] This erosion could have significant negative effects on research as the public may withdraw its support for government funding of research and research institutions and reduce its willingness to participate in research.

B. For Researchers

1. *Employment Prospects*

If commercialization brings more money into public institutions, more jobs for researchers might be created and these (and existing jobs) might have higher salaries. Closer links between industry and universities might result in greater job prospects for students upon graduation if they are seen as better prepared for careers in industry and if they take advantage of increased networking opportunities. If commercialization results in benefits to society (see below), researchers' job satisfaction may increase as they feel that they have made a positive contribution to society. Their job satisfaction may also be higher if their work is valued more by universities and by society.

2. *Financial Rewards*

Individual researchers might find additional personal income through industry funding for conducting research, writing papers, allowing their name to be listed as a paper's author,[72] giving presentations, consulting, and serving on advisory boards. They might also enjoy additional personal income through holding the IP in their own research results (e.g., from the profits realized through patenting).[73]

C. For Students

1. *Funds Available for Educational Purposes*

Through the commercialization of research, public institutions may have access to more unrestricted funds from industry partners. These funds could either come out of the profits from harnessing the IP of their own research or from industry partners (directly as unrestricted gifts or indirectly through overhead on research contracts).[74] While these funds could be used for educational purposes, it is also possible that

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[71] Ulrich Beck, for instance, argues that public distrust of the scientific-political complex has markedly increased: see Ulrich Beck, *Risk Society: Towards a New Modernity*, trans. by Mark Ritter (London: Sage Publications, 1992).

[72] David Healy, "Conflicting Interests in Toronto: Anatomy of a controversy at the interface of academia and industry" (2002) 45 Perspectives in Biology and Medicine 250 at 261.

[73] In most institutions, researchers own the intellectual property rights to their inventions, educational material, industrial designs and trade marks. Statistics Canada, *2003 Survey*, *supra* note 7 at 20.

[74] Overhead costs for research vary among universities, but in research contracts are usually calculated as a percentage of the direct costs of research. Some examples:

Dalhousie University	30%	"Research Contracts", online: Dalhousie University <http://researchservices.dal.ca/research_1487.html>.
Memorial University of Newfoundland	40%	"Policy and Procedures on Indirect Costs of Contract Research", online: Memorial University <http://www.mun.ca/research/overhead_policy.php>.
University of Calgary	typically 40%	"Research Overhead & Indirect Costs Policy", online: University of Calgary <http://www.ucalgary.ca/UofC/research/html/policies/over_indcosts.html>.
University of Prince Edward Island	30% min.	"Contract Research Policy", online: UPEI <http://www.upei.ca/research/research/researchpolicies/contract_policy/contract_policy.html>.
University of Toronto	40% standard	"Policy on Research Contracts and the Recovery of Indirect Costs of Research: Appendix A", online: University of Toronto <http://www.utoronto.ca/govcncl/pap/policies/recontapp.html>.
Wilfred Laurier University	20-50%	"WLU Policy on Research Contracts", online: Wilfred Laurier University <http://www.wlu.ca/page.php?grp_id=1445&s_id=1603>.

universities will spend less money on teaching and more money on research.[75] It is already the case that they are spending more money on professional managerial staff.[76]

2. *Financial Support for Students*

Increased funds might become available to support graduate students through unrestricted funds from the commercialization of research being redirected to scholarships, through new scholarships being funded for commercializable research,[77] and through direct employment on research projects.

3. *Teachers*

If it is true that active researchers are better teachers,[78] and if the phenomenon of commercialization results in more active researchers on university campuses, the educational environment might be enriched. However, in the profiles and activities of educators may change as they redirect their preferences, strengths, and time from teaching to research.[79]

4. *Curricula*

Students may learn more business and entrepreneurial skills and develop attitudes which may prove very useful in knowledge-based economies. With the commercialization of research, we may see the creation of new, commercially oriented degrees and/or diplomas (e.g., the University of Waterloo Masters in Business, Entrepreneurship and Technology).[80] We may also see the emergence of new, commercially oriented courses in established degree programs. For example, the Engineering Department at the University of Western Ontario now offers a course on Technological Entrepreneurship and Innovation.[81]

5. *Student Research Areas and Topics*

Student research areas and topics may be shaped as more funding is available or funding is more readily available for research with commercial potential.[82] In addition, changes in the costs of research tools may also affect student choices of areas and topics.

6. *Space*

Insofar as students are learning in a research environment, their education may be enriched by the increasing amount of research space and the allocation of more resources to research. However, this may reduce the amount and quality of teaching space. A Canadian survey recently found that "for new

Lakehead University	30% min.	"Research: Recovery of Overhead (Indirect Costs) on University-Administered Research Funds", online: Lakehead University <http://policies.lakeheadu.ca/policy.php?pid=29>.

75 This was recognized in an American study by the National Science Board: "As all public institutions increased expenditures devoted to research by roughly four percentage points [in the period of 1977–1996], they decreased expenditures for instruction by approximately six percentage points." Slaughter & Rhoades, *supra* note 2 at 313.

76 In 2003, Canadian hospitals and universities spent over $36 million on intellectual property management. $17 million went to salaries for people devoted strictly to IP management, a 31% increase from $13 million in 2001. Statistics Canada, *2001 Survey*, *supra* note 7 at 5; Statistics Canada, *2003 Survey*, *supra* note 7 at 17.

77 For example, Canadian Institutes of Health Research (CIHR) has some masters and doctoral awards that are available only for industry-partnered research: Canadian Institutes of Health Research, "Graduate Training Award: Master's: Industry Partnered (2005-2006)", online: CIHR <http://www.cihr-irsc.gc.ca/e/27916.html>. NSERC awards Industrial Postgraduate Scholarships which require a student to pursue their postgraduate studies in partnership with industry: online: Canadian Institutes of Health Research, "MD/PhD Studentships: Industry-Partnered (2005-2006)", online: CIHR <http://www.cihr-irsc.gc.ca/e/22425.html>.

78 Sue Wuetcher, "UB prof's book says active researchers are better teachers" (1996) 28:11 State University of New York at Buffalo Reporter, online: State University of New York at Buffalo <http://www.buffalo.edu/reporter/vol28/vol28n11/n6.html>.

79 "In response to surveys, faculty indicated that they preferred teaching to research until the mid-1980s, after which an increased preference for research began to emerge." Slaughter & Rhoades, *supra* note 2 at 312.

80 University of Waterloo, "What is the MBET?", *supra* note 33.

81 University of Western Ontario, "Academic Calendar 2007", online: University of Western Ontario <http://www.westerncalendar.uwo.ca/western/web/2007(new)/Courses_UWO_ES.html#466a/b>.

82 See e.g. the funding available for industry-partnered research: Canada, "Achieving Excellence", *supra* note 18.

academic space on campus, research labs trump teaching space at 15 of the 20 universities surveyed—with ratios as high as eight square metres of new research space to one square metre of new teaching space."[83]

This development may be the result of more money becoming available for research space. It may also be because the funds available for research space require matching funds, and so funds and fundraising resources that might otherwise be directed to teaching space are instead directed toward matching for research space. The same Canadian study found that space may be disproportionately allocated between disciplines. For example,

> of the 164 new academic buildings or additions built or planned at 20 universities, just nine involve faculties of arts and social science, and four involve the fine arts or contemporary arts. These projects carry a price tag of $341.2 million. Three new libraries and five multi-use academic building projects, at a cost of $312.8 million, will also benefit students in the arts and humanities. But this represents a fraction of the total $4.73-billion cost of the new academic buildings captured in the survey.[84]

Some of the new research buildings can be directly linked to commercializable research. At the University of Saskatchewan in Saskatoon, where "the building boom is skewed heavily in favour of research over classrooms",[85] the Canada Foundation for Innovation contributed over 30% of the funding for the Canadian Light Source research lab.[86] According to the University, this project "represents an unprecedented level of collaboration among governments, universities and industry across Canada".[87]

7. *The Free Flow of Ideas*

With the commercialization of research can come a significant reduction in the sharing of information, yet education is enhanced by the free flow of ideas. Students learn, in large part, by sharing their ideas with others and by discussing other people's ideas. All other things being equal, policies and practices that promote secrecy (as are found in the commercial arena) inhibit education.

Furthermore, when research is sponsored by industry or is being commercialized by a university, the disclosure of the research results can be delayed and can seriously harm students' educational progress. Clauses in research sponsorship contracts and time delays related to patenting by the university may hinder student publication and thesis approvals.[88]

8. *Trust between Students and Supervisors and between Students*

Trust between students and supervisors as well as between students can be undermined, as they may worry that the other will steal potentially valuable ideas or will intentionally or accidentally disclose them to others before the IP in the research is harnessed.

D. For Public Institutions

1. *Retention of Faculty*

The commercialization of research in universities may make it easier to retain researchers who would otherwise work for much greater financial rewards in the private sector (e.g., in pharmacology or electrical engineering). They may instead stay in the universities if they are able to benefit from commercialization of their research. On the other hand, this development may lead to the loss of faculty. For some, an increased emphasis on the commercialization of research and the pressure to conduct commercializable research may make working in public institutions less appealing.

2. *Competition and Morale within Universities*

If faculties with more commercializable or commercialized research are seen to obtain more resources from the university or from external sources, or if faculty members with more commercializable or

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83 Sarah Schmidt, "Universities choose labs over classrooms: Survey of 20 universities: Federal funding partly to blame for imbalance" *National Post* (13 January 2005) A4.

84 *Ibid.*

85 *Ibid.*

86 Canadian Light Source, Media Release, "Canadian Light Source Partners Celebrate Building Completion and Full Capital Funding" (26 February 2001), online: Canadian Light Source <http://www.lightsource.ca/media/celebrate.php>.

87 Peter MacKinnon, President, University of Saskatchewan, cited in *ibid.*

88 Such delays can range up to three years: see Slaughter & Rhoades, *supra* note 2 at 110.

commercialized research earn higher salaries or receive other benefits, competition between faculties and faculty members may increase and morale within the university may be undermined.[89]

3. *Public Support for Universities*

The reputation of public universities and hospitals may improve if they are seen as less like "ivory towers". This might translate into growing public support for funding of these institutions, either for a particular university or hospital or for universities or hospitals in general. If research comes to be seen as more relevant and useful, there may be an overall increase in public support for research, researchers, and research institutions, as well as more public participation in research. However, if the negative consequences of the commercialization of research come to dominate public opinion, there may be less public support for the amount of government funding of universities and funds available for education may ultimately drop.[90]

E. For Industry

Through increased government support for commercializable research in public institutions, industry may realize increased growth in revenues, net income, and number of employees. This could in turn benefit the companies' employees and shareholders. The requirements for partnering with industry may increase the number of academics willing to work with industry, which may ultimately lead to more and better research results and, through these results increased industry profits. Finally, the public reputation of industry may be enhanced by its partnership with public institutions and contribution to economic growth.

F. For Society

1. *Consumer Health and Safety*

Advances in research brought about by commercialization may result in the better health and improved quality of life of Canadians. We may witness the emergence of certain health and safety products, services, and processes that, without commercialization, would never have been developed, would have been developed more slowly, or would have been developed but never put on the market.[91]

As we have seen, however, increases in commercialization cause researchers in public institutions to become increasingly involved with industry. Some of these researchers, in turn, become involved with or advise on the regulation of products (e.g., through the United States Food and Drug Administration (US FDA)).[92] These conflicts of interest may result in more dangerous products being placed or kept on the market. This may happen through improper approvals or failure to restrict use, require warnings, or withdraw products. Recent experiences with Vioxx, Celebrex, and Bextra illustrate such risks.[93]

Competition among drug companies can lead to the development of a number of similar drugs for a single condition. This could increase the risk or decrease the efficacy of treatment because "it is difficult for non-specialists to stay well-informed about more than two or three drugs in any one therapeutic class. Moreover, comparative studies would be needed to assess the relative efficacy and safety of the available drugs, but these are not usually done."[94]

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89 Some university professors' salaries are public in some provinces: see e.g. the Ontario *Public Sector Salary Disclosure Act*, s. 2(1), being Schedule A to the *Savings and Restructuring Act, 1996*, S.O. 1996, c. 1.

90 Slaughter & Rhoades, *supra* note 2 at 334.

91 "In order to maximize the development of effective health products and services from health research, CIHR is developing a comprehensive proactive commercialization strategy.... CIHR will continue to work closely with the research community, universities, research institutions and industry partners to enhance the commercial viability of research so that research moves effectively from laboratories and offices to the marketplace and clinics for the benefit of Canadians." Canadian Institutes of Health Research, *Report on Plans and Priorities for the fiscal year 2003-2004*, online: CIHR <http://www.tbs-sct.gc.ca/est-pre/20032004/cihr-irsc/cihr-irscr34_e.asp>.

92 David Healy, *Let them Eat Prozac* (Toronto: James Lorimer, 2003) at 116-119 and Marcia Angell, *The Truth About The Pharmaceutical Industry: How They Deceive Us and What To Do About It* (New York: Random House, 2004) at 210, cited in Trudo Lemmens, "Leopards in the Temple: Restoring Scientific Integrity to the Commercialized Research Scene" (2004) 32 J.L. Med. & Ethics 641 at 652.

93 See Lemmens, *ibid.*, for descriptions and analysis of recent controversies.

94 *Pharma Industry*, *supra* note 53 at para. 175.

Moreover, if the range of research being done is narrowed and less research is done for health promotion and prevention and for interventions or products for diseases or needs that affect few people or the poor, any health benefits of research will be disproportionately distributed. The potential health consequences of this process are obvious.

2. *Participant Safety*

The increasing commercialization of research may generate a growing number of risks for research trial participants. For example, when researchers have personal financial interests in the enrolment and retention of trial participants, these participants may be inadequately informed, improperly enrolled, and unduly kept in trials. The Jesse Gelsinger case from the United States amply illustrates this point: a participant in a gene transfer study (in which the researcher and the research institution had financial interests) was not given full information about the risks of participating in this study. These risks included adverse results in previous animal studies involving the same protocol. The participant died a few days after receiving the adenovirus vector intended to correct his genetically based metabolic disorder, called ornithine transcarbamylase (OTC) deficiency.[95]

The growing phenomenon of "marketing research" may also put trial participants at risk. The real purpose of this so-called "research" is to introduce patients and their physicians to a particular drug in the hope that the patient will continue to use that drug after the "study" has ended. The focus is on increased sales rather than increased health benefits.[96] These patients may be unnecessarily put at risk because they undergo potentially harmful tests aimed at safety monitoring to give the appearance of a research study, but the results of the monitoring may not actually be used for the advancement of knowledge.

3. *Rate of Advancement of Knowledge and Knowledge Translation*

The protection of IP in research results through the use of the patent regimes may result in more sharing of information.[97] This sharing could, in turn, lead to the faster advancement of knowledge, as researchers are then able to build upon the shared research results. With the intermingling and collaborating of various research sectors, complementary skills may be brought together (e.g., basic research and business development skills), and this may lead to the faster translation of knowledge.

Alternatively, the sharing of information may be delayed by the use of patent regimes. For example, universities may introduce a screening process during which information cannot be released while its potential commercial value is being assessed.[98] The sharing of information may be further delayed while patents are being processed.[99]

A more ominous development may be that the advancement of knowledge is not merely delayed, but entirely blocked. A company might buy a research result (e.g., a research tool) and then withhold it because it is in competition with the company's own product.[100] Furthermore, if key elements of research are kept secret, the reproduction of results may be rendered impossible. The advancement of knowledge dependent on the reproduction of results (particularly the case in the physical sciences) may be blocked.[101] Scientists may also be, in effect, prevented from lawfully pursuing a particular research project because

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95 Josephine Johnston & Françoise Baylis, "What Happened to Gene Therapy?: A Review of Recent Events" (2004) 4:1 Clinical Researcher 11; Sally Lehrman, "Virus treatment questioned after gene therapy death" (1999) 401 Nature 517; Rick Weiss & Deborah Nelson, "Gene Researchers Apologize for Lapses in Teen's Fatal Treatment" *The Washington Post* (10 December 1999) A06; Deborah Nelson & Rick Weiss, "Hasty Decisions in the Race to a Cure? Gene Therapy Study Proceeded Despite Safety, Ethics Concerns" *The Washington Post* (21 November 1999) A01; Tim Beardsley, "Gene Therapy Set Back: A Tragic Death Clouds the Future of an Innovative Treatment Method" (2000) 282 Scientific American 21.

96 American Academy of Family Physicians, "Research Policies", online: AAFP <http://www.aafp.org/online/en/home/policy/policies/r/research.html>.

97 See Ann Louise Monotti & Sam Ricketson, *Universities and Intellectual Property: Ownership and Exploitation* (Oxford University Press, 2003) at 47 [Monotti].

98 Slaughter & Rhoades, *supra* note 2 at 115-116.

99 Getting a patent in Canada can take anywhere from 18 months to three years: see Western Economic Diversification Canada, "The Inventors Guide: Obtaining a Patent in Canada & USA", online: Western Economic Diversification Canada <http://www.wd.gc.ca/tools/inventors/protect_c_e.asp> [WEDC].

100 Slaughter & Rhoades, *supra* note 2 at 331.

101 *Ibid.* at 120–121: "They asked scientists whether at least one of their requests for information, data, or materials related to published research results was denied in the past three years. Of the geneticists that responded, 47 percent did so in the affirmative. Because they were denied information, 28 percent of the geneticists reported that they were unable to confirm the accuracy of published results." See also Krimsky, *supra* note 55 at 83.

they are unable to secure all the necessary licenses from the multiple patent-holders implicated by the project's protocol.[102]

4. *Amount and Rate of Access to Useful Products, Processes, and Services*

Through commercialization, we may see more and faster access to useful products, processes, and services.[103] We may have access to products that would otherwise not have been developed because they are not a medical or government priority:

> [T]he industry explores therapeutic areas that have been overlooked by the medical profession, perhaps due to a feeling that "lifestyle" problems rather than medical issues are involved. An area such as impotence, for example, was not traditionally investigated or treated to any extent by the medical profession, despite being of great concern to the individuals affected. In large part due to industry promotion and awareness campaigns, the issue is now more likely to be broached by patients with their GPs, and patients are more likely to receive treatment.[104]

Commercialization potential may also cause products to be developed more quickly by encouraging competition among researchers. Researchers might try to improve their research and come out with newer and better products so that they can reap their financial benefits. This could result in more and better products being available to consumers. Furthermore, competition may cause a number of similar drugs to be available from competing companies and researchers, allowing doctors to choose a specific treatment with the most favourable harm/benefit ratio for each patient's unique circumstances.[105]

However, rather than speeding up access to treatments and products, it is possible that access will be delayed as treatments and products are kept confidential and off the market while applications are made for patents. This process can last from 18 months to three years.[106] In addition, some treatments and products may become less accessible as the costs are increased due to the harnessing of IP.

5. *Amount of Research Funds*

There may be more funding available for research in public institutions through the sponsorship of research from partners (e.g., industry and government), and through the profits realized from public institutions harnessing IP.[107] However, as a result of the commercialization of research in public institutions, research may become more expensive as research tools are patented and have access fees attached to their use.[108]

6. *Use of Research Funds*

Research funds may be used more efficiently as research becomes subject to the discipline of the market. Furthermore, when working towards commercializable results, researchers may maintain a narrow, more efficient focus rather than pursuing non-profitable tangents that they find interesting. Alternatively, research resources may be wasted as researchers duplicate the work of others either because they do not know that it has been done (e.g., it has not been published) or they cannot gain access to the results (the costs may be prohibitive or the research may simply not be shared). In this case, research is inadvertently repeated.[109]

If the market reflects usefulness in the public's mind, and if the research agenda in public institutions is driven by commercial incentives, then commercializable research may be seen as more responsive to public demands and thus a more useful application of research funds.

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102 This hypothetical scenario in which the fact of multiple ownership causes valuable resources to be underused has been dubbed the "tragedy of the anticommons". Multiple sequences of DNA patented by multiple individuals present the classic example of the anticommons problem: see Michael A. Heller & Rebecca S. Eisenberg, "Can Patents Deter Innovation? The Anticommons in Biomedical Research" (1998) 280 Science 698.

103 See Monotti, *supra* note 97 at 47, 524, 529.

104 *Pharma Industry*, *supra* note 53 at para. 161.

105 *Ibid.* at para. 173.

106 See Monotti, *supra* note 97 at 432-433, 522; on the time required to process patents, see also WEDC, *supra* note 99.

107 See discussion above, "Dissecting the Phenomenon".

108 See e.g. Arti K. Rai & Rebecca S. Eisenberg, "Bayh-Dole Reform and the Progress of Biomedicine" (2003) 66 Law & Contemp. Probs. 289 at 295ff.

109 *Ibid.* at 112.

7. *Wealth*

The commercialization of research may have a number of economic implications. Not only will individuals, public institutions, and companies directly involved in research profit from commercialization, but consumers may enjoy lower prices resulting from greater competition in the marketplace. We may also witness more general economic growth as a result of the commercialization of research, leading to lower taxes leading to greater individual wealth overall. In addition, research-led improvements in technology may increase productivity, in turn boosting the general standard of living and per capita income.

Wealth created by the commercialization of research might shift the burden of research costs from the public sector to the private sector (as the private sector becomes more involved in sponsorship) and shift the benefit of research from the private sector to the public sector (as public institutions enjoy the profits from harnessing IP in research results).

It might also be argued that the commercialization of research represents an unjust enrichment of researchers and industry. Researchers who form companies in order to harness the IP of their research are like venture capitalists. However, these researchers run no financial risk and reap the benefits, with the capital coming from the public.[110] Similarly, sometimes industry joins forces with researchers in public institutions on publicly funded research, either reaping all of the profits from the products, processes, or services developed or sharing them with the researchers involved. In such cases, the public funds the research, has no share in future profits, and must ultimately pay for the results.[111]

8. *Jobs*

The commercialization of research may result in an increased number of jobs for skilled workers. Where jobs in "knowledge industries" are considered preferable, these new jobs may be of a higher quality.

9. *Competitiveness for Country*

Commercialization could lead to an improvement in a country's competitive position, for example, in the World Economic Forum Global Competitiveness Report and in the OECD rankings.[112]

10. *Costs for Publicly Funded Health Care Systems*

Research results may lead to cost savings for Canada's publicly funded health care system (e.g., safer products may result in fewer expensive hospital stays). However, as more research results are commercialized, drugs and tests may cost more. This would be particularly harmful to a publicly funded health care system that provides drug coverage, as Canada's system does for some members of society.[113]

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[110] For example, the Stem Cell Network, a Network of Centres of Excellence, *supra* note 21, recently created a company called Aggregate Therapeutics: "Aggregate Therapeutics will gather intellectual property from institutions across Canada, add value to it over a period of three to five years, secure investment and then spin it off into the marketplace.... With agreements in place with eight key research institutions across Canada, Aggregate Therapeutics will serve as an incubator, helping accelerate the development of stem cell therapies and technologies.... Industry Canada sees this process as a potential solution to a problem that has plagued biotechnology." Stem Cell Network, "Catalyzing: Commercialization", online: Stem Cell Network <www.stemcellnetwork.ca/success/commercial.php>. There is an argument that while the researchers are investing intellectual capital, they are using public capital to fund their research.

[111] This is sometimes referred to as the "double payment problem". For an argument as to why the general Canadian public should receive some form of direct return from its substantial investment in the resources expected to be pooled together under the umbrella of Aggregate Therapeutics, as well as a discussion of other concerns relating to this corporation, see Matthew Herder & Jennifer Dyck Brian, "Canada's Stem Cell Corporation: Aggregate Concerns and the Question of Public Trust", Journal of Business Ethics [forthcoming].

[112] See e.g. discussion in OECD, Committee for Scientific and Technological Policy at Ministerial Level, *Final Communique: Science, Technology and Innovation for the 21st Century* (2004), online: OECD <http://www.oecd.org/document/15/0,2340,en_21571361_21590465_25998799_1_1_1_1,00.html>; OECD, Directorate for Science, Technology and Industry, *Main Science and Technology Indicators (MSTI), 2006/2 edition* (Paris: OECD, 2006), online: OECD <http://www.oecd.org/document/26/0,2340,en_2649_34451_1901082_1_1_1_1,00.html>. See also Xavier Sala-i-Martin, ed., *The Global Competitiveness Report 2003-2004* (New York: Oxford University Press, 2004).

[113] Although it is not required by the *Canada Health Act*, most provinces provide some prescription drug coverage to specific groups of people. British Columbia, Saskatchewan and Manitoba provide coverage to all residents, while residents of Alberta can purchase coverage through the government. There are high deductibles in these plans. Quebec sponsors drug insurance for people who do not have a plan with their employer. The Atlantic provinces and Ontario provide some coverage to seniors and welfare

11. *Socially Valuable Institutions*

With the commercialization of research in public institutions, we may see the erosion of some socially valuable institutions. The threat to an independent press is illustrated through the phenomenon of "ghost journalism" described earlier. The threat to a protective regulatory arm is illustrated through the prevalence of conflicts of interest in the US FDA. The threat to universities as disinterested critics and trusted advisors of sources of knowledge is illustrated through the prevalence of connections between researchers and industry and the prevalence of researchers and research institutions in commercial enterprises.[114] Undermining the university's role as a place for social criticism, cultural transmission, and knowledge generation for public consumption may even threaten democracy as a whole.[115]

III
WEIGHING THE POTENTIAL BENEFITS AND HARMS

Having canvassed the potential benefits and harms of the commercialization of research in public institutions, we would normally now turn to an attempt to weigh them against each other. However, doing so is, to quote Derek Bok in *Universities in the Marketplace: The Commercialization of Higher Education*, "much like asking whether an indeterminate number of olives, figs, and grapes should count more than an unknown quantity of apples, pear, and plums. The uncertainties involved cast a fog over the problem and invite personal bias into the calculations of those who make the decisions."[116]

Which of the potential benefits or harms have been or are likely to be realized? Will products, processes, and services reach the public more quickly? Will jobs and wealth be created? Will the advancement of knowledge be hindered? Will research participants be harmed? Will universities cease to be trusted, disinterested sources of knowledge and advice? Unfortunately, these questions are not easily answered. Some data available about job creation are available,[117] and a growing number of studies are examining the impact of commercialization (and the attendant emphasis placed upon IP) with respect to scientists' ability to conduct research.[118] But overall, there is far too little evidence in relation to many of the potential effects outlined above.[119]

Even more unsettling is the fact that we simply cannot know (or more precisely, that we are not doing that which is needed in order to know) the effects of this commercialization phenomenon. That is, much of the information we need in order to analyze the effects of these developments is not being gathered. For example, when benchmarking the effects of commercialization of research in public institutions, many of the potential effects outlined above are not being monitored. While the economic benefits of commercialization are commonly traced,[120] and while benchmarks are sometimes used in relation to

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recipients. All provinces provide assistance to people with illnesses that require high-cost drugs: see Colleen M. Flood, "The Anatomy of Medicare" in Jocelyn Downie, Timothy Caulfield & Colleen M. Flood, eds., *Canadian Health Law and Policy*, 2d ed. (Toronto: Butterworths, 2002) at 31-32.

114 For a helpful discussion of models of the role of a university, see Michael Robertson, "Research and Academic Freedom" in John Dawson & Nicola Peart, eds., *The Law of Research: A Guide* (Dunedin: University of Otago Press, 2003) 27.

115 See Jon Alexander & Charles Davis, "Democratic Theory and the Political Incorporation of Higher Education" (1991) 19 Mondes en Developpement 17.

116 Bok, *supra* note 2 at 118.

117 For instance, Shearmur & Doloreux, *supra* note 46 demonstrated that science parks, contrary to expectations, did not foster "high-tech employment" in Canadian cities, remarking at 1076 that

> [t]he proportion of the workforce in high-tech sectors did not grow faster in cities which opened a park: indeed, it can be observed that the significance level of the difference between the 9 agglomerations which opened a park and the 18 which did not actually decreased monotonically between 1971 and 1996. Thus, at the very least, opening a park in the 1980s did not lead these 9 cities to shift their employment structure towards high-tech employment, and an argument could be made that the opposite occurred.

118 The empirical evidence is, even in this limited respect, ambiguous and complex. For example, Blumenthal *et al.* recently found that data withholding is common in biomedical science and takes many forms, but attributed this situation to the "growing commercialization of U.S. universities": David Blumenthal *et al.*, "Data Withholding in Genetics and the Other Life Sciences: Prevalences and Predictors" (2006) 81 Academic Medicine 137. More narrowly, Walsh, Cho and Cohen reported that material transfer agreements typically pose greater problems than IP *per se* in terms of researchers' difficulties in obtaining research inputs: John P. Walsh, Charlene Cho, & Wesley M. Cohen, "View from the Bench: Patents and Material Transfers" (2005) 309 Science 2002 at 2003. See also Christine Vogeli *et al.*, "Data Withholding and the Next Generation of Scientists: Results of a National Survey" (2006) 81 Academic Medicine 128; Lori Pressman *et al.*, "The licensing of DNA patents by US academic institutions: An empirical survey" (2006) 24 Nature Biotechnology 31.

119 Bok, *supra* note 2 at 60-61. See also Slaughter & Rhoades, *supra* note 2 at 330-331.

120 See e.g. Statistics Canada, *2003 Survey*, *supra* note 7.

scientific reputation (e.g., number of papers published and cited)[121] or health standards (e.g., improvements in mortality and morbidity),[122] it is rare to have benchmarks relating to the shaping of what is researched, how research is carried on, and how it is interpreted and reported. Nor do there exist benchmarks relating to the shaping of curricula, profiles of educators, spending, and space in universities. The potential effects on valuable social institutions are not mentioned, let alone considered.[123]

Still more unsettling are recent developments in the reporting of information, ones that actually make it more difficult to assess the phenomenon of commercialization. For example, the definitions of the different kinds of research (e.g., basic, applied, strategic, and experimental) have been changed over time by Statistics New Zealand. This renders it difficult to assess changes in the amount of each kind of research being undertaken, both as a percentage of all research carried out, and as a percentage of research conducted at universities.[124] In addition, the categories of external sources of funding for university research have been collapsed, so that it is no longer possible to determine the percentage of university research that is funded by industry.[125] Similar changes might happen in Canada.

Generalizing somewhat from available documents on indicators, it appears that the realization of potential benefits is being monitored, while the realization of potential risks is not. To start with objectives and then outline outcomes, targets and benchmarks tests only for positive results. Such an approach is like running a clinical trial and testing for efficacy, but not for safety. This would not be allowed in the assessment of a new drug. Should we accept this approach in the realm of social policy? We would argue that we need to monitor for safety and, like clinical trials, we need something analogous to independent data that monitors committees with appropriate expertise (including, for example, the social costs related to the potential effects outlined above).

It must also be noted that even if much of the information were gathered, it might not be shared. As research is commercialized, more and more information about it may become cloaked in claims of "commercial in confidence" and less information may be made available to the public. For example, Statistics New Zealand changed its reporting of external funding for universities "[d]ue to confidentiality reasons" and explained, "we were prohibited to release comparable data for the University sector in 2004 R&D HoTP for source of funds."[126] Again, similar changes could happen in Canada.

A great deal of information is required to make informed decisions about whether this grand social experiment in the commercialization of research in public institutions is a good idea, and is being conducted well. If we never gather and gain access to the information about the realization of potential benefits and harms, we may never get from indeterminate to determinate and from uncertain to certain.

There are still further problems with respect to weighing the potential harms and benefits of the commercialization of research in public institutions. There is both a lack of public debate about the relative value of the various potential harms and benefits, and a lack of independent expert advice in relation to public policy and practice regarding commercialization. In relation to independent expertise, it is revealing to look at the composition of the groups most actively involved in the commercialization of research. It would not be surprising (or inappropriate) for industry organisations to consist solely of those engaged in the industry. However, it is surprising (and arguably inappropriate) for government bodies

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121 See e.g. Milken Institute, "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization: September 2006", online: Milken Institute <http://www.milkeninstitute.org/pdf/mind2mrkt_2006.pdf> at 75-86.

122 Statistics Canada, "Health Indicators" 82-221-XIE (2004), online: <http://www.statcan.ca/english/freepub/82-221-XIE/2005001/pdf/framework.pdf>. See also Andrew Sharpe & Jeremy Smith, "Measuring the Impact of Research on Well-being: A Survey of Indicators of Well-being" (2005), online: Centre for the Study of Living Standards <http://www.csls.ca/reports/csls2005-02.pdf>.

123 Very few people are discussing the potential dangerous effects of commercialization of university research. In a 1999 article, Gary Matkin comments on this issue but tries to use some recent, small-scale examples to predict what could happen in the future. Gary W. Matkin, "University Intellectual Property Management in the 20th Century: How Did We Get Here and Where Are We Going?" (Paper presented to the Conference on Research and Development Investment and Economic Growth in the 20th Century, University of California, Berkeley, 26-28 March 1999), online: University of California Berkeley <http://cshe.berkeley.edu/events/randdconference1999/papers/matkin.html>.

124 Of course, it might be argued that the definitions of "basic", "applied", "strategic", and "experimental" are not appropriate, and that more meaningful definitions for different kinds of research should be adopted. We do not dispute this possibility, but rather seek to highlight the implications for comparative analysis over time with respect to the effects of commercialization that accompany changes in definitions in statistical reviews.

125 See Statistics New Zealand, online: Statistics New Zealand <http://www.stats.govt.nz> (definitions changed, reporting categories collapsed).

126 Email from Daniel Martin, Statistical Analyst, Statistics New Zealand, to Jocelyn Downie (2 June 2005).

and bodies charged with policy-making or advising tasks to be similarly limited in their membership. Yet, consider some past and present examples of such bodies:

- The Council of Science and Technology Advisors (advises the federal Cabinet on the management of the government's science and technology activities);
- The Advisory Council on Science and Technology (aims to "review Canada's performance in research and innovation, identify emerging issues of national concern, and advise on a forward-looking agenda with a view to positioning Canada in an international context"); and
- The Governing Council of the Canadian Institutes of Health Research.

None of these bodies as presently constituted appears to include anyone with expertise in ethics, the sociology of higher education, or other areas relevant to the potential risks of the commercialization of research in public institutions.[127]

If we are to ensure that the social experiment in the commercialization of research in public institutions is consistent with public values, there needs to be more public discussion and debate about the values that we want to see pervade the public research institution sector. Unfortunately, the nature, extent, and impact of the commercialization of research in public institutions is not widely known or understood by the public. Furthermore, some of the government's engagement with the public is problematic, as it seems directed toward advocacy rather than education (and truly seeking the public's opinions on appropriate directions for policy and practice).[128]

So what are we to do? We would argue that we must start by gathering and sharing all of the relevant information pertaining to this phenomenon. We must then involve all those whose interests are at stake in discussions of the relative values, policies, and actions. We must also involve those with expertise relevant to all of the potential effects outlined earlier. We must then ground policies and actions in the arena of commercialization in these discussions (tempered, as needed, with core values found in the *Canadian Charter of Rights and Freedoms* and with surveys of Canadians regarding core values for the health care system).[129] We must then hold the policies and actions to benchmarks directly related to all of the objectives. Brendan Nelson, the Australian Government Minister for Education, Science, and Training said recently: "[W]e should never be frightened of turning knowledge back into money."[130] Perhaps not—but, quite clearly, we should be much more careful.

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127 See Council of Science and Technology Advisers, "Members", online: CSTA <http://www.csta-cest.ca/section.php?ID=3&Lang=En&Nav=Section>; Advisory Council on Science and Technology, "Members", online: ACST <http://acst-ccst.gc.ca/member_e.html>; Canadian Institutes of Health Research, "Who We Are", online: CIHR <http://www.cihr-irsc.gc.ca/e/7263.html>.

128 See e.g. Canada, "Innovation in Canada", *supra* note 15; Advisory Council on Science and Technology, "Public Investment in University Research: Reaping the Benefits", online: Advisory Council on Science and Technology <http://acst-ccst.gc.ca/comm/rpaper_html/report_toc_e.html>.

129 *Canadian Charter of Rights and Freedoms*, Part I of the *Constitution Act, 1982*, being Schedule B to the *Canada Act 1982* (U.K.), 1982, c. 11; "Values Working Group Synthesis Report", in National Forum on Health, Canada Health Action: Building on the Legacy: Synthesis Reports and Issue Papers, vol. 2 (Ottawa: Health Canada, 1997), online: Health Canada <http://www.hc-sc.gc.ca/hcs-sss/pubs/care-soins/1997-nfoh-fnss-v2/legacy_heritage2_e.html>.

130 Brendan Nelson (Address to the National Press Club, Canberra, 24 March 2004), online: <http://www.dest.gov.au/Ministers/Media/Nelson/2004/03/ntscript240304.asp>.