

The Quality of University Research:
Innovation Policy and Funding

OCUFA RESEARCH PAPER SERIES

ONTARIO CONFEDERATION OF UNIVERSITY FACULTY ASSOCIATIONS

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Executive summary

- This research paper highlights the mis-directed approach of the Ontario and federal governments' research and development policies, policies that are reiterated in the platforms of both the Liberal and Progressive Conservative platforms in this Ontario election.
- Ontario's total investment in R&D compares poorly to other industrialized nations. Our investment in research and development, as a proportion of GDP, is 14 per cent below the G7 average.
- Notably, it is our business sector that is underperforming. In Ontario, business R&D spending as a proportion of GDP lags its G7 counterparts by 16 per cent.
- Ontario governments have been trying to encourage business to invest more in R&D by channeling public money into "commercially viable" R&D projects. The Ontario Ministry of Research and Innovation's strategic plan, for example, is geared almost exclusively to aligning "investments in research with industrial needs and opportunities...." Many of these R&D projects are conducted by universities.
- One problem with the Ontario government's approach is that universities are required to support these commercial projects, meaning they have to divert faculty, graduate students, facilities, equipment and money away from basic research. Government policy, therefore, seems designed to encourage business R&D activity and funding on the cheap – and on the backs of universities.
- As a result, our greatest R&D strength – Canada's high level of university R&D spending – is being threatened by government policy initiatives that would require universities to redirect scarce resources from basic research to commercial research. Ontario universities, *lead* the G7 nations in research expenditures by universities – by 36 per cent.
- There is also the even greater danger that commercial criteria will actually hurt our overall R&D results by skewing our research program increasingly away from basic research – the very research that has led to the greatest commercial innovations.
- Strength in basic research is a feature of all strong economies.

- Even the United States – our main competitor and comparator, whose universities are cited as exemplars of commercial performance – is favouring basic research over “development,” that is, commercial projects. American business recognizes the commercial value of independent, university basic research and routinely lobbies Congress for additional funding for it.

In this election, the party platforms recognize the importance of research to Ontario’s economic development. But we need to break from the current approach adopted by successive governments. To turn this pattern around, OCUFA recommends:

1. That the Ontario government invest more in R&D. Ontario needs to increase its total support for R&D to \$944 million next year if it is to meet the G7 average, almost double the amount funded in 2004, the year after the last election.
2. That the Ontario government boost university operating funding so that universities can increase their support for independent, basic research.
3. That the Ontario government increase research funding for universities to \$560 million next year. And \$405 million of this should be dedicated to basic research.
4. That the Ontario government also encourage business R&D – but not at the expense of university basic research. Incentives for business R&D should be independent from university research funding.

Amidst the continuing loss of manufacturing, the relocation of headquarters and the hollowing out of corporate Canada, and continuing proclamations of a productivity gap by business-oriented think tanks, Canadian governments have responded with renewed strategies to leverage knowledge in support of an “innovation” agenda.

Over the past two and half years, the provincial government of Ontario and the federal government of Canada announced significant funding commitments for research and development (R&D). The 2005 provincial pledge is for \$1.7 billion over five years for research, innovation and commercialization. The 2007 federal science and technology strategy announcement outlined funding initiatives worth \$1.9 billion over several years.

The funding is accompanied by plans to further commercialize university research. A plan released by Ontario’s Ministry of Research and Innovation outlines new mechanisms for setting research priorities, allocating funding and assessing performance in research and development.¹ The Government of Canada’s own strategy paper proposes to increase the levels of university-industry collaboration and “accountability.”²

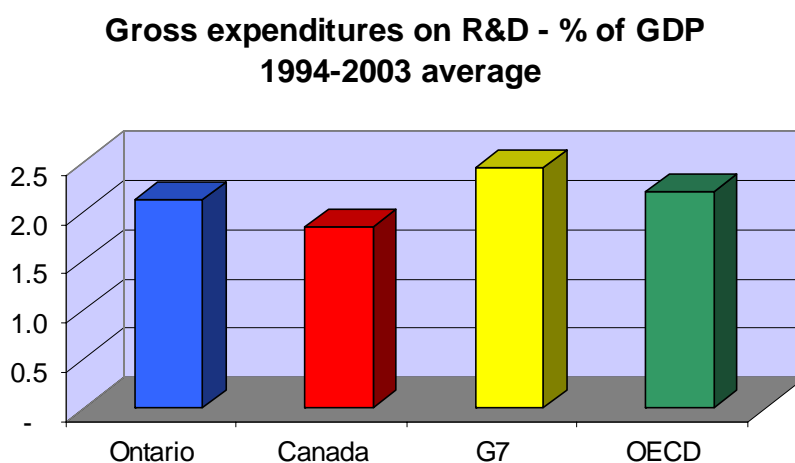
Advancing knowledge can only benefit social and economic objectives. Despite this, evidence on Canada’s and Ontario’s R&D spending and funding shows that government policies are out of step with Canada’s global counterparts. Without substantially increased levels of government funding and programs clearly distinguishing between support for basic research and for leveraging business investment in R&D, government policy is essentially designed to encourage business R&D activity and funding on the cheap and on the backs of universities.

¹ Ontario, Ministry of Research and Innovation, *Strategic Plan*, November, 2006.

² Government of Canada, *Mobilizing Science and Technology to Canada’s Advantage*, May, 2007.

Research and development – the evidence

In Canada, the total amount spent on research and development as a per centage of Gross Domestic Product (GDP) has typically been less than the G7 averages.³ Canada and Ontario are falling further behind the rest of the G7; over 10 years Canada has spent 25 per cent less on all the R&D it conducts than the rest of the G7.⁴ The rate of expenditure on R&D in Ontario is higher than the rest of Canada, but is still 14 per cent lower than the G7.⁵



³ G7 includes: Canada, France, Germany, Italy, Japan, United States, United Kingdom. All averages cited for the Organisation for Economic Cooperation and Development (OECD) and G7 are weighted averages – the total of reported expenditures on R&D over the combined GDP of the reporting jurisdictions – excluding Canada. Except where noted, averages are for the decade 1994-2003. GDP data used are expenditure-based estimates as reported in OECD National Accounts, expressed in US dollars at Purchasing Power Parity (PPP). OECD PPP conversion rates are used.

⁴ Data sources: OECD; Statistics Canada. Data for Canada used in comparison with the rest of the OECD and G7 countries are generally from Statistics Canada sources to provide a common point of reference for comparisons between Ontario and the OECD and G7. OECD and Statistics Canada figures for Canada are not always identical, but close.

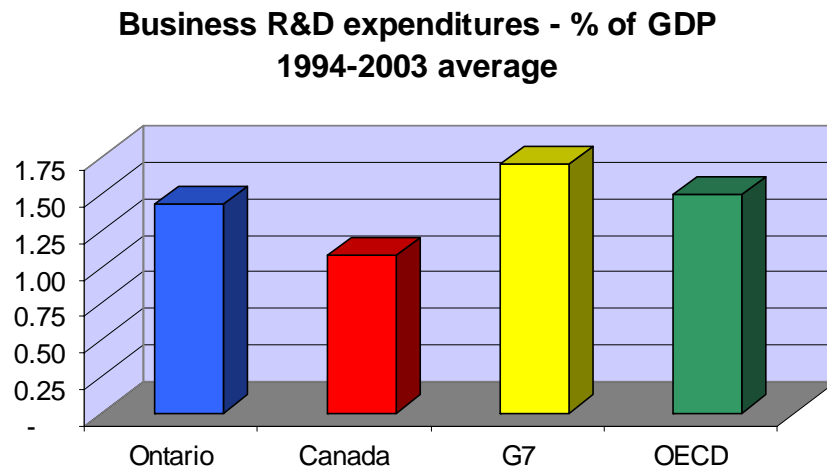
⁵ Compared to the rest of the OECD, Canada's expenditures were 16 per cent less; Ontario's 4 per cent less.

Expenditures by performing sector

Breaking out the data on total expenditures on R&D by “performing sector” (i.e., the sector undertaking the research and incurring the direct costs) shows that business and government are the underperforming sectors. Higher education, in contrast, conducts a significant portion of R&D in Canada.

Business typically spends the most on R&D, primarily on development.

However, business expenditures on R&D in Canada and Ontario lag behind G7 counterparts even more markedly than total R&D spending. Between 1994-2003 Canada’s business spending on R&D trailed 37 per cent behind the G7. Despite a rate of growth in expenditures by Ontario business that exceeded expansion in other sectors, Ontario business R&D was 16 per cent lower than the G7.⁶

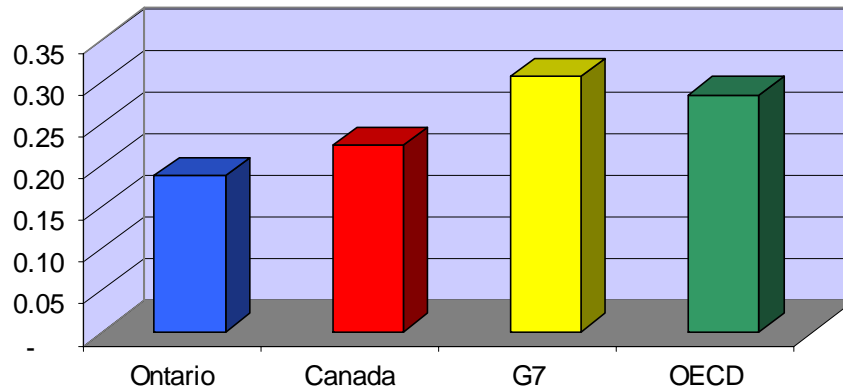


Government expenditures on R&D fall behind other developed countries by a substantial margin. Over 10 years the Canadian government has spent about 27 per cent less than the rest of the G7 on R&D. For Ontario, combined federal and

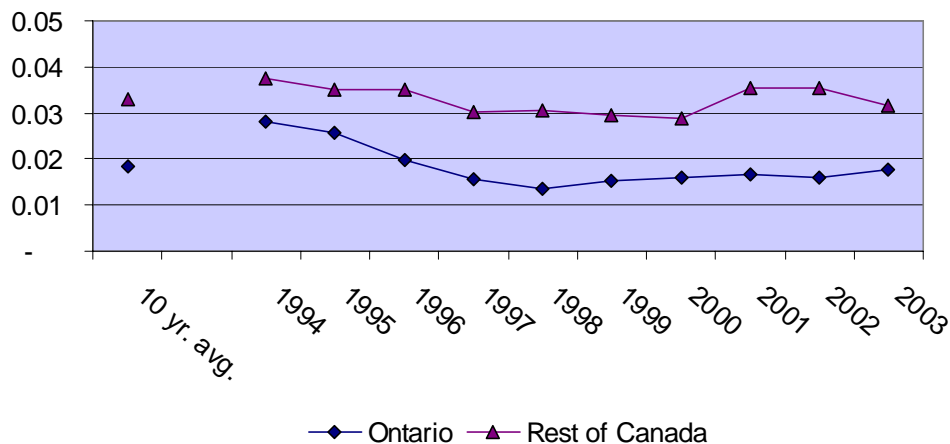
⁶ Compared to the OECD, Canada’s rate was 28 per cent lower, Ontario’s 4 per cent less.

provincial government spending is 39 per cent less than the G7.⁷ Ontario's provincial government expenditures on R&D are 44 per cent lower than the other Canadian provinces.

**Government R&D expenditures -
% of GDP, 1994-2003 average**



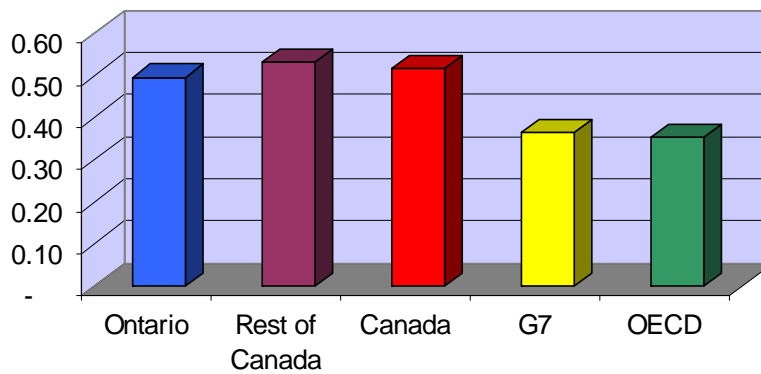
Provincial gov't R&D expenditures - % GDP



⁷ Compared to the OECD, Canada's rate of expenditure was 21 per cent less, Ontario's 34 per cent less. Note also: Statistics Canada collects data on R&D in the National Capital Region (NCR) separately from Ontario and Quebec: *Estimates of Canadian Research and Development Expenditure (GERD), Canada, 1995 to 2006, and by Province 1995 to 2004*, Catalogue no. 88F0006XIE – No. 009, 2006. Virtually all of the expenditures and funding for R&D are by or from the federal government. For this analysis, expenditures within the NCR are allocated to Ontario and the "Rest of Canada" proportionate to Ontario's share of the national Gross Domestic Product.

In contrast, the rate of higher education expenditures on R&D in Canada is 41 per cent higher than other countries in the G7. The rate in Ontario is likewise considerably higher than other G7 countries, by 37 per cent, but it is lower than the rest of Canada by 7 per cent.⁸

**Higher education R&D expenditures - % GDP
1994-2003 average**



University researchers and institutes are the researchers of choice. To some extent, universities may be conducting some R&D on behalf of government and business. If the effect of a possible transfer of government R&D activity is removed, the rate of spending on R&D in higher education in Canada is still higher than across the rest of the OECD and G7.

Such a hypothetical transfer of business R&D activity to universities does not fully account for the lagging levels in business R&D. If the presumed transfer is removed, there is still a deficiency in Canadian business expenditures of 0.3 per cent to 0.4 per cent of GDP. In Ontario the difference is 0.1 per cent of GDP,

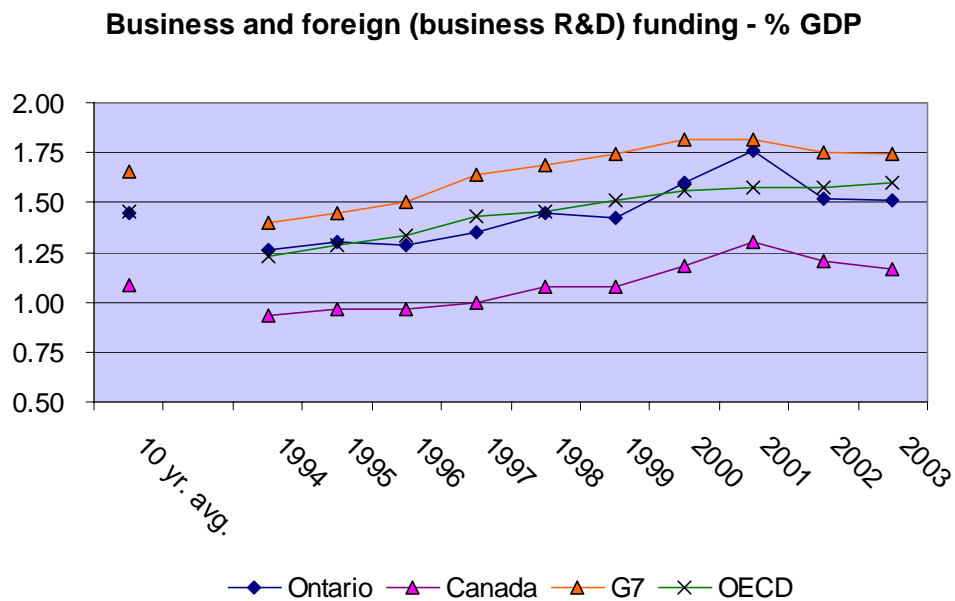
⁸ Compared to the OECD, Canadian levels were 46 per cent higher, Ontario rates were 40 per cent higher.

which could amount to a shortfall in business expenditures on R&D of \$500 million in 2007.

Funding by sector

National differences in who performs R&D are less telling than the differences in who funds R&D. Canada's weaknesses and strengths in funding follow a similar pattern as expenditures.

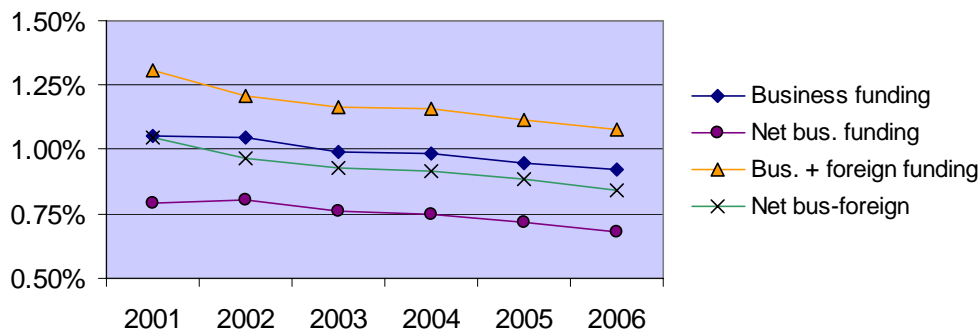
Domestic funding for R&D by business is lower in Canada and Ontario than in other G7 countries. While increases in business funding have improved Ontario's standing relative to the G7, in 2003 the pace of business funding still remained 26 per cent behind other G7 countries. If foreign R&D funding to Canadian and Ontario business is added to business R&D funding, the gap is less. But since 2001, funding from foreign sources has dropped off, with the result that the rate of combined funding in Ontario in 2003 was 13 per cent lower than the remainder of the G7.



The bulk of business expenditures on R&D are funded by internal resources, but businesses may receive two types of support for R&D from governments: direct funding and tax incentives. When government cash and tax credits are subtracted from the amount business actually paid for its own R&D activities, the resulting level of combined business funding and foreign funding to Canadian business is 38 per cent behind G7 averages.⁹

Such figures are not definitive, but they are illustrative of the magnitude of the difference in the willingness of different countries' business enterprises to invest in R&D as a competitive strategy. Even though government support to business as a percentage of GDP has remained relatively constant, since 2002 there has been a steady decline in the level of business and combined business-foreign funding, both before and after government cash and federal tax credits are taken into account.¹⁰

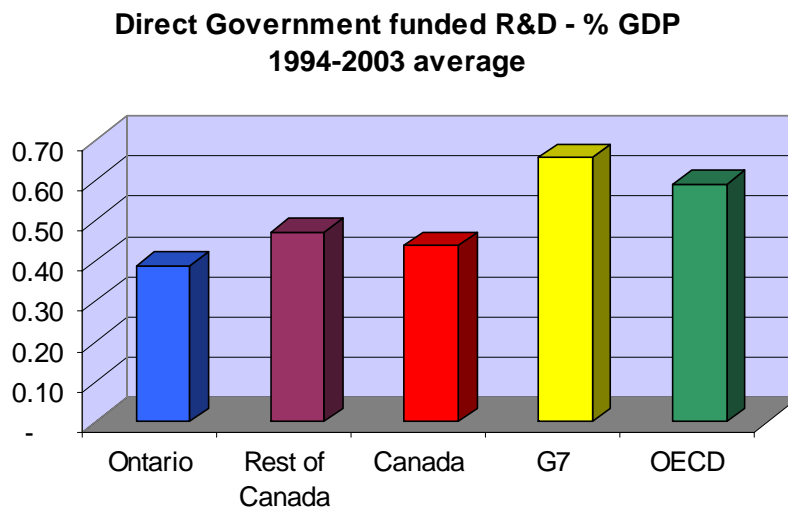
**Business funding & foreign \$ for business R&D,
Canada - % of GDP**



⁹ Indirect government support for business R&D was estimated by applying OECD estimates of tax subsidy rates to business funding for business R&D. Subtracting the result from total business funding indicates effective business funding. For tax subsidy estimates, see Table 35, *OECD Science and Technology Outlook, 2006*. Rates for years for which data are not provided are assumed to be the same as the nearest subsequent year.

¹⁰ For federal scientific research and experimental development investment tax credit data, Canada, Department of Finance, *Tax Expenditures and Evaluations, 2006*: http://www.fin.gc.ca/toce/2006/taxexp_e.html.

The 10-year average level of direct government funding for all types of R&D in Canada is a third lower than G7 counterparts. In Ontario, the lag in funding is even worse – 41 per cent lower than the G7.¹¹ In addition, Ontario’s provincial government funding for R&D has been 23 per cent lower than other Canadian provinces.

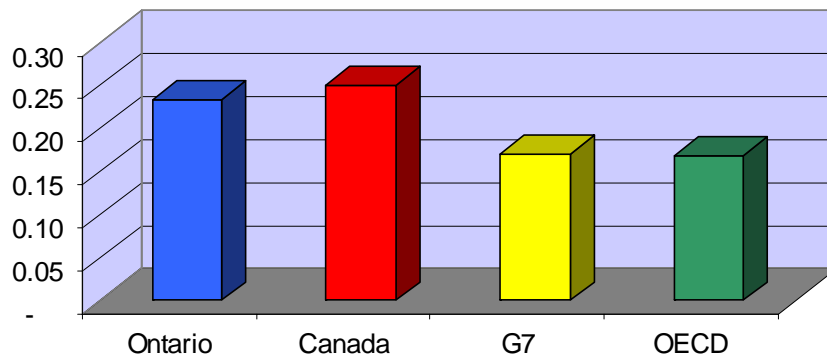


In contrast to the deficit in business and government funding, the rate of funding for R&D by Canadian institutions of higher education is 49 per cent greater than in other G7 countries (shown in the following chart). The difference is less noticeable for Ontario higher education, but the rate of funding still runs 39 per cent higher than the average of G7 counterparts.¹²

¹¹ Compared to the OECD, funding rates are 26 per cent lower in Canada, 34 per cent lower in Ontario.

¹² Canadian higher education institutions fund R&D at a rate 47 per cent more than other OECD countries; Ontario funding rates are 37 per cent higher.

**Higher education funded R&D - % of GDP
1994-2003 average**



Policy directions

It is plain that universities are, in fact, the strongest links in the R&D chain. It should be equally clear that building on that strength in Ontario requires substantially increased support from both government and business. In allocating government funding and seeking to secure greater investment by business, policy development also requires recognition, first, of the importance of basic research to the entire R&D enterprise and, second, of differences in each sector's R&D missions and competencies.

That basic research is an essential element of the R&D enterprise is not contentious. Much applied research and subsequent development follows from basic research. And just as there may be no clear use for the knowledge expected from basic research at the time it is initiated, or a predictable path from theoretical and experimental innovation to implementation, neither is this basic research limited to science and technology.

In a 1999 report to the Ontario government, Dr. Heather Munroe-Blum stressed the importance of basic research. Her report recommended that governments

“create an optimal university research policy environment” because “innovation depends on both basic and applied research and draws on the full range of scholarly disciplines.” She also reminded her readers that strong universities are able to react appropriately to “social and economic concerns” and therefore do not require excessive government supervision.¹³

A vibrant culture of basic research also attracts and retains talent. In addition to faculty, it draws graduate students, many of whom remain in the province to pursue their careers. These are the graduates who become the next generation of faculty researchers and those who bring their knowledge and expertise to the Ontario firms and organizations that activate innovation. In highlighting this, Munroe-Blum is echoed by Mike Lazaridis, President and CEO of Research in Motion, Ltd., and Chancellor of the University of Waterloo:

“The number one reason to fund basic research well and with vision is to attract the very best researchers from around the world. Once here, they can prepare Canada's next generations of graduates, masters, PhDs and postdoctorates, including the finest foreign students. All else flows from this.”¹⁴

The importance of basic research is recognized in other countries. The available data on OECD and G7 countries indicate that expenditures on basic research in all sectors except business R&D have been increasing over the past decade. In the United States, the overall amount allocated to basic research increased by 3 per

¹³ Heather Munroe-Blum, *Growing Ontario's Innovation System: The Strategic Role of University Research*, 1999, pg. 12.

¹⁴ “The Importance of Basic Research,” Re\$earch Money Conference, Ottawa, November 2004.

cent between 1995 and 2004. US federal government funding allocated to basic research increased by 12 per cent.¹⁵

It is universities that form the centre of gravity for basic research. Basic research accounted for an average of 65 per cent of R&D conducted at higher education institutions in the G7 over a decade. In the US, universities conduct even more basic research.¹⁶ In contrast, just 5 per cent of higher education expenditures in the G7 were on development. In the United States, whose university sector is cited as an exemplar of commercial performance, the portion of university spending on development has fallen. Excluding federally-funded research and development centres, university development expenditures fell to 3.5 per cent.¹⁷

There is, to all intents and purposes, a complementary division of labour between universities and business. The amount of money business spends on development and basic research is essentially the inverse of patterns in higher education. In the G7, business spent 5 per cent on basic research, but 74 per cent on development purposes.¹⁸

It follows that a forward-looking policy would contain two key features. First, it would seek to preserve, if not enhance, the role of basic research and a broad spectrum of university research across all disciplines. Second, it would ensure that programs to induce greater business investment would be targeted so as not to compromise the research mission of universities. If it is necessary to establish institutions to bridge any gap between university research and business development, Centres of Excellence for example, these measures must be in

¹⁵ National Science Foundation, *National Patterns of R&D Resources: 2004 Data Update*, NSF 06-327, September 2006.

¹⁶ The ten-year average in the US is 72 per cent.

¹⁷ Including federally-funded R&D centres, the proportion spent on development fell from 15 per cent to 7 per cent. There are no comparable Canadian or Ontario data on basic research.

¹⁸ Each sector spends approximately the same proportion, one-quarter, on applied research.

addition to, not substitutes for, university-based research. By the same token, if greater industry investment in R&D is to be leveraged by providing government financial support, funding programs must be separate from and in addition to those for university research. Achieving a balance means nothing less than adequate funding. In Ontario's case, it requires substantially more funding from government sources.

Policy mis-directions

Rather than expanding the depth and breadth of basic research at Ontario universities, the current provincial strategy is more apt to compel universities, in effect, to subsidize business research and development activities. Without substantial additional government funding for R&D, including for university research, provincial funding criteria that give priority to university-industry partnerships and commercialization of research box universities into the corner of diverting limited research resources away from independently-defined basic research, and toward projects of interest to industry.

Research funding

The first constraint is, simply, the amount of money provided to perform the multiple tasks of R&D. As it is, the ability of Ontario universities to contribute basic and applied research to the R&D enterprise is financially constrained.

The greatest portion of funding for research performed in higher education in Ontario is provided by the institutions themselves from operating funds – about 45 per cent in 2004.¹⁹ Yet Ontario universities have been chronically under-

¹⁹ Internal funding includes faculty time spent on research, support for graduate students and research assistants, and indirect costs such as research infrastructure and administration, for example. Provincial support for indirect costs under the Research Overhead and Infrastructure

funded compared to other Canadian universities and peer institutions in the US. In 2004-05, Ontario universities' American peer institutions received approximately 46 per cent more operating funding (per student) from state governments. For 2008-09 alone, the projected level of provincial operating funding would have to increase by \$1.1 billion to achieve parity.

The United States also has been increasing its significantly greater funding for university research. Meanwhile, Ontario universities' share of funding from the main federal granting agencies has consistently been less than Ontario's share of Canadian GDP. Ontario governments have also been less forthcoming than other provinces with direct research funding.

To match the U.S. level of funding, total federal and provincial government funding for R&D in Ontario higher education would have to increase to almost \$2 billion in 2008-09. If the Ontario provincial government shared in that funding in the same proportion as the other provinces, it would have to commit \$600 million to university R&D activities, or 53 per cent more than in 2004-05. If the U.S. pattern for basic research funding were adopted, \$435 million of the \$600 million would be destined for basic research.²⁰

Six hundred million dollars for higher education R&D is more than the \$490 million the Ontario government provided for *all* R&D in 2004. To reach G7 levels in Ontario in 2008-09, combined federal and provincial government spending on all R&D would have to be \$4.1 billion or 86 per cent above 2004 levels. If, in addition to attaining the level, the Ontario government were to increase its

Envelope has remained unchanged for 20 years, falling from 20.1 per cent to 8.9 per cent of funding from federal granting agencies. Council of Ontario Universities, *Ontario Universities – 2007 Resource Document*. In 2005-06, combined provincial and federal funding for indirect costs related to federal funding was just 21 per cent, well short of the recommended 40 per cent.

²⁰ Future Canada and Ontario GDP estimated using growth projections in 2007 federal and provincial budgets.

funding to provide the same share of the government total as other provinces, it would have to increase its funding by 93 per cent over 2004 levels to \$944 million. If the current pattern of distribution to higher education were maintained, at least \$560 million would be allocated to R&D in Ontario's institutions of higher education, of which \$405 million could go to basic research.

Neither federal nor provincial funding levels are increasing at a rate to ensure the integrity of the university research mission. Federal current funding for 2007-08, plus one-time transfers amounts to a 15 per cent increase over 2004-05 levels.²¹ Provincially, the estimates for Ministry of Research and Innovation transfers, including capital grants, are 37 per cent higher than in 2004-05. Money for commercialization has almost doubled, while current and capital funding dedicated to research increased by only 26 per cent.

Research priorities

Other features of Ontario funding programs channel research into a commercial current. At the most general level, criteria such as "market potential," "emerging technologies," and "industrial strength" identified in the MRI *Strategic Plan* are geared almost exclusively to "align investments in research with industrial needs and opportunities...."

The commercial orientation of the provincial programs is sustained through the composition and role of advisory bodies and the research proposal review process. Representation in the Ontario Research and Innovation Council (ORIC) and the Ontario Research Fund Advisory Board (ORFAB), for example, is almost exclusively from the scientific, engineering and business disciplines. In addition

²¹ To attain the level of government direct funding for all R&D provided in the G7, total Canadian government funding for R&D in 2008-09 would have to be approximately \$10.2 billion, or 68 per cent above its 2004 levels. This is not to be confused with Science and Technology spending levels cited in the federal strategy paper. Science and Technology includes R&D, plus other spending.

to the customary scientific peer review, the MRI plans to add external “experts” to assess research proposals for their “relevance to industry” and “potential for commercialization.”

In this environment, the sciences and engineering receive the bulk of attention as the disciplines most likely to generate research with commercial potential. Like research in the social sciences and humanities, establishing commercialization as a criterion for strategic relevance sets a bar which even basic research in the natural sciences may not achieve.

That process of exclusion and diversion of funds applies also to provincial funding requirements that research projects be based on partnerships and joint funding between universities and the private sector. There are already strong relationships between universities and business in Ontario and the rest of Canada. Since the early 1990s, for example, business support for research in higher education has been greater than in other countries. But the mandatory nature of the funding program effectively allows industry partners leverage over the choice of research subjects. Their buy-in is required for a proposal to be approved. As a result, to secure funds that are tied to private sector participation, universities are enticed to divert limited resources to some disciplines and projects at the expense of others.

Program and research assessment

In addition to the front-end influence of criteria for funding, the Ministry of Research and Innovation’s proposal to measure results reinforces the commercialization agenda. To the extent that private firms stand to gain financially from public funds, it is not surprising that some means of assessing the performance of the private sector and the efficacy of the policy would be part of the overall provincial strategy. Measuring success and research quality by

commercial criteria and the use of indicators and “metrics” is problematic and inimical to the broader university research mission for two reasons.

The first difficulty is ensuring that benchmarks and indicators are appropriate and meaningful. Most economic and commercial indicators simply do not apply to the range of university research. Even where some commercially-related outcomes appear to be linked to university research unproblematically, they may be misleading. The number of patents generated per millions of dollars in research expenditure, for example, will vary between countries simply because of differences in patent law.

It is also difficult to trace such outcomes back to the funding source. Federal granting councils provide the largest share of research funding to universities. It would be inappropriate for provincial bodies to assess general research performance when it includes activities that are supported by other agencies and funded according to other criteria. If provincial funding must be leveraged with funds from a federal granting agency, the effect is equally perversely to extend provincial, commercial, criteria to programs that are a primary source for basic research funding.

Finally, the experience with metrics and research assessment exercises in the United Kingdom, Australia, and New Zealand indicates several shortcomings. Among other things, the process is extremely time-consuming, and may come at the expense of other university functions like teaching and learning. In addition, it discourages long-term planning and development of research capacity. To the contrary, it encourages game-playing by giving incentives to universities to seek short-term advantage, by poaching faculty for example. Such a market atmosphere is not conducive to basic research.

Conclusions and recommendations

Strong economies fund basic research. Innovation in Ontario cannot keep pace with other countries if commercial development of research is funded at the expense of basic research. Policies to foster research and encourage business investment in R&D must ensure adequate funding and be in keeping with the respective roles and competencies of the private and university sectors.

Therefore, research funding and policy for the next Ontario government should include the next steps:

1. Immediately increase direct funding for all R&D activities to levels adequate to ensure that commercial R&D activities are not supported by, or at the expense of, independent university research – basic and applied – across all disciplines. Provincial government funding for all programs should be increased to \$944 million or more for 2008-09. Funding for R&D at universities should be increased to \$560 million at minimum.
2. Establish funding programs and threshold levels of funding for basic research undertaken at universities that are clearly separate from programs that are directed at increasing business activity in R&D. At least \$405 million of the \$560 million should be designated for basic research in 2008-09.
3. Programs for joint university-industry R&D projects should be separate from those supporting general university-based research. Funding for such research partnerships must be in addition to, and not at the expense of, funding for basic research.

4. Future funding should include provisions to increase funding for indirect research funding costs to a level equivalent to 40 per cent of government-sponsored research.
5. Future funding should also include the annual portion of at least \$205 million to match \$510 million Canadian Foundation for Innovation funding announced by the federal government in March 2007.
6. Increase operating funding to universities to facilitate the recruitment, development and retention of the “talent quotient” of innovation.