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UNLEASHING BUSINESS INNOVATION IN CANADA

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By Alexandra Bibbee

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ABSTRACT/RESUME

Unleashing business innovation in Canada

This paper discusses how to improve Canada's business innovation in order to boost labour productivity and output growth. Many general framework conditions are highly favourable to business risk-taking and innovation, including macro stability, openness, strong human capital, low corporate tax rates, low barriers to firm entry and flexible labour markets. However, they can be improved further by reduced external and interprovincial barriers in network and professional service sectors, more efficient capital markets, fewer capital tax distortions and improved patent protection. A second focus should be on ensuring that incentives arising from government subsidies are targeted on actual market failures. The very high level of support to business R&D via the federal Scientific Research and Experimental Development (SR&ED) tax credit and provincial top-ups may affect the incentives of small firms to grow and should be redesigned. A plethora of small, fragmented granting programmes, mainly geared to SMEs, should be streamlined for better government-business collaboration. The large public share in venture capital should be wound down, as it may crowd out more productive private finance. A final focus should be on boosting manager and worker skills that are intrinsic to all forms of innovation, by filling gaps in training, mentoring and education. This Working Paper relates to the 2012 *OECD Economic Review of Canada* (www.oecd.org/eco/surveys/Canada).

JEL classification codes: I23; H25; O31; O32; O34; O38
Keywords: innovation; productivity; multifactor productivity; research and development; intangibles; venture capital; angel investing; business taxes; R&D tax credits; subsidies; academic research grants; vouchers; intellectual property rights; patents; technology transfer; competition; entrepreneurship

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Libérer l'innovation des entreprises au Canada

Cette étude se penche sur la manière de renforcer l'innovation dans les entreprises canadiennes afin de stimuler la productivité de la main-d'œuvre et la croissance de la production. De nombreuses conditions-cadres canadiennes sont très propices à la prise de risques et à l'innovation dans les entreprises : stabilité macroéconomique, ouverture sur l'extérieur, solidité du capital humain, faible imposition des bénéfices des sociétés, rareté des obstacles à l'entrée des entreprises sur le marché, flexibilité des marchés du travail. Ces conditions-cadres peuvent toutefois s'améliorer encore grâce à une diminution des barrières extérieures et interprovinciales dans les secteurs des réseaux et des services professionnels, à une plus grande efficience des marchés financiers, à de moindres distorsions de l'imposition du capital et à une meilleure protection des brevets. Un deuxième axe pourrait consister à s'assurer que les incitations découlant des subventions de la puissance publique ciblent bien les carences effectives du marché. Il se peut que le très fort soutien à la R-D des entreprises représenté par le crédit d'impôt fédéral pour la RS&DE (recherche scientifique et développement expérimental) et par ses compléments provinciaux entame le désir de croissance des petites entreprises ; peut-être donc faudrait-il redessiner ces aides. La kyrielle de petits programmes fragmentaires de subventionnement visant principalement les PME devrait être rationalisée pour améliorer la coopération entre le milieu universitaire et le monde de l'entreprise. Il faudrait réduire la trop grande place des fonds publics dans le capital-risque, car il se peut qu'elle évince des financements privés plus productifs. Un dernier axe devrait, par des actions cherchant à combler les lacunes de formation, de tutorat et d'enseignement, privilégier la stimulation des compétences de l'encadrement et du personnel qui s'appliquent à toutes les formes d'innovation. Ce Document de travail se rapporte à l'*Étude économique de l'OCDE du Canada 2012* (www.oecd.org/eco/etudes/Canada).

Classification JEL : I23 ; H25 ; O31 ; O32 ; O34 ; O38
Mots clefs : innovation ; productivité ; productivité multifactorielle ; recherche et développement ; biens immatériels ; capital risque, tutorat-investissement ; impôt sur les sociétés ; crédits d'impôt pour la R-D ; subventions ; subventions pour la recherche universitaire ; bons, droits de propriété intellectuelle ; brevets ; transferts de technologie ; concurrence ; entrepreneuriat

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The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Unleashing business innovation in Canada

By

Alexandra Bibbee[1]

Innovation is the key long-run driver of productivity and income growth. It is likewise the main means of confronting looming structural challenges in Canada and other OECD countries. Innovation to boost product quality and variety will enable Canada to stay competitive against formidable new global suppliers; innovative breakthroughs in agriculture and energy seem to be more necessary than ever to reach the elusive goal of green growth; and radical cost-reducing innovations in health-care organisation and delivery are needed for the affordable care of ageing populations.

At the same time, global economic forces may be acting to constrain innovation in Canada (Rao, 2011). Alongside sluggish recovery in the OECD, which accounts for the bulk of Canada's export markets, strong non-OECD growth has induced large terms–of–trade shifts for Canada, causing resources to move from areas of increasing returns to scale (tradeable manufactures) to those of diminishing returns (exhaustible resources). This reduces aggregate R&D capacity and contributes to environmental degradation. Competition for highly skilled people worldwide, including by the large emerging markets, is increasing while their supply within the OECD is shrinking due to accelerating baby boomer retirements. This may hamper businesses' ability to innovate and adopt technology. Hence, policies should be oriented to providing a domestic environment that is conducive to innovation and human capital accumulation.

Innovation is most likely to flourish under sound structural conditions. There may be various reasons for more specific public intervention that provides a framework for innovation by private business and accords an appropriate level of protection to its fruits while encouraging their diffusion (OECD, 2007). Public subsidies can help to overcome the failure of financial markets to invest sufficiently in intangible assets, which are hard to value and plagued by information asymmetry problems, yet in the case of business R&D have strong spill-overs. Public policy can further assist the transition to a knowledge economy through provision of vital public goods like education and basic research, while compensating the lower skilled and others who are made worse off as a result of technological change. All OECD countries currently implement a mix of policies aimed at supporting innovation, and many are reinforcing them in light of the global crisis.

1. Senior Economist, OECD Economics Department; e-mail: alexandra.bibbee@oecd.org. This paper is a lightly revised version of Chapter 1 of the OECD *Economic Survey of Canada* published in June 2012 under the authority of the Economic and Development Review Committee. The author wishes to thank Calista Cheung, Bev Dahlby, Andrew Dean, Yvan Guillemette, Robert Ford, Peter Jarrett, John Lester, Alistair Nolan, Creso Sa, Karen Wilson, and Canadian government officials for their valuable comments. Special thanks are due to Shahrzad Mobasher-Fard for assistance in preparing the material on female entrepreneurship, Françoise Correia for statistical research and Mee-Lan Frank for technical preparation.

The Canadian productivity paradox

A striking paradox that has baffled Canadian policy makers and researchers alike is this: despite rich natural and human-capital endowments, generally strong institutions, social capital and policy fundamentals, deep economic integration with the technology leader (the United States), and ample public spending in support of innovation, Canada's business innovation activity is by any aggregate measure lacklustre, and productivity growth has persistently lagged behind that of its OECD peers.

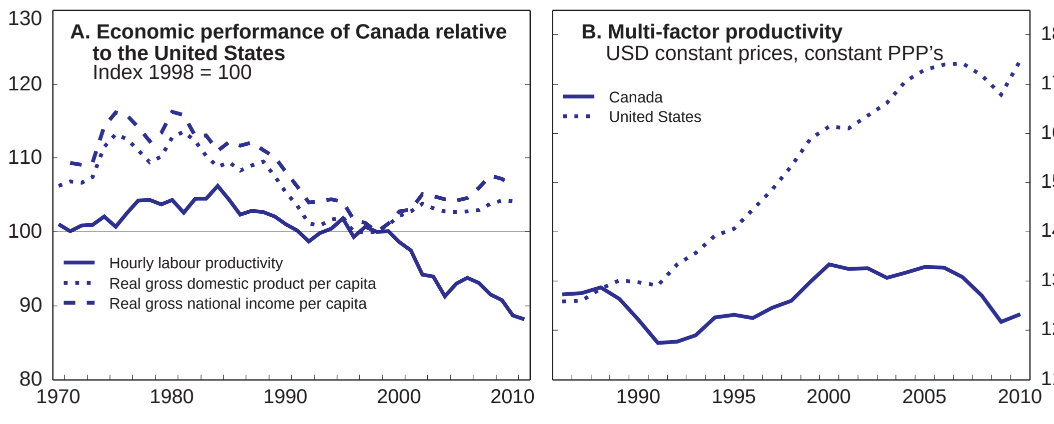
The productivity growth gap is due to MFP

Canada is one of the few OECD countries to trail the United States in productivity growth over a long period of time. Comparisons with the United States are compelling for two reasons. First, similar geography, endowments, free-market institutions, cultural and social affinities, high cross-border labour mobility and close trade and investment linkages might on the whole point to expected convergence rather than divergence. Second, efforts have been made by the Canadian statistical authorities to correct for numerous inconsistencies *vis-à-vis* the United States in the measurement of real output, labour and capital inputs, and although measurement issues remain, notably regarding PPP price deflators, quality adjustments for ICT and capital depreciation rates (Baldwin and Gu, 2009; Tang *et al*., 2010), they may mainly affect comparisons of productivity levels rather than growth rates.

Persistently weaker Canadian productivity growth since around the mid-1980s has opened up a significant and widening gap in productivity levels with the United States (Figure 1, Panel A). As the latter is Canada's major competitor, this has contributed to rising relative unit labour costs in Canada. The Canada-US productivity growth gap can be entirely attributed to a longstanding multi-factor productivity (MFP) growth shortfall (Table 1). Capital deepening, except in the recession of 2008-10, and improvements in labour quality (as measured by changes in educational attainment rates) have been somewhat stronger in Canada. By 2010, the capital intensity of the Canadian economy was some 110% of the US level, whereas MFP was only about two-thirds as large.

Figure 1. **Productivity in Canada relative to the United States**

Total economy



Source: Centre for the Study of Living Standards (2011), *Aggregate Income and Productivity Trends, Canada vs. United States – www.csls.ca/data/ipt1.asp*; calculations from (OECD 2012), WP1 on Macroeconomics and Structural Policy Analysis – Long-term growth scenarios; OECD *Annual National Accounts database.*

Table 1. **Decomposition of Canada-US gap in average annual labour productivity growth**

Differences in percentage growth rates: Canada minus the US, business sector

	1961-2010	1961-1980	1980-2000	2000-07	2008-10
Gap in labour productivity growth	-0.2	0.4	-0.4	-1.7	-2.8
a) Capital deepening	0.3	0.8	0.2	0.1	-1.0
b) Workforce composition	0.2	0.4	0.1	0.1	0.0
c) Multifactor productivity	-1.0	-1.0	-0.6	-1.8	-1.8

Source: US Bureau of Labor Statistics and Statistics Canada.

Over the past few decades, multifactor productivity (MFP) in Canada has been stagnant, and it has even fallen since 2002 (Figure 1, Panel B). Per capita income growth has nevertheless held up thanks to increasing factor utilisation and, since 2003, robust terms-of-trade gains. Regarding the former, and reflecting earlier tax and benefit reforms, female participation has risen strongly, and the share of the population working is now 4 percentage points higher in Canada than in the United States.[2] Capital intensity is also slightly higher in Canada, although it is heavily weighted toward engineering structures to the detriment of machinery and equipment. The composition of output can also affect measured productivity, but weak productivity appears to be spread widely across sectors and therefore controlling for composition still leaves most of the puzzle to be explained (see below).

The MFP lag in turn suggests an innovation lag

MFP is a "black box" residual, but as an empirical matter it captures the main sources of rising living standards over the long term. There is some evidence that it is the product of investments in human capital and innovation (Jones, 2002; Jaumotte and Pain, 2005; Hall *et al.*, 2010). Indeed, MFP growth is sometimes used as a direct measure of innovation (NEC, 2011). MFP can furthermore be broken down into three components: average returns to scale, allocative efficiency effects and a technological residual (Basu, 2010). The last can be viewed as the benefit of innovation proper and depends on factors like public infrastructure, the "free" receipt of knowledge externalities from academe and other firms, management and organisation, human capital of workers and managers, "own" R&D and other investments. Policies to boost productivity should be targeted at all three components: firm growth, resource mobility and innovation. This paper will focus on innovation, though all three channels are mutually reinforcing and tightly bound. For example, adjustments to economic shocks occur via innovations to adapt to the new conditions but also depend on the ability to reallocate resources to successful innovators, allowing them to grow and prosper, while less adaptive firms exit (Andrews and de Serres, 2012). Thus, many factors influencing innovation will also affect resource allocation and growth capacities.

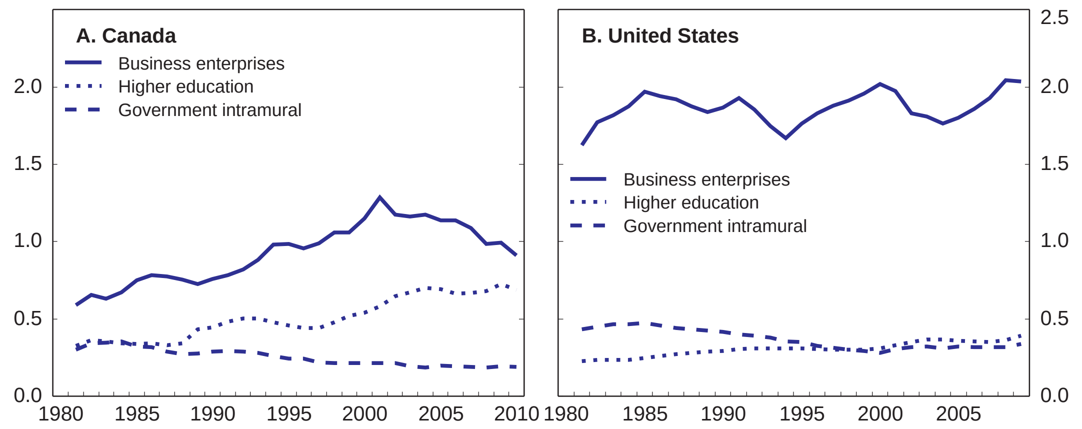
Empirical studies suggest that the Canada-US MFP gap is related to three underlying and interdependent gaps in: R&D; machinery and equipment (M&E) investment, in particular ICT; and human capital, specifically university education attainment of the working population which is 31% higher in the United States (Rao, 2011). Business expenditure on research and development (BERD) is often considered to be the best single predictor of MFP growth (Jaumotte and Pain, 2005). Canada's BERD intensity is less than half of its US counterpart, and since 2001 it has steadily declined, whereas that of the United States initially dipped but then bounced back (Figure 2). Both countries' R&D capacities were strongly shocked by the bursting of the ICT bubble in 2001, but Canada was harder hit by the subsequent commodity price

2. Looking only at the working age population, the share that participates in work is 15 percentage points higher in Canada than in the United States, reflecting that participation of the over-65 population is markedly lower.

boom and exchange-rate appreciation, which induced resources to move from manufacturing (which is R&D intensive) to mining and oil and gas extraction (which are not). Higher education expenditure on R&D (HERD) in Canada has grown steadily since the early 1980s, while government expenditure on R&D (GERD) has drifted downwards; the opposite pattern can be seen in the United States.

Figure 2. **Research and development expenditure**

As a percentage of GDP



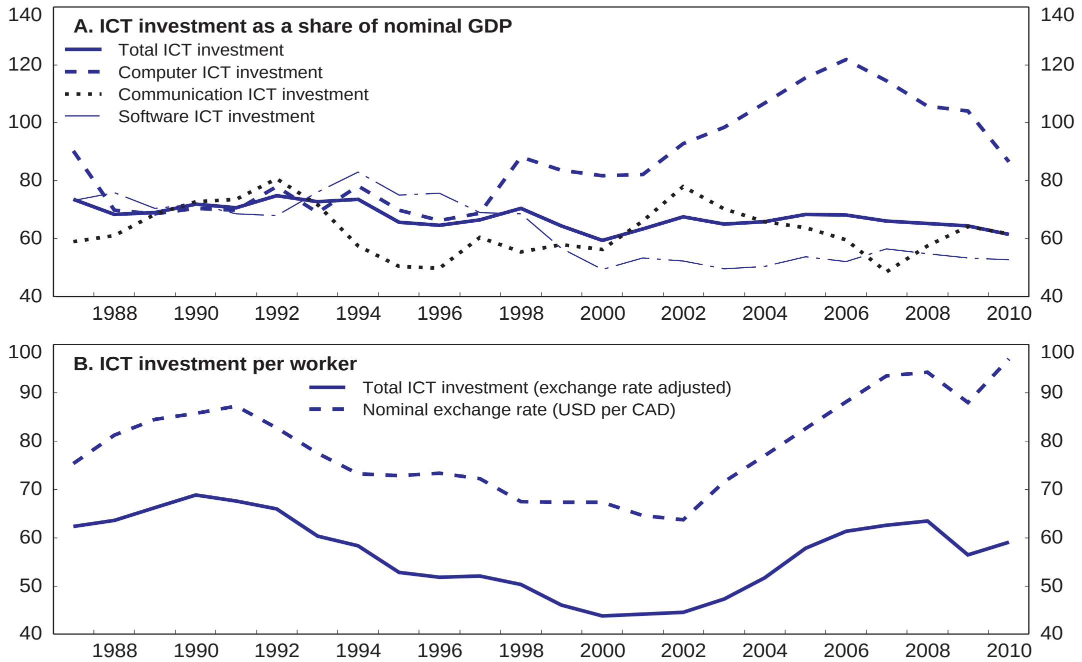
Source: OECD.stat, Main Science and Technology Indicators database.

Research has found a significant positive correlation across Canadian industries between the MFP and ICT capital-intensity gaps (Rao *et al*., 2008; Figure 3, Panel A). The wide gap in ICT investment per worker displays a marked correlation with the exchange rate, likely reflecting that during the long period of currency weakness, the cost of ICT capital (most of which is imported) was inflated relative to the cost of labour, and conversely since the dollar has appreciated (Figure 3, Panel B). A strong Canada advantage in non-M&E, on the other hand, reflects engineering capital (pipelines, utilities, oil and gas sector, etc.), the intensity of which is four times the US level (Baldwin and Gu, 2009).

The Canada–US productivity gap might reflect structural composition, as opposed to a systemic problem. While such structural differences may explain a part of the gap, research indicates that it is not large, whereas the *levels gap in MFP* is widely spread across the economy. Negative gaps are particularly large (30-50% below the US level) in sheltered sectors like utilities, information and culture, arts and entertainment, and professional, scientific and technical services and high-tech manufacturing, which also tend to be highly knowledge intensive and dynamic, exhibiting increasing returns to scale (Table 2). Even though a number of sub-sectors show productivity near or above US MFP levels, notably oil extraction, manufacture of raw materials, food processing, and services open to competition (*e.g.* construction, wholesale trade, waste management), many of these are at the lower value-added end of production.

Figure 3. **ICT investment in Canada relative to USA**

USA = 100



Source: Centre for the Study of Living Standards, database for *information and communication technology*; OECD (2011), *Economic Outlook 91 database*.

Table 2. **Labour productivity, multifactor productivity and capital intensity comparisons**

USA = 100

Sector or Industry	Labour productivity		Multifactor productivity		Machinery and equipment	ICT
	2002	2007	2002	2007	2000-07 average	2000-07 average
Goods sector						
Agriculture, forestry, fishing and hunting	85.5	86.4	82.8	86.2	70.5	79.1
Mining	88.9	88.0	79.3	72.5	80.0	31.2
Mining, except oil and gas industry	58.1	47.3	52.2	39.4	57.0	35.1
Oil and gas extraction industry	87.9	81.6	94.9	100.3	100.5	25.6
Utilities	76.5	62.7	53.9	49.0	51.0	73.6
Construction	149.5	192.5	151.8	196.9	79.2	14.7
Manufacturing	84.4	73.2	91.1	77.2	91.1	36.6
Service sector						
Wholesale trade industries	73.7	90.0	97.8	120.3	29.9	45.6
Retail trade industries	81.3	75.6	95.3	85.5	70.4	72.1
Transportation and warehousing industries	123.8	108.1	112.5	96.7	86.8	19.7
Information and cultural industries	64.5	46.6	69.9	52.3	82.8	98.5
FIRE** and management of companies industries	70.0	72.1	75.7	74.9	105.4	72.2
Professional, scientific and technical services industries	45.4	38.6	54.0	47.6	45.7	42.3
Administrative and waste management industries	113.5	107.6	144.1	126.2	39.9	49.9
Education, health care and social assistance industries	99.4	95.9	102.0	98.0	34.2	17.8
Arts, entertainment and recreation industries	39.6	39.0	49.4	47.9	39.3	128.7
Accommodation and food services industries	74.1	72.2	85.2	78.8	28.3	47.1
Other services (except public administration) industries	145.3	143.8	181.6	178.3	61.1	102.1
Average for all sectors and industries (business sector)	**77.3**	**72.1**	**75.4**	**68.5**	**74.5**	**47.9**

** FIRE stands for finance, insurance, real estate and leasing.

Source: Tang *et al.* (2010).

Given the sheer magnitude of the 2002-12 terms of trade uptrend, it could be hypothesised that the decade's fall in MFP is just a composition effect in response to the workings of comparative advantage. However, over time, the within-sector effect appears to dominate the effect of changes in composition for the business sector as a whole (Table 3). Much of the weakness is accounted for by the mining sector, where MFP fell by over 6% at an annual rate as high oil prices made profitable the exploitation of marginal reserves of a depleting resource.

Table 3. **MFP growth decomposition**

	Value-added share		MFP (index 2002=100)		Within-sector effect	Shift-share effect[1]
	2000	2008	2000	Per cent annual growth 2002-08		
Agriculture, forestry, fishing and hunting	2.9	2.4	109.7	1.68	0.05	-0.51
Mining and oil and gas extraction	7.9	13.4	110.3	-6.25	-0.49	5.68
Utilities	3.4	3.0	91.7	0.34	0.01	-0.40
Construction	6.5	9.3	94.8	-0.72	-0.05	2.68
Manufacturing	24.4	15.0	102.3	-0.71	-0.17	-9.49
Wholesale trade	6.6	6.8	96.6	1.84	0.12	0.14
Retail trade	6.7	7.2	93.5	1.56	0.10	0.52
Transportation and warehousing	5.7	5.4	102.4	-0.51	-0.03	-0.31
Information and cultural industries	4.2	4.3	93.1	2.25	0.09	0.10
Finance, insurance, real estate and renting and leasing	14.1	14.2	99.5	0.04	0.01	0.13
Professional, scientific and technical services	5.7	6.3	99.0	-0.33	-0.02	0.63
Other services (except public administration)	12.1	12.8	98.6	-0.62	-0.08	0.65
Business sector	100.0	100.0	100.0	-0.60	-0.45	-0.18

1. Includes interaction term.

Source: Statistics Canada.

Firm dynamics and economies of scale also matter

Firm turnover and growth are an important source of MFP growth. For the United States and other countries, entry and exit rates facilitate aggregate productivity growth by the process of creative destruction. This process may not be as effective in Canada as in the United States. Specifically, Leung and Cao (2009) find that, contrary to the United States, job creation and destruction are negatively correlated in Canada, implying that job destruction following economic shocks is associated with slower redeployment, and possible product- or labour-market rigidities.

A major source of firm dynamics is also in the middle of the size distribution. There is little direct evidence as yet on the impact of firm dynamics on the Canada-US productivity gap (Rao, 2011). However, the unincorporated sector (sole proprietorships and partnerships) is responsible for a sizeable portion of the Canada-US productivity gap: self-employment, which is less productive than in the United States, is relatively high in Canada, and partnerships are much less productive. As unincorporated firms are often at the first stage in their life cycles, the gap in productivity could reflect not so much a lack of entrepreneurs at the early-development stage as a failure to grow this dynamic group, *e.g.* due to smaller market size. It is also possible that tax incentives encourage the more productive small firms to incorporate more frequently in Canada or paid workers to become self-employed (Baldwin *et al.*, 2011).

The state of innovation

Innovation is a multifaceted activity and difficult to measure because of the intangible nature of its output, which is new knowledge proximately and productivity (MFP) ultimately. Available indicators show a mixed picture of Canadian performance, with strong basic research but weak commercial pay-off.

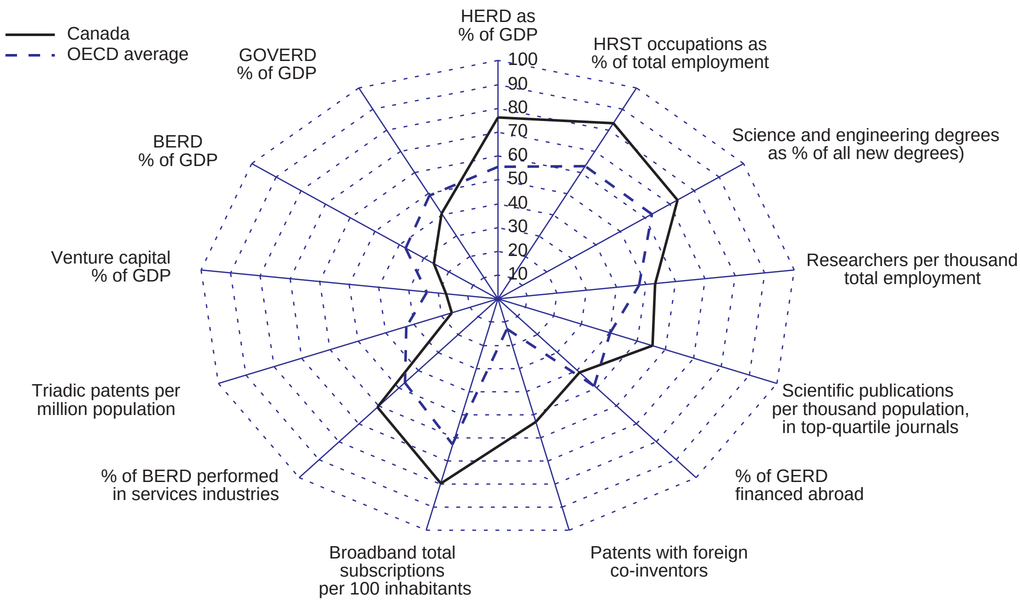
The innovation ecosystem

The public supply of knowledge

The public supply of knowledge is rich in Canada, as measured by two key indicators: scientific articles per capita (quality adjusted for journal ranking) and spending on higher education R&D in proportion to GDP (HERD), which is fourth highest in the OECD (Figure 4). The public education system has likewise apparently kept up with the needs of the knowledge economy. The workforce displays a high share of human resources in science and technology (HRST). Science and engineering degrees, as well as the number of researchers, are slightly above their OECD averages. BERD and patenting, which are positively correlated, are two areas where Canada does not perform well compared to other OECD countries, on the other hand. This might seem surprising, given the quality of its human capital. It should nevertheless be noted that Canada performs well compared to other OECD countries for the incidence of innovation, as measured by innovation surveys (OECD, 2009; see also Figure 5 below). The relatively high level of broadband penetration should also provide critical infrastructure for innovation diffusion (Figure 4).

Figure 4. **Science and innovation profile of Canada[1]**

2010 or latest available year



1. For each indicator in the radar graph, the OECD country with the maximum value is set at 100 (with a position on the outer ring of the radar). The average is calculated by taking into account all OECD countries with available data.

Source: OECD.dat; OECD Science, Technology and Industry Outlook 2010; OECD Science, Technology and Industry Scoreboard 2011.

Making Canada a global science and technology (S&T) leader has long been a policy objective, one that, as just seen, has to a large extent been achieved in the realm of academic output. Support for innovation ranks very high on the list of government priorities, and it has been appropriately protected from the 2012 budget cuts. The federal government supports research in Canada mainly via the National Research Council (NRC) and the three granting councils (NSERC, SSHRC, CIHR for the natural, social and health sciences, respectively). The 2007 federal science and technology strategy identified four areas of public research focus, namely energy, environment, health sciences and ICT, and called for an expansion of human capital in STEM subjects (science, technology, engineering and mathematics), backed up by increased funding to public research in all subsequent budgets (Government of Canada, 2007). To increase the effectiveness of public research, the strategy expanded public-private partnerships, notably in the framework of the networks of centres of excellence.

The imbalance between world class academic research and lacklustre business R&D has led policy makers to re-examine the linkages between academe and business. The government has commissioned three major reports covering areas of: competition policy (Competition Policy Review Panel, 2008); business innovation strategy (Council of Canadian Academies, 2009); and R&D policy (the Jenkins panel: Independent Panel on Federal Support to R&D, 2011). Many of the recommendations put forward by these reports have been or will be appropriately implemented. The recent Jenkins report for the federal government (IPFSRD, 2011) recommended that the NRC be reconfigured to be more focused on demand-driven applied research better able to serve the needs of business. This refocusing has already gotten underway, and in its new budget the federal government has committed to carrying it further.

In conclusion, innovation policy as a whole is still mainly viewed through a traditional S&T lens, centred on the universities, though this is slowly changing in line with growing recognition of a commercialisation gap between academic and applied research.

Business demand for innovation

Innovation covers a broader range of science-based investigative activities than just R&D, extending also to non-scientific forms of knowledge creation with commercial and social value potential. The knowledge produced by R&D is mostly patentable, and its key characteristic is novelty.[3] Most business R&D occurs in the pre-commercial experimental development phase, whereas most basic and applied research is undertaken by university and public sectors (IPRFSRD, 2011; MacIntosh, 2012). Engineering and production departments often contribute to innovation in its earliest stages, suggesting ideas that are later developed by R&D departments (Baldwin *et al.*, 2009). Later stages of the innovative process concern mainly the implementation of the new concept, *i.e.* its integration into production. Non-R&D scientific activity usually encompasses such later pre-commercialisation stages. IP is also purchased for later commercialisation via licensing of patents, contracting out of R&D and other professional (*e.g.* business, engineering, architectural) services to other firms or academe. Software and related database development occurs within firms or it may be outsourced. With the increasing importance of services sectors to economic output and innovation activity, organisational and managerial innovations, as well as training and marketing, are gaining in importance relative to product and process innovation that are chiefly associated with manufacturing. Design is increasingly a key component of innovation in all its aspects, and many countries are giving it greater policy prominence (Diamond and Lewis, 2011). This is not to say that the traditional interest in R&D is becoming any less important. If anything this focus will grow, as revolutionary innovations will almost always be science and technology based, even in services.

3. R&D, as defined, pertains to basic and applied research and experimental development geared toward the acquisition of new knowledge and the resolution of uncertainty concerning its practical applications.

However, significant measurement issues are involved in capturing of innovation inputs more broadly (Box 1). According to experimental Statistics Canada data, business R&D represents only about one-quarter, and purchases of intellectual property (IP) another quarter, of all estimated intangibles investment (Table 4). A key missing link, as also suggested by preliminary OECD cross-country data (Table 5), may be managerial ability to commercialise knowledge developed within Canada.[4] Within firms, this also may reflect managerial failure to make fullest possible use of human capital. Furthermore, adapting technology from abroad may be less productive than performing "own" R&D, given that spill-overs from the latter are likely to be much larger (Andrews and de Serres, 2012). The large numbers of S&T personnel not performing R&D (Figure 4) may be engaged in less productive adaptive and implementation activities.

Box 1. **Capturing innovation inputs through intangible investments**

Statistics Canada (Baldwin *et al.*, 2009) has made estimates of business-sector intangible investment including the full scope of science-based innovation along with advertising (branding) and resource extraction. Over the past three decades, business investment in intangibles has grown markedly faster than in tangibles, and by 2001 outweighed business fixed investment in importance (Table 4). Over the entire period, R&D represented only about one-quarter of total innovative investments, purchases of external IP another quarter and non-R&D scientific activity plus a small amount of software the other half. Manufacturing and services (notably professional, scientific and technical services) accounted for the bulk of R&D investments and of non-R&D scientific in-house investigations, in roughly even amounts. Services as a whole were much more heavily engaged in advertising and software investments. Purchases of external IP were mainly carried out by manufacturing where it is notably larger than in-house R&D; this may in part reflect the large auto sector, which tends to import its R&D from its US and Japanese parents. It is also very significant in the construction sector, which outsources virtually all of its architectural and engineering IP. Mining and exploration activities, which, though not classified as R&D or even as scientific innovation, are constantly being adapted to new challenges and contain a high degree of sophisticated science and engineering content. Emerging high technologies that are attempting to limit the environmental damage wrought by resource extraction involve a significant amount of measured R&D, moreover (STIC, 2011).

The OECD has published experimental figures on intangibles for a set of OECD countries, including Canada, for around the year 2006 (Table 5). Following a slightly different classification than above (narrower for R&D and broader for branding activities and including economic competencies like worker training and organisation capital), it shows less but still sizeable intangible investment in Canada, not far behind the United States and Japan and significantly higher than in the European Union or Australia. The OECD figures also suggest that Canada's main lag *vis-à-vis* the United States is to be found in managerial, marketing and organisational rather than scientific human capital. They also point to a strong lead by Canada in total intangibles investments *vis-à-vis* the OECD average. The fact that it is not reflected in relative productivity performance reinforces concerns about the quality of science-based innovation and/or the ability to commercialise it.

Intangible investment should cumulate to a stock of knowledge assets entering the economy's production function. Currently, intangibles expenditures are subtracted from revenues as an expense rather than added to demand as an investment (except for software and mineral exploration). But, insofar as they provide a flow of services lasting more than one accounting period, they should properly be considered as investment rather than intermediate expenditures, albeit with depreciation rates presumably much higher than for physical capital. If all intangibles were to be reclassified as investment, this would significantly boost GDP and productivity measures. If all countries were to do this, Canada's relative productivity performance might improve, given its strong intangibles investment flows, though early estimates of the GDP impact of capitalisation of intangibles suggest otherwise (Andrews and de Serres, 2012). R&D expenditures have indeed been capitalised in the 1993 System of National Accounts (SNA93), though only in the satellite accounts.[5] This area remains a significant challenge for statisticians.

4. There have been numerous cases, *e.g.* canola oil, in which Canada developed the technology but failed to commercialise it, ending up having to pay large royalties on foreign patents (CIC, 2011).

5. This is changing. On 1 October 2012, Statistics Canada published a revised set of national accounts which included, *inter alia*, R&D as an investment item on the expenditure side of the accounts. Business and government R&D investments picked up the level of nominal GDP by some 2 ½ per cent in the new base year 2007, and R&D has grown faster than tangible investment up until 5 years ago when it slowed.

Box 1. **Capturing innovation through intangible investments** (*cont'd*)

Table 4. **Intangible investments**

Business sector, as per cent of GDP

	Advertising	Mineral exploration	Innovation science				Total science	Total intangible investment
			Purchased science and engineering	Own-account				
				Research and develop-ment	Software	Own-account other science		
1981	1.5	0.5	1.9	1.5	0.2	2.7	6.4	8.3
1985	1.6	0.5	1.8	1.6	0.3	2.9	6.7	8.7
1990	1.9	0.3	2.2	1.6	0.5	3.1	7.4	9.6
1995	1.7	0.4	2.1	1.9	0.7	3.0	7.8	9.9
2001	2.1	0.8	2.6	3.6	0.9	3.2	10.3	13.1
Avg 81-01	**1.8**	**0.5**	**2.1**	**2.0**	**0.5**	**3.0**	**7.7**	**9.9**
of which (%):								
Goods	36.2	100.0	80.3	45.6	20.0	47.1	54.0	53.1
Services	63.8	0.0	19.7	54.4	80.0	52.9	46.0	46.9

Source: Baldwin *et al*. (2009).

Table 5**. Intangible investments, selected OECD countries**

Business sector, as a per cent of GDP

	Compute-rised informa-tion	Innovative property				Economic competencies				**Total**
						Brand equity				
	Software	Scientific R&D	Mineral explora-tion	Copyright and licence costs	Other product develop-ment design and research	Adverti-sing	Market research	Firm specific human capital	Organisa-tion capital	
Australia (2005-06)	0.77	0.82	0.26	0.07	1.10	0.76	0.11	0.45	1.57	5.90
Canada (2005)	1.03	1.83	1.14	0.11	1.92	0.40	0.09	2.15	1.11	9.78
Japan (2005)	2.14	2.88	0.00	1.01	1.94	1.14	n.a.	0.38	1.18	10.67
United States (2007)	1.38	1.82	1.01	n.a.	1.82	1.43	n.a.	4.01	n.a.	11.43
EU27 + Norway (2005)	1.04	1.04	n.a.	0.83	0.48	0.61	0.32	0.53	1.63	6.49

Source: INNODRIVE Intangibles Database, May 2011, http://www.innodrive.org/; Fukao, K., T. Miyagawa, K. Mukai, Y. Shinod and K. Tonogi (2008), "Intangible Investment in Japan: New Estimates and Contribution to Economic Growth, http://www.euijtc.org/news/events_2007/20080719/Fukao.pdf.; Barnes, P. and A. McClure (2009), "Investments in Intangible Assets and Australia's Productivity Growth", Australian Government Productivity Commission Staff Working Paper, Canberra, Australia; Corrado, C.A., C.R. Hulten and D.E. Sichel (2006), "Intangible Capital and Economic Growth", National Bureau of Economic Research, Working Paper 11948; Belhocine, N. (2009), "Treating Intangible Inputs as Investment Goods: The Impact on Canadian GDP*", IMF Working Paper,* WP/09/240, November.

System performance

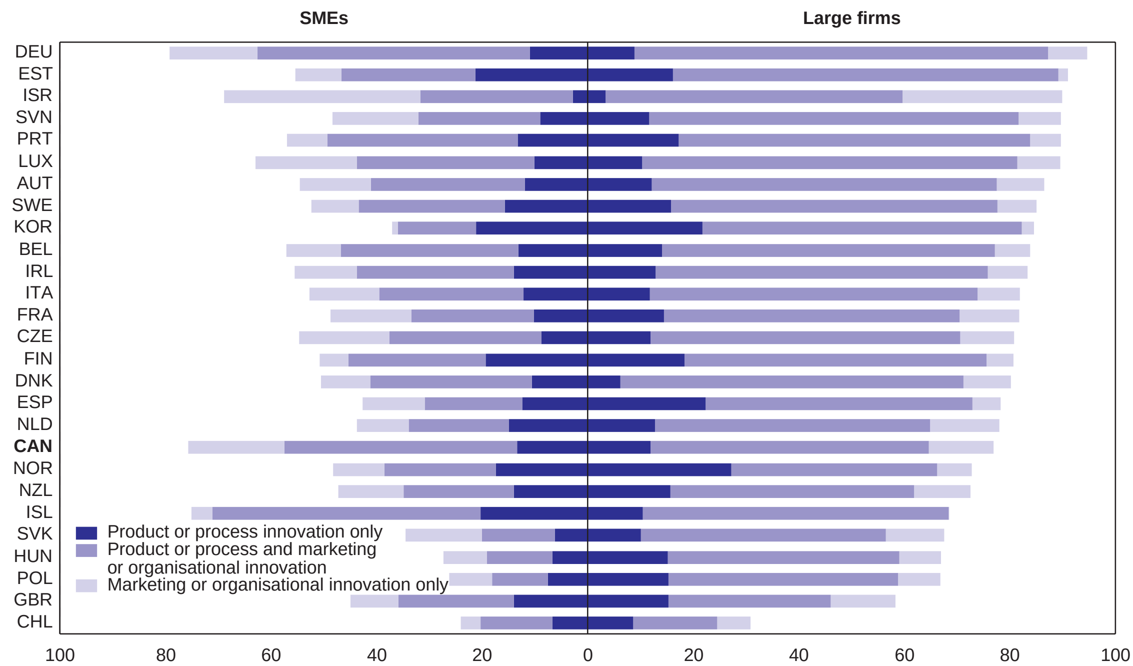
Although total intangibles investment appears to be ample, the weak (and indeed, negative) rate of MFP growth may imply a relatively unproductive pattern of innovation. For example, there may be too many S&T human resources devoted to engineering processes in industries of declining MFP (Figure 4), and – despite many outstanding exceptions – too few efforts devoted to original R&D or organisational (workplace, global supply chain, etc,) innovations may be holding back MFP growth. Furthermore, the fact that BERD intensity is comparatively low and declining, whereas fiscal support to BERD is substantial and rising, suggests either inefficiency of such policies and/or countervailing barriers to innovation.

Firm-level evidence

The 2009 Canadian *Survey of Innovation and Business Strategy* (SIBS) (Government of Canada, 2011), based on updated notions of the OECD's Oslo manual (OECD and Eurostat, 2005), indicates that a large share of firms in all sectors introduced one of the four types of innovation – product innovation (creating new products), process innovation (producing more efficiently), marketing and organisational innovation – between 2007 and 2009. Comparing across firm sizes and with other OECD countries, this share was particularly high among SMEs (Figure 5), possibly reflecting the large proportion of public support devoted to SMEs (see below). The SIBS also substantiates complementarities in the different types of innovation and between innovation and other business activities – product innovations being frequently coupled with organisational and marketing activities, a result also found in the EU Community Innovation Survey (CIS) – and the greater likelihood that manufacturing rather than

Figure 5. **Innovation strategies by firm size, 2006-08**[1]

As a percentage of all SMEs and large firms



1. Canada, 2007-09; Chile, 2007-08; Korea, manufacturing, 2005-07; New Zealand, 2008-09.

Source: OECD (2011), *Science, Technology and Industry Scoreboard 2011*.

non-manufacturing firms will adopt advanced technology. The survey also gives some perspective on what businesses themselves see as the main challenges to their ability to innovate effectively. Respondents have identified uncertainty and risk as the biggest obstacles to innovation, followed by lack of skills and then lack of internal financing. Regulatory issues and IP protection were not seen as major problems, though the former is relatively more important for medium-sized firms and the latter for larger firms.

Research has tried to assess the relative output benefits from product versus process innovation, with possible policy implications. Jaumotte and Pain (2005) find (at the macro level) that product innovations have higher productivity impact. OECD (2009), using firm-level microeconomic data, also finds that product innovations are highly productive in terms of sales per employee, while process innovations reduce productivity, at least in the short run, perhaps reflecting transition costs. Van Leeuwen and Klomp (2006) using CIS data for the Netherlands, obtain a similar result and suggest that it may reflect a missing endogenous employment response (*i.e.* process innovation causes unit labour use to fall but total employment expands due to increased competitiveness in output markets). The latter study also finds: *i*) a strong impact of innovation output (measured as sales of innovative products) on demand and thereby on MFP growth, suggesting that science is relevant mainly for the explanation of inputs into innovation, but that the use of market sources for technological inspiration (customers, suppliers or competitors) contributes more directly to innovation output and MFP; but also *ii*) a sizeable impact of permanently performing R&D on the level of innovation output (absorptive capacity hypothesis). Such studies seem to confirm the importance of all types of innovation and their joint use.

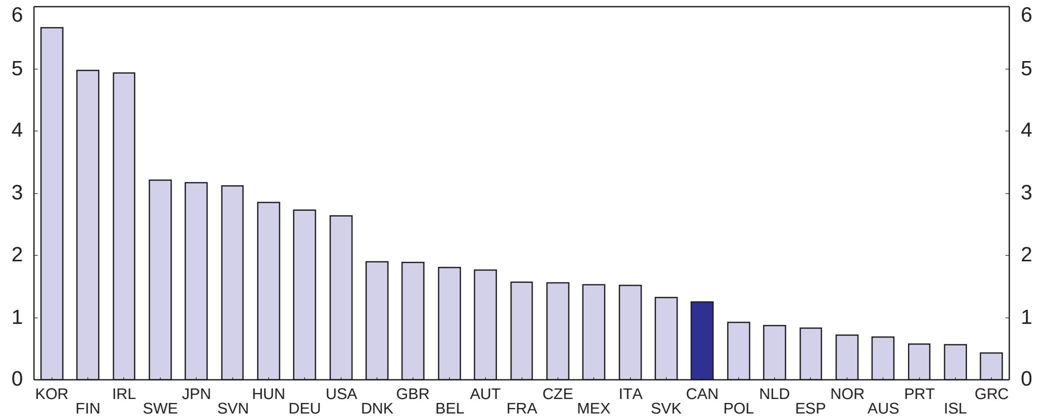
What seems needed is more research on the economic and social benefits of the main types of intangible investment (R&D, organisational, purchased S&T, non R&D scientific activity, software, mineral exploration, branding); the OECD is in the early stages of just such a project (Andrews and de Serres, 2012 and OECD, 2012b). Early research supports the hypothesis that investment in ICT is a important driver of MFP, because it is the vehicle through which innovations are put to use, implying important complementarities (spill-overs) between R&D, human capital accumulation and ICT investments (Rao, 2011). Corrado *et al.* (2012) find strong positive interaction effects between ICT and intangible investments in the determination of MFP growth in a panel of European countries plus the United States. These authors suggest that countries may benefit from tax breaks to software in addition to those often given to R&D and training, whereas the major tax advantages typically given to tangible capital are less warranted given the lack of spill-over from such investments.

International comparative advantage and natural resource intensity

A large technology deficit on the balance of payments (CIC, 2011) and comparatively many patents with foreign co-inventors (Figure 4) are likely to reflect structural features of Canada's "branch plant" economy, *i.e.* the strong role of US subsidiaries that frequently draw on technology flowing from the United States. Innovation could thus be viewed as a comparative advantage of the United States, with Canada importing R&D from the technology leader (as an early adopter), while supplying resources and resource-based semi-finished goods for export. However, absorptive capacity requires that a critical mass of innovation be performed within the technology-importing country itself. Empirical work has identified two significant effects of R&D on productivity and growth: the first is a direct effect of R&D on innovation creation and the second an indirect influence through the absorption of new technology. The importance of the indirect effect depends positively on the distance from the world frontier of each industry (Nicoletti and Scarpetta, 2003). While Canada is at the forefront of a number of industries, notably those that are natural resource based, it appears to be rather far from the R&D-intensive high-tech manufacturing frontier (Figure 6); it follows that Canada should raise industrial R&D in order to better exploit the indirect benefits of absorption, whilst moving toward the technology frontier through innovation.

Figure 6. **Share of high technology manufacturing in GDP**

2009 or latest available year

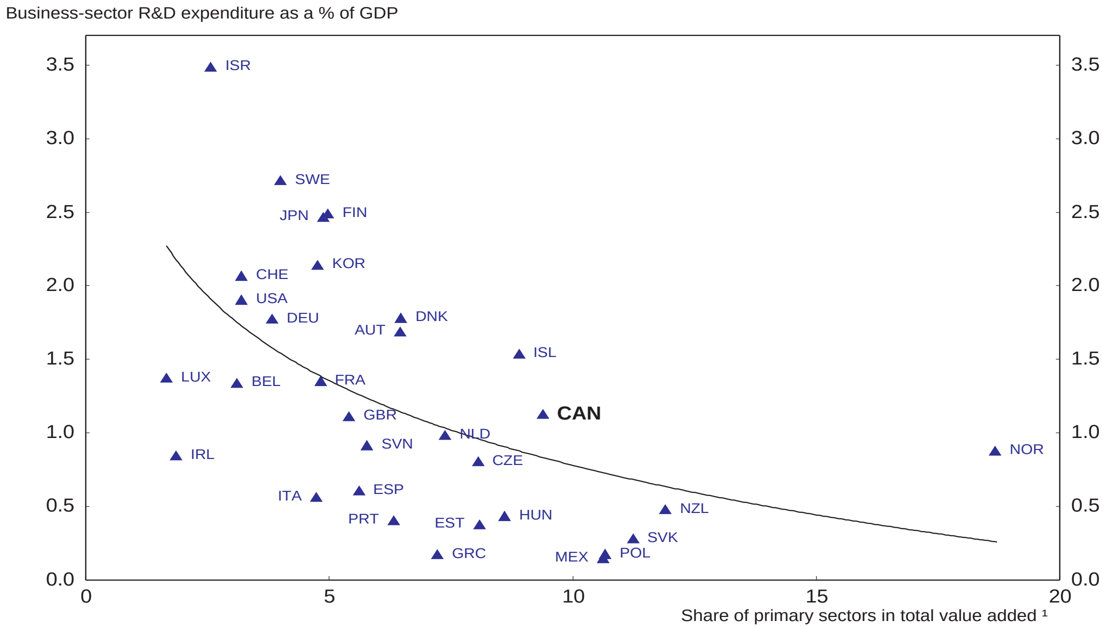


Source: OECD.stat, STAN database and OECD, Economic Outlook 91 database.

Natural resources may matter for innovation propensity. It is indicative that resource-rich countries like Canada, New Zealand and Norway all appear to underperform when it comes to innovation (controlling for GDP), whereas their resource-poor counterparts like Israel, Korea and Japan, are highly innovative (Figure 7). This may reflect a level of per capita income that is "too high" owing to resource rents, boosting the denominator of the BERD-intensity ratio. But the presence of resource rents might itself dull the drive to innovate, by attracting labour and capital to less BERD-intensive sectors like mineral exploitation, refining and transportation.

Figure 7. **Business R&D intensity and natural resource intensity**

Average of 2000 to latest available year



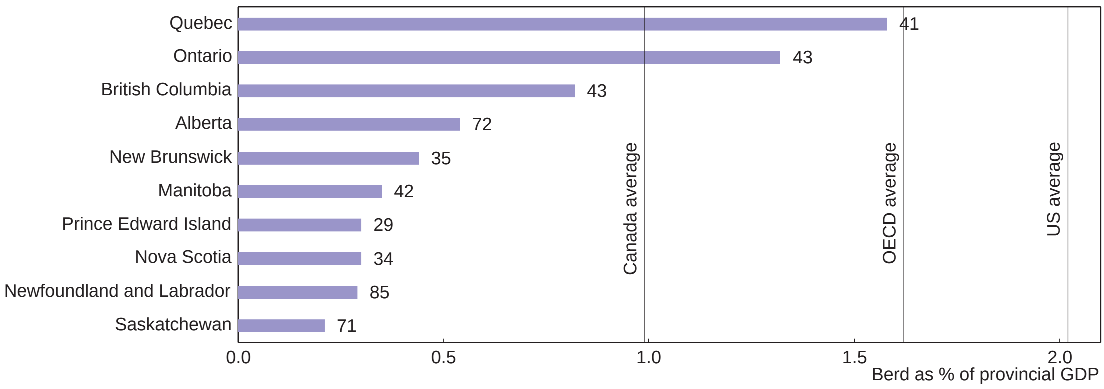
1. Primary sectors include agriculture, forestry, logging and related activities, fishing and related activities and electricity, gas and water supply.

Source: OECD.stat, Main Science and Technology Indicators database.

Regional differences within Canada likewise suggest a link between innovation and resources. Per capita incomes are higher in the resource-rich provinces of Alberta, Saskatchewan, and Newfoundland and Labrador, owing to resource rents, but BERD is higher in the central manufacturing and business services-based provinces of Ontario and Québec (Figure 8). The latter two provinces are still more heavily exposed to resource-based industries than the typical OECD country; otherwise their BERD intensities might be even closer to the OECD average. A feature of the low-BERD jurisdictions is that their resource industries are able to generate large amounts of GDP without the need for correspondingly large investments in R&D (Freedman, 2011). Cross-provincial income disparities, as measured for instance by the Gini coefficent of income inequality (OECD, 2011i), have been growing due to strong relative price shifts coupled with unequal resource endowments. Addressing this problem in a structural manner may require extra efforts in building human capital and innovation capacity in the resource-poor regions.

Figure 8. **BERD intensity in Canada**

By province, 2008



Note: The figure at the end of each bar is the province's productivity level (CAD per hour worked) in the business sector (goods and services) in 2008.

Source: Statistics Canada.

International scoreboards

Global rankings provide a barometer of the strengths and weaknesses of national innovation systems, based on consistent methodologies for calculating various performance indices. The 2012 *Global Innovation Index* (INSEAD, 2012) ranks Canada as 12th highest out of 141 countries on its global innovation index, down from 8th highest in 2011, as is consistent with its per capita GDP (also 12th highest). A rather low ranking for innovation efficiency suggests an overall poor return in terms of innovation output per unit of input – well behind global innovation leaders such as Switzerland, Sweden, Singapore and Finland. Major strong points are: the business environment, secondary education pupil-teacher ratio, electricity output, quality of scientific research institutions, scientific and technical articles, investment climate, new businesses, video uploads on YouTube, creative services exports, and trade tariff rates. Particularly low global rankings occur for: ecological sustainability, gross capital formation, GDP intensity of exports and imports and of net inflows of FDI, productivity growth, resident trademark applications and patent filings with foreign inventors.

The European Commission's 2008 *Global Innovation Scoreboard* (EC, 2009) compares innovation performance in the EU27 to that of 16 other major R&D spenders in the world, including Canada. Three "pillars" of innovation are proposed, supported by the relevant indicators: firm activities and outputs (BERD, triadic patents per population); human resources (S&T tertiary enrolment ratio, labour force with tertiary education, R&D personnel per capita, scientific articles per capita); and infrastructure and absorptive capacity (ICT expenditures per capita, broadband penetration per capita, GERD). Canada ranks second in human resources (though the methodology does not account for the mix of different types of tertiary education, which is unusual in Canada; see OECD, 2012d, Chapter 2), eighth in infrastructure and 18th in firm innovative output. No other country in the global peer group displays such a wide divergence between human resources/research infrastructure and firm R&D/patenting activity. Germany and the Netherlands manifest an opposite conundrum: relatively weak human resources but strong firm innovation output, although in these countries in-work training is likely to be a very important dimension of human resources perhaps not well captured by the indicator.

Policy drivers and barriers to innovation

Innovation is an exceedingly complex, lengthy and risky process. It can be promoted by multiple enabling factors in the broader economy and society itself. Efficient resource allocation, characterised by the fluid entry and growth of innovative firms and exit of less productive ones, magnifies the benefits of innovation (Andrews and de Serres, 2012). Canada possesses many of these assets, notably macroeconomic stability and a good regulatory framework. . However, disadvantages include uneven (though relatively low) capital taxation, limited capital markets for funding innovation, insufficiently strong competitive pressures in certain sectors, and weak "connective tissue" that links research to commercialisation. Also, with relatively abundant labour and low relative labour costs, at least until recently, Canadian firms have been under less pressure to innovate than firms in other countries. This section explores major determinants of business innovation so as to identify key drivers and barriers that may help to explain the Canadian paradox and which may be amenable to policy influence.

Taxation is becoming more competitive internationally

Cutting corporate income tax (CIT) rates increases the returns to innovation (as to any investment). A lower capital gains tax supports venture capital (VC), since VC investors' returns take that form. Canada's statutory CIT rate has become one of the lowest in the G7, whereas it had been the highest only a few years ago. This should stimulate business innovation in Canada, including by attracting more foreign firms and the technological and managerial know-how that they often bring.

However, marginal effective tax rates on capital remain uneven. Tax breaks to manufacturing and natural resources (abstracting from oil and gas royalties) penalise services, which are a critical emerging area for the knowledge economy. The small business deduction for Canadian controlled private corporations (CCPCs) provides tax relief to SMEs that is phased out as a corporation grows in size. Indeed, small firms account for a substantially larger share of employment in Canada than in the United States. While the tiny population of innovative start-ups are responsible for a disproportionate amount of breakthrough innovations and net job creation, not all small firms are young, and MFP growth appears to be concentrated at the medium-sized range (ICP, 2012). The reduction in the general federal CIT rate will not only improve the international competitiveness of large firms fully subject to this rate, but also serve to reduce the disparity in domestic treatment of large and small firms, to that extent encouraging small innovative firms to expand sales, enter foreign markets and attain the scale needed for successful innovation, competitiveness and high MFP growth.

Is competition providing the necessary spur to innovation?

Vigorous competition is a key motivator of innovation, as firms are driven to innovate to stay in business (CCA, 2009; Sharpe, 2010). Competitive behaviour is nurtured by openness to trade and foreign direct investment internationally and by low barriers to entry and exit in product and labour markets at home. Reducing anti-competitive regulations in sheltered sectors is found to be the second most powerful incentive for increased business R&D spending (Jaumotte and Pain, 2005). Conversely, firms that are sheltered from competitive pressures may earn sufficient rents to survive without innovating, even if that condemns them to remain small. Canada's product-market policy settings are largely in line with OECD best practice. Barriers to entry, as captured by the OECD's Product Market Regulation (PMR) indicators, are among the lowest in the OECD (Figure 9, Panel A). Employment protection is also moderate, which facilitates firm entry and organisational innovation (Panel D).

Yet, there are residual impediments to competition. In 2011, the OECD's *Going for Growth* (OECD, 2011a) identified Canada's network sectors and professional services as offering ample scope for regulatory improvement (Figure 9, Panels B and C). There are signs that some of these barriers are being recognised and tackled:

- OECD work shows that infrastructure sectors are critical to translating the benefits of innovation, notably in ICT, into generalised productivity gains, and so rigidities there may reduce efficiency in all sectors (Conway and Nicoletti, 2007). The government is, encouragingly, committed to sustaining competition in telecoms, and foreign-investment restrictions have begun to be eased (see below). New competitors have emerged in the wireless telephony market. The government has also implemented the competition policy recommendations of *Compete to Win* (CPRP, 2008). Competition authority powers of monitoring and enforcement against cartel-like behaviour and abuses of dominant market positions have been strengthened, and merger and acquisitions notifications and review procedures have been streamlined.

- Canada has to its credit dismantled most merchandise trade barriers, allowing for competitively priced inputs into production. A notable exception is tariffs sheltering supply-managed dairy and poultry products, as well as a few consumer products like clothing and footwear (Hart, 2012). The government should move toward removal of such protections on the basis of a cost-benefit analysis (see the chapter on agriculture in the OECD 2008 *Economic Survey of Canada*).

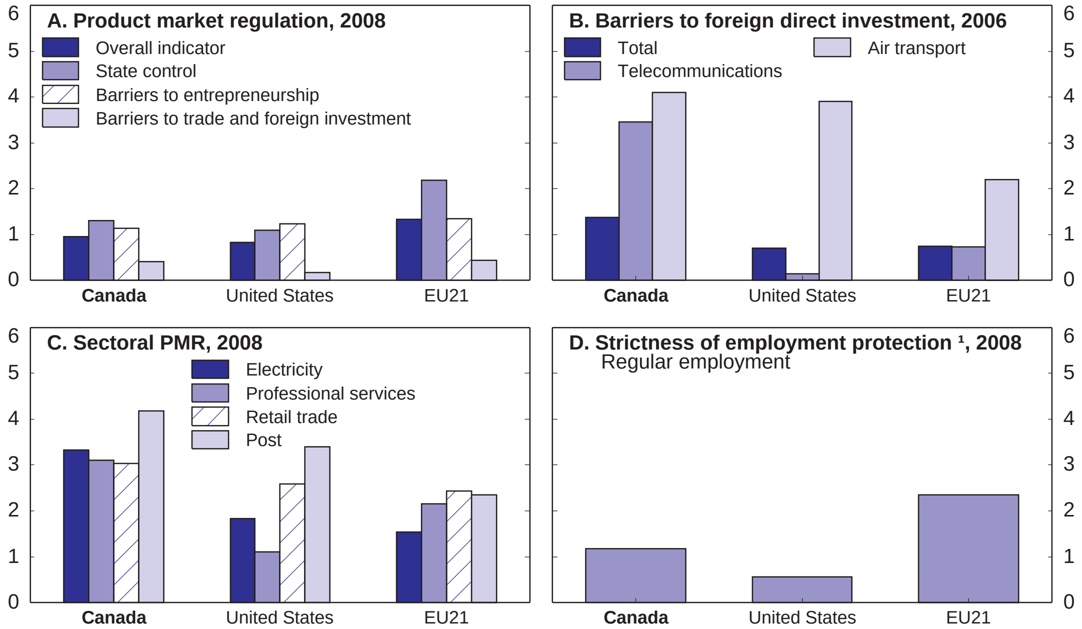
- Inter-provincial barriers to goods, services and resource flows reflect a lack of openness internally, limiting market size, competitive pressures and the gains from trade. Differences in provincial certification requirements for regulated professions that prevent their mutual recognition create barriers to the interprovincial mobility of workers in these occupations. . Professional services such as architecture, engineering, and various other businesses and skilled trades include skills necessary for many intangible investments. The 2009 amendments to the Agreement on Internal Trade (AIT, Chapter 7) have resulted in principle in the recognition of certified workers across provinces and territories and encouraged the adoption of common inter-provincial standards that facilitate mobility. Implementation of the Chapter is still ongoing.

- In health care, one of the fastest growing sectors representing 10% of the economy, rigid prohibitions on private entry hamper innovation (OECD, 2010c). In the wake of relaxations on the restrictions on provinces in this area along with a tightening long-term budget constraint (OECD, 2012d), provinces have formed an interprovincial body on health-care innovation and should seize the opportunity to foster it.

Canada has undergone much structural reform over the years, and pressing forward with remaining issues may be correspondingly difficult. A competitiveness council, as recommended by the Competition Policy Review Panel (CPRP, 2008), or else a national innovation council, as recommended by the Jenkins Panel (IPFSRD, 2011), could catalyse reform efforts, as the Productivity Commission did in Australia and a similar newly created agency is starting to do so in New Zealand.

Figure 9. **Product and labour market regulation indicators**

Index scale of 0-6 from least to most restrictive



1. The OECD indicators of employment protection are synthetic indicators of the strictness of regulation on dismissals and the use of temporary contracts.

Source: Panels A and C: OECD, OECD.stat – Market regulation database; Panel B: Koyama and Golub (2006), OECD's FDI regulatory restrictiveness index: revision and extension to more economies, OECD Economics Department Working Paper No. 525; Panel D: OECD.stat – Employment protection database.

Economic openness: more to do

Free trade agreements

As a relatively small market, Canada's ability to reap the benefits to innovation of both scale and competition requires fully exploiting international trade opportunities. But geography can be viewed as both a handicap and an advantage. Economic integration with the United States offers major opportunities for market expansion, scale economies, knowledge spill-overs and competitive intensity. Mobility of goods and services, capital and labour is high, particularly following the 1980s US-Canada Free Trade Agreement and the 1990s North American Free Trade Agreement (NAFTA). In 2010, three-quarters of Canada's exports went to the United States, and more than half of Canadian manufacturing sales were by affiliates of US multinationals. North-south trade and capital flows across contiguous US states and Canadian provinces are more extensive than east-west integration across the Canadian provinces themselves.

The impact of increased continental competition on Canada's productivity growth has been less clear, although the weak Canadian dollar until recent years may have induced Canadian firms to delay or avoid restructuring (Rubin and Lester, 1999). Also, as the junior partner in the bilateral relationship, Canada may be particularly vulnerable to the impacts of persisting impediments to trade such as border delays and regulatory differences (Hart, 2012). Following the September 11, 2001 terrorist attacks, moreover, border security was dramatically tightened. A recent US-Canadian government effort (*Beyond the Border: A Shared Vision for Perimeter Security and Economic Competitiveness*) presents a detailed action plan to make the border more open, predictable and secure, and it is making encouraging progress.

The recent economic crisis has highlighted the risks of overdependence on one large market. Canada's exports have also lost more global market share since 2000 than any other G20 country except the United Kingdom. Poor trade performance reflects both waning competitiveness (changes in exchange rate, relative wages and productivity) and a failure by Canadian firms to adapt to changing global demand, notably by means of a reorientation toward dynamic Asia (Hart, 2012). In a welcome development, Canada has recently become party to the Trans-Pacific Partnership (a trade and investment agreement being negotiated by 11 Pacific Rim countries, including NAFTA) and it has negotiated a foreign investment agreement with China. Success in expanding and diversifying trade linkages will also depend on investing heavily in transport infrastructure (McMillan, 2011). Provisions in the 2012 federal budget, in fact, resulted in significant streamlining of regulatory approvals for major infrastructure projects such as oil pipelines.

The international investment regime

It is frequently asserted that R&D and other high-value-added activities have been displaced to head offices of US multinationals, with a consequent "brain drain" out of Canada and a diminution of Canadian innovative and business prowess ("hollowing out"). Similar concern has been voiced over the fact that of 137 VC-backed Canadian firms whose ownership changed hands in 2006-10, nearly 60% were sold to foreign buyers mainly for their valuable IP, taking Canadian-educated talent with them (CIC, 2011). However, integrated production chains allow ready access by Canadian affiliates of US multinationals to the latest US technological and managerial know-how. In the auto industry, Canadian affiliates of US auto firms have typically been more productive than their US counterparts, mainly through a tradition of innovation in work processes and organisation, despite doing less R&D (CCA, 2009), although this advantage has waned in light of the 2000s terms-of-trade shock (Rao, 2011). Foreign-controlled manufacturing firms in general display higher MFP than their Canadian-controlled counterparts, even after accounting for differences in other firm characteristics (Rao *et al.*, 2008). The resulting benefits in terms of competitive intensity and access to knowledge flows are likely to be diffused more widely, as domestic competitors and suppliers learn by example and strive to catch up (Bergevin and Schwanen, 2011).

Barriers to FDI are mainly in the form of ownership restrictions or regulatory discretion over mergers and acquisitions in specific sectors. The more general "net benefit test" has long been thought to have insignificant disincentive effects. However, its recent first-time use by the government to deny proposed investments in certain sectors (aerospace and potash) and subject others to questionable scrutiny (Target), relatively low thresholds for review in sheltered sectors (culture), and a lack of transparency in the review process, could have a dissuasive effect on future FDI and on openness to Canadian companies abroad and risks being used as a protective device (Bergevin and Schwanen, 2011).

To take full advantage of FDI, Bergevin and Schwanen (2011) and CPRP (2008) have recommended that the Investment Canada Act's (ICA) net benefit test for foreign investments should be either removed or the onus shifted to government to prove that a proposed investment is *not* in Canada's interests, with the reasons publicly stated. As announced in the 2012 budget, the federal government is in the process of making targeted improvements to the *Investment Canada Act* to enhance transparency while preserving investor confidentiality. The Ministries of Industry and Canadian Heritage would do well also to create procedures to provide foreign investors with timely and binding opinions concerning ICA compliance of prospective transactions (CPRP, 2008). At the same time, ownership restrictions in sheltered sectors, notably telecommunications and broadcasting, need to be lifted in order to get much needed capital, contestability and management talent. This process has already begun: in 2010, foreign ownership restrictions were removed for Canadian satellites and changed to permit greater foreign investment in the air transport sector; and in 2012, the federal government lifted foreign investment restrictions for telecommunications companies that hold less than a 10% share of the total Canadian telecommunications market.

Entrepreneurship: is there a commercialisation gap?

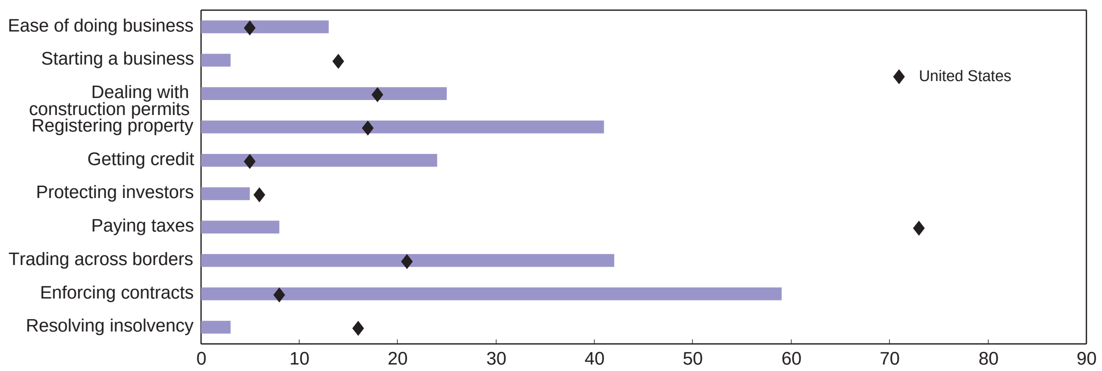
The culture of commerce

Entrepreneurial firms are the subset of firms that are growing and innovative. These firms take advantage of technological and market opportunities, and a few grow into global leaders. They also include "gazelles", young firms that experience high growth (OECD, 2010b; ICP, 2012). Ease of entry and doing business is needed to stimulate competition and innovation, even if only a small number of innovative start-ups (perhaps 2-4%) eventually grow into large firms (IPRFSRD, 2011 and MacIntosh, 2012).

The World Bank's ease of doing business index indicates many favourable factors for entrepreneurship in Canada (Figure 10). The number of days needed to start a business is low, bankruptcy procedures are particularly simple, and paying taxes is easy. On the other hand, the number of days needed to get an electrical connection is higher than in most countries, and enforcing contracts is also difficult. Compared with the United States, it is also significantly harder to obtain credit in Canada owing in part to lenders' collateral requirements, and trade across provincial borders is relatively hampered. Such indicators echo some of the Global Innovation Index rankings.[6]

Figure 10. **Ease of doing business[1]**

June 2011



1. Ranking on the ease of doing business among 183 economies. A high ranking on the ease of doing business index means the regulatory environment is more conducive to the starting and operation of a local firm. This index averages the country's percentile rankings on 10 topics (getting electricity is not shown), made up of a variety of indicators, giving equal weight to each dimension.

Source: World Bank, Doing Business database.

The OECD Innovation Strategy accords a key role to new, young and entrepreneurial firms as exploiting opportunities neglected by more established companies (OECD, 2010b). Risk-taking is a defining characteristic of entrepreneurs: successful entrepreneurs seem to have a higher than average propensity for risk-taking (ICP, 2012). According to the SIBS, the risks and uncertainty of innovation outputs are the main impediments to undertaking it. Case studies have pointed to commercial failure as the most frequent cause of exit of innovative start-ups, which tend to be led by technically, rather than managerially, skilled people (Barber and Crelinsten, 2009). More broadly, an apparently high degree of

6. Nevertheless, there is a strand of research that concludes that policies that make business entry harder, such as strict bankruptcy laws or higher taxes on success, may lead to increased lending and higher-quality entrepreneurship. In US states with generous bankruptcy laws, for example, it is more difficult for low-income households to obtain loans (Gropp *et al.*, 1997).

risk aversion in doing business, rooted in a fear of failure, is one characterisation of Canadian social attitudes toward commerce.

These attitudes are partly confirmed by some empirical evidence suggesting more cautious attitudes to risk by Canadian as compared with US businesses (Box 2). In the United States, the prevailing wisdom is that business or professional failure is a valuable learning experience and that entrepreneurs are deserving of second chances. New US business theories are also putting emphasis on "delighting the customer" as the key to corporate survival (as exemplified by Apple) and, in principle, the main driving force of innovation (Denning, 2011). However, according to Roger Martin, Dean of the University of Toronto's Rotman School of Management, Canadian businesses are significantly lagging in adopting such a mindset. In order to improve the innovative capacity of Canadian companies, senior managers need to enhance customer understanding and the pursuit of customer satisfaction.

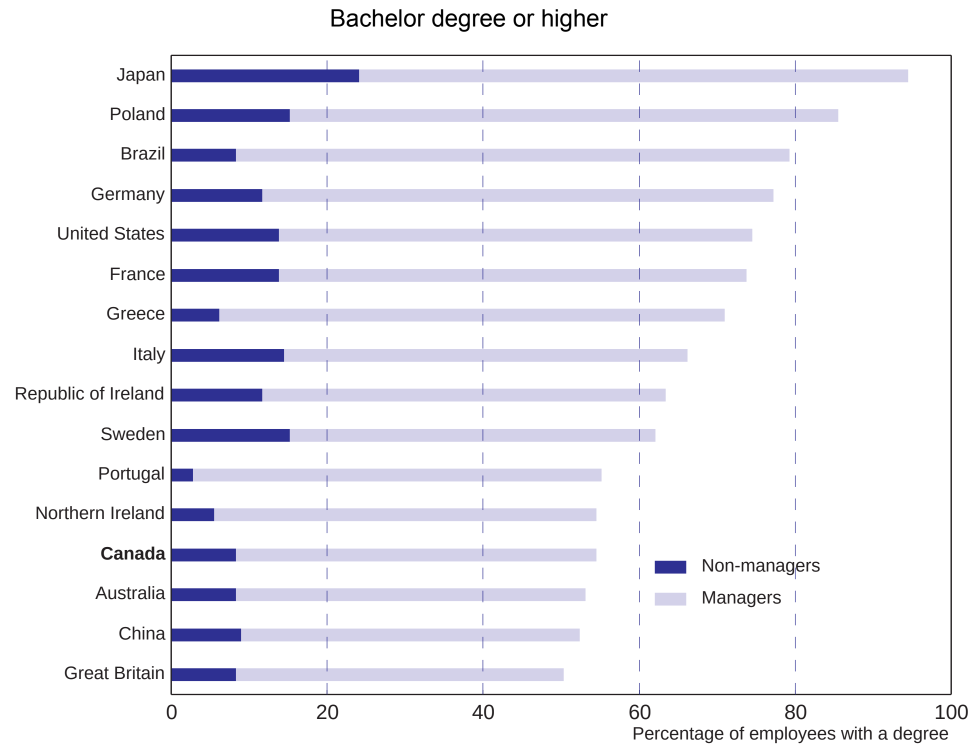
The best way to stimulate willingness to take risk may be to boost competitive pressures and openness, as discussed above, and to complement this by enhanced attention to management training and diversity at all educational levels. More tertiary education in general is also needed (OECD, 2012d, Chapter 2): Canada still lags in attainment of university degrees, whereas highly educated persons are much more likely to be owners of high-growth innovative firms (ICP, 2012; Box 2).

Box 2. **Attitudes to risk and managerial quality**

Available business innovation surveys such as SIBS and CIS suggest relatively highly risk-averse behaviour by Canadian managers when undertaking innovation. For example, whereas in Canada, 44% of medium-sized firms reported uncertainty and risk as a major obstacle to innovation, in the United Kingdom the corresponding figure was 36% (McCann, 2010), although this difference is not significant. A recent survey by a major polling firm of a wide spectrum of Canadian and US firms focused on the attitudes of senior executives to assuming business risks associated with growth and innovation (Deloitte Research, 2011). Whereas Canadian executives see themselves as neither more nor less willing to take on reasonable risks than their colleagues south of the border, the level of risk tolerance displayed by the actual decisions that they reported making, filtered by researchers through the heuristics used in arriving at these decisions, suggest that American respondents are 13% more tolerant of risk than the Canadians. The gap widens to 18% when adjusting for the more negative current economic state and future outlook of US respondents in 2011. This result is driven by a much lower R&D rate of participation among risk avoiders in the two countries (70% versus 83%), rather than higher R&D intensity among risk takers or a difference in the proportional sizes of these two groups (Deloitte Research, 2011). The survey data also suggest a greater reliance by Canadian firms on government support in order to motivate investments in R&D. US firms indicate a greater responsiveness to an expansion in the availability of risk capital or an improvement in the protections afforded to IP rights. While excessive optimism among US managers has also been documented, and could lead to reckless behaviour, research shows convincingly that a high degree of managerial optimism can lead to more socially optimal levels of innovation, especially when combined with product market competition (Galasso and Simcoe, 2011).

An international survey and empirical analysis of management quality in manufacturing by Bloom (2011) sheds further light. It finds that firms in Canada, in fact, follow good practices similar to those found in firms in Germany, Japan and Sweden, and better than in most other European and developing countries. However, 22% of Canadian firms are worse managed than the average from Brazil, China and India, suggesting a long tail of Canadian manufacturing vulnerability. US firms outperform Canadian ones by a significant margin. One reason for superior US performance is competition and market discipline: well run firms are rewarded more quickly with greater market share, while poorly managed firms are forced to shrink and exit. According to this author, Canada is not far from the United States in terms of openness of product markets and lightness of labour market regulation, though its higher rate of trade unionisation (36% *versus* 16%) may restrict some management practices. The two countries are also not too dissimilar in ownership patterns, with mostly well managed publicly quoted and private equity-owned firms as opposed to family (inherited) and government managed firms as in some other countries. The one area where Canada appears to lag markedly is in worker and manager education (Figure 11). The author's estimations show that worker education is as important to management quality as manager education, reflecting that workers often drive innovation and productivity improvements.

Figure 11. **Educational attainment of managers and workers**



Source: Data have been drawn from Bloom, N. (2011), "Management and Productivity in Canada: What does the Evidence Say?", *Industry Canada Working Paper Series*, Nº 2011-05.

Education and diversification to boost entrepreneurship

Entrepreneurship skills are acquired by a process of lifelong learning, but education is an important first step and can be provided at all levels. Innovation/science awards by age group are increasingly popular as a motivational device. At the tertiary level, entrepreneurship education is a rapidly developing field. US business schools are the acknowledged leaders in this area, providing courses in entrepreneurship, small business management and new venture creation with an approach using case studies, business plans, discussions and lectures by business owners and guest speakers. Though similar courses are taught in Canadian business schools, they are not as well developed, and participation is only one-third that in US business schools (OECD, 2010a).[7] The University of British Columbia, though, offers a course on commercialising technology, which allocates half the seats to MBA students and half to graduate students from science and engineering departments, and also provides access to a network of industry people who serve as guest lecturers; this has contributed to technology transfer (spin-offs) by encouraging a culture of commercialisation on campus (Agrawal, 2008). Beyond formal education, training at work is essential. Ultimately, however, the cognitive and social skills that characterise entrepreneurs do not necessarily bear a causal connection with education or management training, and

7. A recent OECD study of eastern Germany showed that teaching can have a greater effect if linked to support for enterprise start-ups by students and staff, including mentoring, grants and incubation facilities (OECD, 2010a). This is starting to happen in Canada, where colleges are at the forefront of developing such support systems.

human capital of different sorts is associated with survival probabilities in start-ups. Attitudes toward risk, moreover, may be largely a function of institutional context rather than culture or training.

Another important route to imbuing society with entrepreneurial dynamism is through continuing immigration and ethnic diversity. Economic immigrants are by definition system outsiders and often originate from highly entrepreneurial cultures themselves. They must take risks, be entrepreneurial and work hard in order to advance materially and socially. Research has found that many successful R&D-intensive start-ups are foreign-born entrepreneurs, often more pragmatic, frugal and prepared to do what it takes to succeed in commerce (Barber and Crelinsten, 2009).[8] First- and second-generation Canadians are also prominent in the pool of university-educated labour force entrants, crucial for productivity in the knowledge-based economy. Second-generation Canadians are also much more likely to have a university degree and be employed and less likely to rely on social assistance, and their average earnings are higher than those of young adults of Canadian-born parents.

The federal government recognises both the near- and long-term benefits to Canada's economic growth resulting from skilled immigration, which is a focus for Canada's immigration programme. Some immigration programs such as the Federal Business Immigration Program are specifically designed to select experienced investors, entrepreneurs and self-employed immigrants, targeting more active investment in Canadian growth companies and more innovative entrepreneurs. Under its 2012 budget, the federal government outlined that it will begin to target more active investment in Canadian growth companies and more innovative entrepreneurs under the Business Immigration Program. Nonetheless, given the variable quality of foreigners' current performance – notably reflecting official language proficiency, access to business and professional networks, and cultural adaptability – it is suggested that additional focus could be put in the short term on attracting graduate students to Canada and giving them easy access to work visas following receipt of their advanced Canadian degrees (OECD, 2012d, Chapter 2). This, though, may become more difficult as economic opportunities multiply in China, India and elsewhere.

A greater inclusion of women in the ranks of managers and owners could also tap into latent talent. Statistics indicate a mediocre performance in this regard, however, with the share of individually owned enterprises with a female owner varying between 20% and 40% across OECD countries. Furthermore, empirical evidence suggests that enterprises founded by women tend to have lower levels of innovation activity relative to enterprises founded by men. Recent OECD research has found that, while part of the gap in the propensity to innovate across gender groups may be explained by the disparity in the characteristics of the enterprises owned by women relative to men, there is increasing evidence that the difference may be largely attributable to the owners' characteristics. A number of barriers to innovation activity for women entrepreneurs have been identified: *i*) an education and careers experience gap in certain innovative or high-tech fields; *ii*) an equity financing gap; and *iii*) a networking gap, generated by the low numbers of women entrepreneurs in innovation-intensive industries and by the low visibility of successful innovative women. Policies should be used to address such barriers. Women could also help fill the looming shortages in STEM and other advanced technical skills, but they are vastly underrepresented in the STEM disciplines. Women's scientific inclinations should be nurtured at an early age via enlightened teaching, science clubs, contests and the like that encourage girls to participate.

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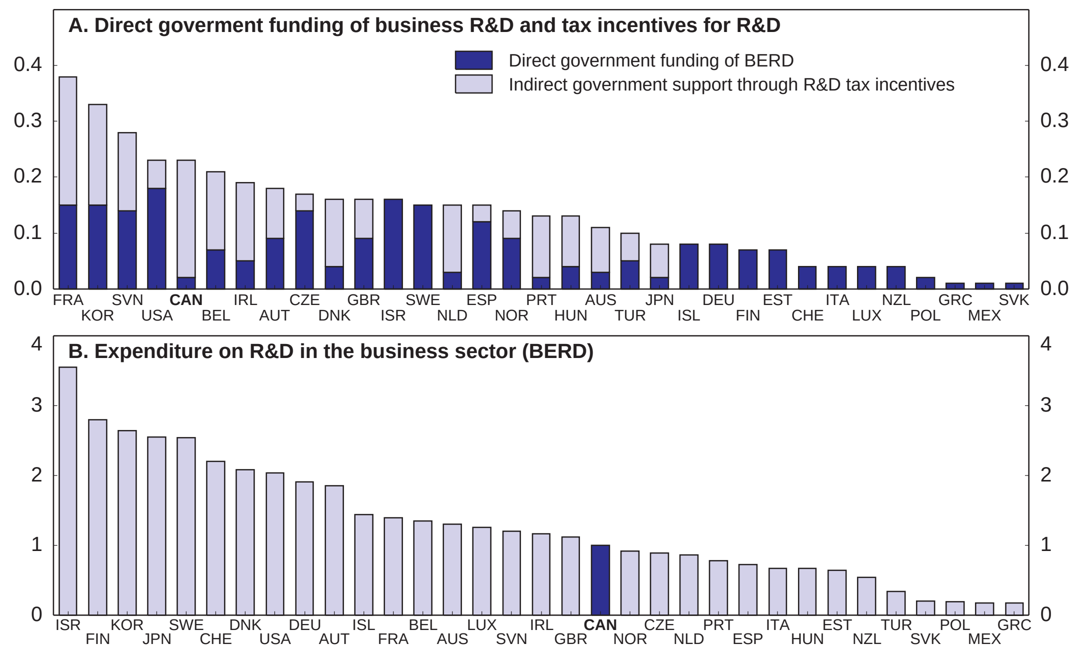
8. US-based research has found there was at least one immigrant key founder in 25.3% of all engineering and technology companies established in the United States between 1995 and 2005 inclusive (Wadhwa *et al.*, 2007).

Fiscal incentives: finding the right mix

Canadian government support to business innovation is among the most generous among OECD countries, but its composition is atypical. Indirect funding *via* generally available R&D tax credits is the second highest among a sample of OECD countries, after France, whereas direct funding of business innovation is one of the lowest (Figure 12, Panel A). This reveals a choice by the Canadian authorities to stress forms of funding that apply neutrally, so as to establish a "level playing field" and a presumably more efficient "let markets decide" approach to R&D resource allocation. The government thus attempts to avoid "government failures", notably those that require "picking winners" by means of grants. However, the downside of such a policy is a lack of targeting and possible tax deadweight costs. Moreover, the playing field is not truly level: small, Canadian-owned firms are substantially favoured in the design of the tax credits over foreign-owned and large firms. It is also possible to lower the risk associated with picking winners by means of competitive grant procedures.

Figure 12. **Fiscal support and business R&D investment, 2009**[1]

As a percentage of GDP



1. Or latest available year.

Source: OECD, OECD Science, Technology and Industry Scoreboard 2011.

R&D tax credits

The Scientific Research and Experimental Development (SR&ED) tax credit is one of the most expensive tax expenditures in Canada (costing CAD 3.6 billion for the federal government in 2011 and an estimated CAD 1.5 billion for the provinces and territories). Its high cost reflects the high rate of subsidisation rather than intensity of business R&D activity (Figure 12, Panel B). The general federal SR&ED tax credit rate is currently 20% of eligible R&D performed in Canada. Unused credits may be carried back up to three years and forward up to 20 years. For small Canadian controlled private corporations (CCPCs), the credit increases to 35% (up to a maximum of CAD 3 million in qualified expenditures), in which case it is also refundable.[9] Almost all provinces top up the federal tax credit with their own variants (Table 6). The common base includes both capital and current expenditures plus "overhead" costs (of up to 65% of wage costs) and most R&D contracts with tertiary institutions (except for Québec which counts only wage costs plus 50% of such contracts). On top of these investment tax credits, qualifying SR&ED expenditures are fully deductible from taxable income, and unused deductions may be carried forward indefinitely. Since R&D current and capital spending may be considered to be an investment, allowing its immediate expensing (rather than capitalisation) provides a significant benefit to firms.

The SR&ED credit adds to complexity in the tax code, raising administrative and compliance costs. Activities eligible for the SR&ED tax incentives involve systematic investigation or search carried out in a field of science or technology by means of experiment or analysis. In general, three broad categories of activity are eligible: basic research, applied research, and experimental development. The definition of SR&ED for income tax purposes is largely consistent with the OECD definition of R&D, as presented in the Frascati Manual (OECD, 2002), and with the definitions in other industrialised countries for their R&D tax incentives. Firms must demonstrate that their R&D activities meet this definition. The SR&ED tax incentive program is administered by the Canada Revenue Agency (CRA), which sets out three qualifying conditions: *i*) the activity must generate information that results in scientific or technological advancement; *ii*) the outcome must be unknown in advance of undertaking the activity; and *iii*) the activity must be carried out by qualified personnel and involve systematic investigation through experiment and design (Parsons, 2011). For small firms, complexity in the SR&ED program may lead them to use SR&ED-related consulting services, whose high contingency fees reflect the magnitude of the tax credit. The 2012 budget announced a study of contingency fees charged by tax preparers. It is estimated that small firms spend on average 14% of their tax credit in compliance costs, while large firms pay around 5% (IPRFSRD, 2011).

Table 6. **Federal and provincial tax credit rates (%)**

Provinces	Provincial tax credit	Federal plus provincial[1]	
		Small CCPCs	Other firms
Alberta and British Columbia	10	42	28
Manitoba	20	48	36
New Brunswick, Newfoundland and Labrador, Nova Scotia, Saskatchewan and Yukon	15	45	32
Northwest Territories and Prince Edward Island	0	35	20
Ontario (small/large firms)	10/4.5	42	24
Québec (small/large firms)[2]	37.5/17.5	48	27

1. The federal credit is 35% for small CCPCs (Canadian-controlled private corporations) and 20% for other firms. The base for the federal credit is reduced by the amount of provincial credits.
2. The Québec credit is paid on wages and salaries plus 50% of contracts. The federal-provincial rate is expressed as a percentage of R&D costs eligible for the SR&ED credit.

Source: Independent Panel on Review of Federal Support to Research and Development – Expert Panel Report (2011), *Innovation Canada: A Call to Action*, Ottawa.

9. Small CCPCs are defined as having up to CAD 500 000 in prior-year taxable income and up to CAD 10 million in prior year taxable capital. As these thresholds are exceeded, the qualifying R&D expenditure limit for the 35% rate is phased out. At CAD 800 000 in income or CAD 50 million in capital, the firm is considered large and fully subject to the 20% general subsidy rate. Tax credits earned at the 35% rate are fully refundable for current expenditures and for 40% of capital expenditures. Those earned at the 20% rate are non-refundable, with the exception of qualifying expenditures of small CCPCs in excess of the CAD 3 million limit, which are eligible for 40% refundability (see Parsons, 2011).

The policy rationale for the enhanced refundable credit is to internalise the positive externalities of R&D performed by CCPCs and to compensate for their constrained access to finance. However, the generosity of the subsidy could result in the allocation of too many resources to small firms. The difference between the small and large firm effective subsidy rates is the largest in the OECD (Figure 13), exacerbating the incentive to stay inefficiently small. Moreover, the refundable tax credit offered to small CCPCs is renewable without limit, encouraging entry though giving rise to a soft budget constraint that could keep some companies going beyond a point where they should have exited, as they do not need to earn a market return in order to get revenue. Furthermore, firms undertaking R&D have access to a wide range of federal and provincial support programmes and frequently obtain funding for the same project from more than one, creating a "stacking" of R&D support. In 2007, 70% of all small firms received financial assistance amounting to 40-50% of their spending on R&D and 10% received more than 50% (RFSRD, 2011). This gives rise to a high effective tax on earnings above the income qualifying threshold of CAD 500 000. There is also the question of how well the enhanced subsidy targets firms most in need of support. The age of a company (start-up or mature) may say more about its problem with access to capital than its size (OECD, 2006; Parsons, 2011). The best response to market failures that may adversely affect SMEs is unlikely to be through size-related tax measures (Parsons, 2011).

Figure 13. **Tax subsidy rate on investment in R&D[1]**

2009, percentage

1. The data include income tax deductions and R&D tax incentives provided by sub-national governments. The element of income tax deductions corresponding to an economic depreciation allowance is not a subsidy and thus not included.

Source: Department of Finance (2009), Tax Expenditures and Evaluations 2009, Part 2, "An International Comparison of Tax Assistance for Investment in Research and Development", Ottawa.

A further problem is the suspected deadweight cost of the tax credit for large firms, which may have performed the R&D in any event (Baghana and Mohnen, 2009, suggest such an outcome in Québec). Nonetheless, the broad literature on stimulative effects of R&D credits shows that they do effectively increase the total amount of R&D spending, though small firms may be more responsive to the price signal, possibly reflecting that they are more concentrated in R&D intensive sectors (Corchuelo and Martinez-Ros, 2009). It has been suggested that use of an incremental-based R&D credit increases large-firm responsiveness and from that perspective may be preferable to a volume-based credit (Baghana and Mohnen, 2009). While incremental tax credits are more efficient for government (minimising the amount of "subsidised" R&D that would have been undertaken even in the absence of support), they are also more complex to implement. The general OECD trend has been to make R&D tax incentives more generous and simpler to use (OECD, 2010e).[10]

The key issue regarding the SR&ED is not the extent of financial-market failure but the level of subsidisation that is justified by externalities (*i.e.* the efficient effective tax credit rate). The "net benefit" of the SR&ED tax incentive has been calculated to be positive (Parsons and Phillips, 2007), but wide ranges of uncertainty around the parameters used make this calculation highly uncertain (Parsons, 2011). Furthermore, the analysis was based on an "average" federal tax credit, so that the expected net return for the much richer tax credits for CCPCs might well be negative. The Jenkins report concluded that the calculation of the net benefit is not sufficiently precise at this time to permit a benefit-cost ranking of the government's various business R&D support programmes, though that remains a worthy goal (IPRFSRD, 2011). A preliminary analysis by Lester (2012b) provides just such a ranking and finds that whereas the general SR&ED credit rate is around the optimal level, the refundable credit and Industrial Research Assistance Program (IRAP) (the major grant programme targeting SMEs) may not be, as their beneficial spill-overs (*i.*e. the social return less the private return of the additional R&D induced by the subsidy) are strongly outweighed by the economic cost of financing the assistance with taxes that harm economic performance plus the costs of administering and complying with the programmes.[11] His calculations show that the negative net benefit of the refundable SR&ED can be eliminated if the subsidy rate falls to 18% and administrative and compliance costs respectively fall by 25% and 50%.

The ongoing dramatic reduction in the statutory federal corporate income tax (CIT) rate has not changed the unit value of the SR&ED credit, but made it less likely for large firms to fully benefit from the credit in the year in which the costs are incurred. Hence, they face larger "tax risk" in that they must have sufficient tax payable in order to fully benefit from the credit (since carrying unused credits forward is not costless). Such tax risk may have the advantage of "targeting success" (IPRFSRD, 2011), though only in a limited sense, as large businesses unable to use the credit are those that make consecutive losses until they finally fail. Nevertheless, the 2012 federal budget proposes, as of 2014, a reduction in the general SR&ED investment tax credit rate from 20% to 15%, in line with the recent federal CIT reductions (from 22% in 2007 to 15% in 2012) (Government of Canada, 2012). The small-firm tax credit remains at 35%; being refundable, it is unaffected by the CIT reductions. This enlarges the gap with large firms, however, a step in the wrong direction. Also, the general rate would appear to be now somewhat too low from the viewpoint of social welfare (Lester, 2012a). The lower CIT rate, if anything, might justify a larger subsidy insofar as it reduces the deadweight costs of taxation.

The Jenkins report (IPRFSRD, 2011) recommended that the enhanced refundable credit apply to wage costs only (as is already the case in Québec). Such streamlining of the base would help to reduce small-firm compliance costs, though at the peril of creating a new distortion in favour of labour-intensive small firms, which may be less innovative. The panel, nevertheless, recommended maintaining capital

10. Australia, for example, introduced in 2001 a premium R&D tax concession (over and above the baseline tax concession) for incremental R&D above a firm's most recent three-year average R&D expenditures, which is thought to have resulted in an acceleration of business R&D in that country (Cumming, 2007). However, in 2010 it replaced the hybrid volume and incremental-based schemes with a simpler and more generous volume-based scheme (OECD, 2010e). The R&D tax concession was then replaced in 2011 by an R&D tax incentive scheme based on a tax credit (Australian Government, 2011).

11. The parameters used for the calculations are based on surveys of the empirical literature for Canada. The spill-over rates for SR&ED are assumed equal for large and small firms (56% on average, 110% for basic/applied research and 42% for experimental development), despite some evidence that they may be larger for large firms. Elasticities of response to R&D credits are also assumed equal across firm sizes. The spill-over benefit is assumed to be higher for IRAP-financed projects due to its use of targeting. See Lester (2012b).

expenses in the base for large firms, where they are likely to be a more significant part of R&D activity. It also called for the credit for small firms to be made only partially refundable, with this change to be phased in. Refundability for small firms may be justified insofar as they have difficulty getting outside funding for their R&D efforts, whereas non-refundability would help to reinforce small firms' motivation to succeed. Making the small firm credit partly refundable could help to balance this trade-off. However, partial refundability would result in firms not being able to claim the SR&ED tax credits in the year that they are earned and in ongoing growth of unused tax credits until such time that the firm earns a return.

The 2012 federal budget proposed to exclude capital costs as of 2014 from the expenditure base of the SR&ED, but for *all* firms, large and small, on the argument that the rules regarding the eligibility of capital expenditure are the most complex for businesses to comply with (Government of Canada, 2012). However, this multiplies concerns about distorting technology choices due to non-neutrality of the base. It further reduces the effective subsidisation of large firms beyond that already implied by the cut in the general tax credit rate. The budget also lowers the cap for eligible overhead costs and removes the profit element from covered contract costs, a more welcome tightening in that it reduces distortions. Calculations by Lester (2012a) suggest that the effective regular tax credit rate, taking into account all the budget provisions, falls from 17.2% currently to 11.5% post-budget changes (the effective enhanced credit rate falls from 35.7% to 32.3%). As just 75 larger firms perform about half the R&D in the economy, and 25 perform one-third (IPFSRD, 2011), the substantial drop in their effective subsidy rate below the presumed optimal level may pose risks to BERD. Even so, several other OECD countries have credit schemes that focus only on R&D wages, presumably as a way to control public cost or boost high skilled employment.

In conclusion, it would be preferable to lower the small-firm rate toward the general rate, while also reducing small-firm administrative and compliance costs. The general rate should be kept at 20% and capital should stay in the qualifying expenditure base (though overhead and contract costs should be streamlined as planned). As the small-firm credit accounts for around 45% of the total federal SR&ED tax expenditure of CAD 3.6 billion, reducing it from 35% to 20% would yield fiscal savings of nearly CAD 700 million per year. Even going only part way to this goal would address both fiscal and economic efficiency considerations. Liquidity constraints could be best addressed by retaining (partial) refundability.

Business grants

Fiscal savings from these reforms could be used to shore up targeted business grants and to provide vouchers for use in academic contracting. Subsidies to small Canadian-owned firms may be one way of targeting funding on the commercialisation gap. The voucher approach has been successfully piloted in Alberta and used extensively outside Canada, notably in the Netherlands, and it is effective because the fiscal spending is controllable and directly stimulates technology transfer, while leaving full autonomy to firms in defining projects.

Direct subsidy programmes in the form of grants, subsidised loans, provision of services and public procurement of research or innovative products are numerous at both federal and provincial levels. They are geared predominantly to small businesses, on the grounds that they lack internal resources and face difficulties in obtaining external funding. However, they are generally inefficient (IPFSRD, 2011). Business grant programmes have rarely been evaluated or culled, which has led to a proliferation of small and fragmented schemes at both federal and provincial levels. Consolidation and co-ordination could at once reduce administration costs and help businesses to understand what help is available and access it.

One scheme that stands out as an exception to this general picture is the IRAP, which is the largest programme at 15% of all granting, yet still small by international standards. The 2012 federal budget doubled the programme's contributions to small and medium-sized businesses, using part of the savings from the streamlining of the SR&ED. It provides funding for R&D and various other innovative activities, including marketing and organisation, which are not provided for in the restricted base of the R&D tax credit, along with commercialisation advice to small businesses. However, such advice is very expensive and could reduce the net benefit of the IRAP (Lester, 2012b). Moreover, while outsourcing the advice function bolsters the skill set of decision makers, it does not provide firms with the mentoring associated with venture capitalists (below), and these advisors do not have strong financial incentives, since they are fixed rather than residual claimants (MacIntosh, 2012). Direct funding also lends itself much more easily to political interference, and one safeguard could be to target such funding on sectors of maximum beneficial social spill-overs. IRAP is broadly patterned on the US small-business innovation research (SBIR) programme, which in turn is widely credited as being an important part of the US small-firm innovation success story and development of the venture capital (VC) market (OECD, 2011c). SBIR-like programmes have been gaining popularity in other OECD countries as well. However, the dominant OECD pattern has been one of decreasing reliance on grants and increasing use of tax credits (OECD, 2010e).

The Jenkins report (IPRFSRD, 2011) provided an original contribution in attempting to evaluate the main grant programmes' effectiveness. It recommended using the savings from streamlining the small-firm SR&ED to expand IRAP and commercialisation vouchers, while consolidating the myriad of smaller programmes along several distinct "product lines".[12] The report also proposed an arms-length federal agency – the Industrial Research and Innovation Council (IRIC) – to advocate for a whole-of-government approach to innovation, and to fund, oversee and deliver the various business-support programmes in close collaboration with provinces and business. As the report states, governments further need to evaluate the performance of tax-credit and direct-support programmes to assess their comparative cost-effectiveness in stimulating R&D as a guide to future resource allocation. It will thus be important to build federal capacity to undertake such evaluations. Also, as innovation support is being rebalanced toward more grants and strategic use of procurement (below), it will be important to ensure competitive and open awards with safeguards against capture, *e.g.* by support of general-purpose rather than specific technologies.

Demand-side policies

Many countries have noted that a significant challenge for innovation is often not the lack of knowledge or technology, but rather the lack of a receptive market for these innovations. Some Canadian experts argue for a broadening of demand-side, sector-specific support policies as the priority for public policy to promote innovation (Côté and Miller, 2011). This is particularly the case for markets with important public-good characteristics, *e.g.* in environmental, health and other public services. The OECD has recognised that supply-push policies may be ineffective in isolation, and action on the demand side is needed to complement them (OECD, 2011d). Demand-side policies have the added attraction of relatively low costs, depending on their design, in a context of heavy pressure on public resources. Policies to foster demand for innovation – such as innovation-oriented public procurement, standardisation of platform technologies to stimulate firm entry and network effects, taxes or subsidies notably in the environmental area to correct for externalities – are comparatively underdeveloped in Canada.

The Jenkins panel report supported using public procurement to bolster innovation, particularly for SMEs. Whenever feasible, procurement tenders should be framed in terms of needs to be met or problems to be solved, rather than of detailed technical specifications that leave little scope for innovative proposals

12. The report also makes reference to the German Fraunhofer institutes as particularly effective institutions for business finance and support. The Fraunhofer Gesellschaft operates a network of 60 institutes as an integral part of the technological virtuosity of German industry and competitive strength of its economy. It is funded one-third by government subsidies, one third by industry, and one-third by competitive public research grants. The institutes are customer-oriented, applied research organisations striving to transform scientific findings into useful innovations. They provide: *i*) highly specialised, professional R&D services to industry; *ii*) demand-driven research combined with scientific excellence; *iii*) strong integration with academia; and *iv*) autonomy combined with simple corporate rules and a strong brand (IPRFSRD, 2011).

(IPRFSRD, 2011; OECD, 2011d). In health sciences and green innovation, social spill-overs might be greatly enhanced by supporting promising new platform technologies such as hydrogen cell technology, genome- and nano-technologies that can spawn as yet unimagined applications, rather than specific ones such as wind power, biofuels, etc. The federal government should work collaboratively with provincial and municipal governments – municipalities are major procurers for infrastructure projects, and provinces are responsible for health-care spending, where there is likely to be substantial potential for innovative procurement – toward the same end. It would also be well to open all public tendering to foreign firms (even if not required by international trade agreements), in order to stimulate competition and knowledge transfers, and to make transparent the amount of implicit subsidy involved.

Innovative demand-side policies can help reduce the costs of avoiding environmental degradation. Green innovation displays positive externalities common to all forms of innovation but also reduces the negative externalities of environmental degradation (air and water pollution, climate change, biodiversity loss, etc.) and will in any case be needed if Canada is to transition to a low-carbon economy. The OECD Innovation Strategy (2010b) concludes that such policies can succeed only if a price is put on such environmental externalities, ideally in this case through a carbon tax or an emissions trading scheme. Such pricing not only corrects for externalities but also can be a source of government revenue. British Columbia, Québec and Alberta have moved a small way towards carbon pricing, and Alberta is also subsidising innovative technologies like carbon capture and storage, but this appears to require higher prices on carbon to be profitable. It will be important to encourage green innovation via adequate pricing of environmental externalities associated, notably, with carbon emissions and water quality.

The federal government has accorded substantial funding to clean energy projects and sustainable agriculture via genomics but is not prepared to impose generalised carbon pricing so long as the US government is uncommitted, given the very close economic linkages. It also provides direct support for green innovation to the private sector, for example by innovative procurement and by leadership in standards setting, helping to create a critical mass of market demand. Other OECD governments have used schemes such as feed-in tariffs to motivate green commercial innovations, though with mixed success and sometimes heavy costs. The 2012 budget provided funding for several environmental initiatives and also proposed to speed up environmental assessment procedures for natural resource exploitation. This reinforces the need to balance environmental and economic growth objectives through price incentives.

Do financial markets allocate funds to innovation effectively?

A well functioning financial system is important for allocating capital to firms and sectors, while pricing risk efficiently. Financial markets in Canada are highly developed, yet several indicators suggest room for improvement. The median cost of equity (risk-free rate + equity risk premium) has been higher for Canadian than for US firms by some 50 basis points after adjusting for firm size and industry structure, despite nearly equal risk-free interest rates (Witmer and Zorn, 2007). Canadian firms may likewise be forced to maintain higher profitability than US firms to attract footloose foreign capital (Freedman, 2011).

Banking

The Canadian banking system is well regulated and supervised, and profitability is high. At the same time, however, there may be a trade-off between banking-system stability and economic dynamism (OECD, 2010c). Canadian banks' prudence in lending served them well in the global economic crisis, but financial innovation could also have significant benefits for consumers (Lerner and Tufano, 2011). Canada's banking culture also implies a preference for collateral-based lending; hence, domestic mortgages account for a share of bank assets that is high by international standards (OECD, 2010c).

Banks are not involved in early-stage seed-capital funding for innovative start-ups because intangible investments by definition lack a physical form that can be collateralised. Furthermore, the entrepreneur may have no track record and few product lines so that cash flow deficits and surpluses across multiple products cannot be used to offset each other. Business surveys reveal that SME financing is more problematic in Canada than in the United States, and there is evidence of a greater reliance on loans from family and friends, suggesting a lower availability of formal debt financing (Leung *et al*., 2008). Whereas 29% of all business loans in the United States go to SMEs, only 17.5% do so in Canada (OECD, 2012c). This may reflect that US lenders effectively price risk whereas Canadian lenders follow a more uniform pricing policy. Thus, riskier SMEs benefit by being able to obtain credit more cheaply, but less risky ones end up paying higher interest rates than they would in the United States (Leung *et al*., 2008). While its aggregate impact on the cost of SME finance is uncertain, this would still imply a less efficient allocation of capital in Canada.

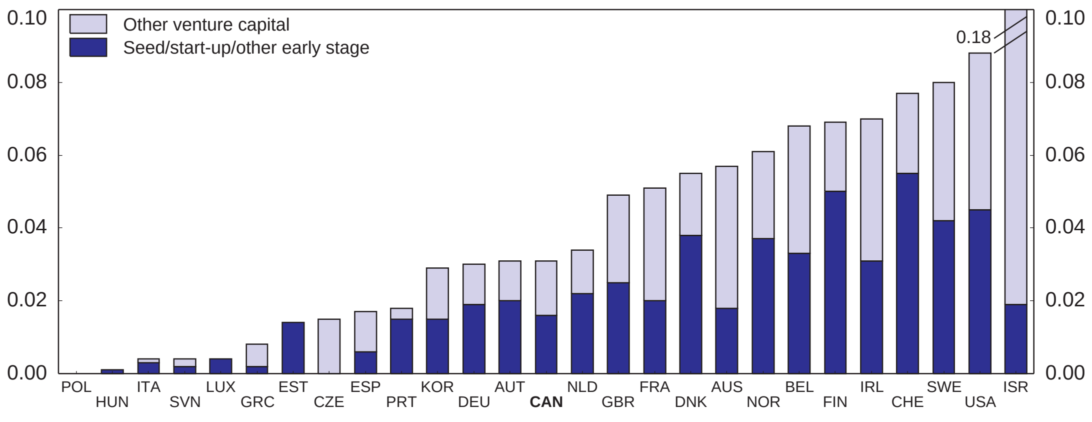
Securities markets

A liquid and dynamic capital market can provide ample and affordable funding to innovation by spreading risk across many investors. Large established firms prefer cheaper internally generated funds for their R&D. But severe information asymmetries, exacerbated by the non-rival nature of intangible assets (making innovators reluctant to reveal much of their plans to competitors), lead to a high cost of capital for small and start-up firms, in part to cover the risks of market "lemons" (Hall and Lerner, 2009). Venture capital (VC) and private equity segments of the capital market specialise in innovative start-ups and other high-risk ventures. Venture capitalists can be enticed to take the high risks of funding unknown start-ups by relying on their own entrepreneurial and industry experience for monitoring to reduce informational asymmetries, and even then only under the prospect of lucrative exits in the form of initial public offerings (IPOs) or mergers and acquisitions (M&As). VC firms thus provide not only growth capital for entrepreneurial companies, but also add skills, know-how and networks of connections (Fancy, 2012).

Canada's VC market is significantly smaller, relative to GDP, than in the United States and Israel, as well as many European countries, though similar in size to that in Korea, Germany, Australia and the Netherlands (Figure 14). Expressing VC investments as a percentage of BERD virtually eliminates the gap between the two countries, however. This suggests that the Canadian VC market is itself limited by fundamentally weak business innovation and/or that the lack of VC financing could be contributing to Canada's low BERD ratio. International experience shows that venture and other start-up forms of capital are important enabling factors for business innovation, as well as *vice versa* (Lerner, 2009).

Figure 14. **Venture capital investment, 2009**

Percentage of GDP

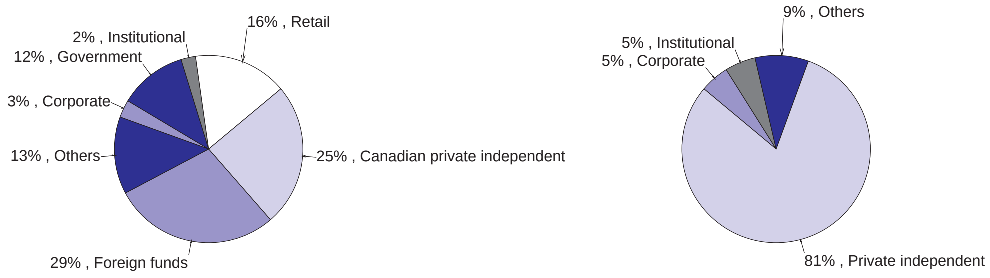


Source: OECD, OECD Science, Technology and Industry Scoreboard 2011.

Besides being proportionately smaller than the US market, the Canadian VC market is dominated by government guaranteed and foreign investors (Figure 15). This partly reflects the fact that the United States is the VC originator and leader, but it could also be related to a lack of experienced venture capitalists, entrepreneurs and a well-functioning ecosystem in Canada. Institutional investors such as pension funds have shied away from the Canadian VC market segment but are sorely needed to provide it with depth.

Figure 15. **VC funding sources in Canada and the United States**

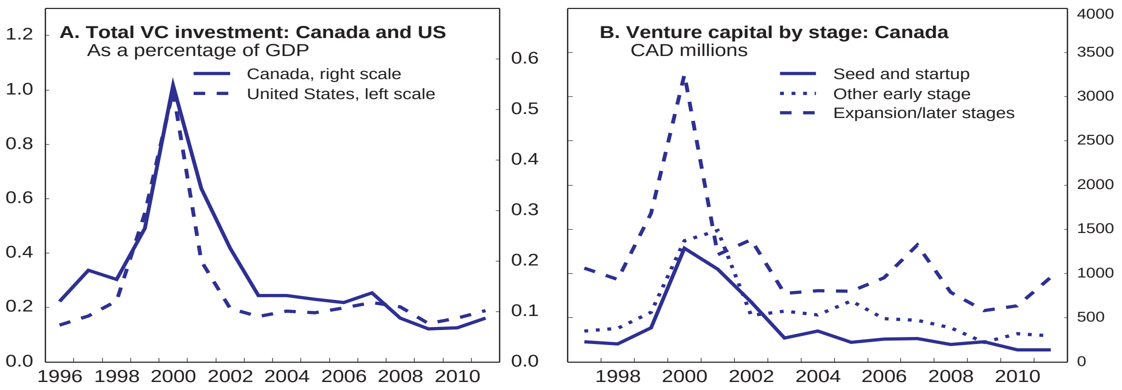
2011



Source: Thomson Reuters for the Canadian Venture Capital and Private Equity Association.

VC markets everywhere collapsed in the aftermath of the "dot.com" bubble and have languished since the 2007-09 financial crisis (Figure 16, Panel A). VC funds have at the same time refocused their attention on late-stage start-up funding, which is less risky (Figure 16, Panel B). The durability of the VC model can be questioned given that it is apparently dependent on equity-market bubbles to score occasional big wins and that only a tiny share of companies (1 or 2%) get VC funding. The US success story seems to be driven by two outliers, Massachusetts and California, suggesting a high degree of path dependence in this market. Indeed, the VC solution to the problem of financing innovation has its limits: it tends to focus only on a few ("hot") sectors at a time, with minimum size too big for some start-ups, and it is very hard to establish as it requires at least three interacting institutions: investors, experienced venture fund managers and a deep market for IPOs (Hall and Lerner, 2009). Nevertheless, the contribution of VC funding to employment and value added has been very much out of proportion to its small size (CVCA, 2011).

Figure 16. **Trend in VC investment, USA and Canada**

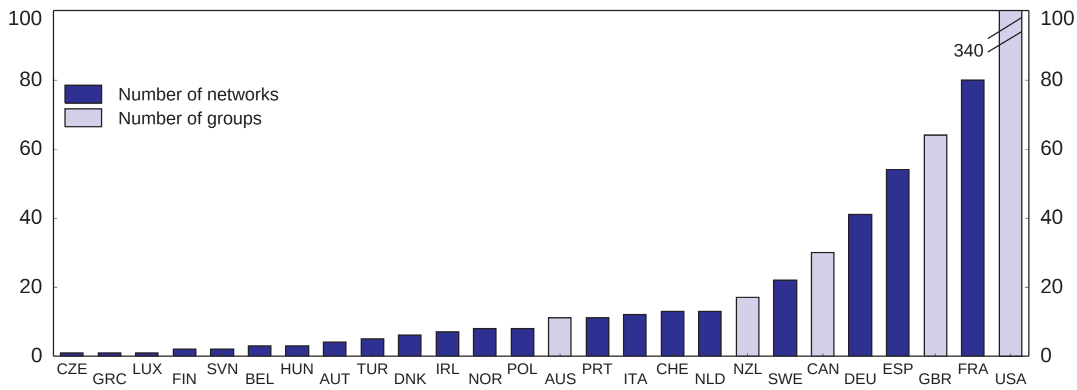


Source: Canada: Thomson Reuters VC Reporter; United States: PricewaterhouseCoopers/National Venture Capital Association MoneyTree; OECD (2012), *Financing SMEs and Entrepreneurs 2012: An OECD Scoreboard*, OECD Publishing. http://dx.doi.org/10.1787/9789264166769-en.

The decline of the VC sector has shifted policy attention to angel investors, who typically operate at even earlier stages than venture capitalists and also provide the hands-on support that nascent entrepreneurs need. Angel investors tend to be experienced "serial entrepreneurs" who have been successful themselves and provide valuable mentoring and patronage as well as financial support to start-ups in an alignment of philanthropy and self-interest. Although data are sparse, reflecting the largely informal nature of angel investing, estimates are that angel and venture capital investments are roughly equal to each other in size within both the United States and Canada, though, looking at only seed and early stages, angel capital is much bigger (OECD, 2011g). So far, the angel market in Canada is developing, and angels are increasingly investing through groups and becoming more visible (Figure 17). A good source of angels might be Canadian entrepreneurs returning from the United States, bringing back valuable experience gained there.

Figure 17. **Business angel networks/groups**[1]

2009



1. Business angel groups are formed by individual angels joining together with other angels in order to evaluate and invest in entrepreneurial ventures. The angels can pool their capital to make larger investments. A business angel network is an organisation whose aim is to facilitate the matching of entrepreneurs with business angels.

Source: OECD (2011), *OECD Science, Technology and Industry Scoreboard 2011*.

Subsidies to innovation finance

Significant failures in the market for innovation finance are often used to justify public intervention, though such measures must be carefully designed and subsequently evaluated, given a strong risk of unintended consequences (Lerner, 2009). Canadian governments provide two main types of support. The first is federal and provincial tax credits to retail investors in VC or angel funds. The main ones are Labour-Sponsored VC Corporations (LSVCCs). Retail investors can claim a credit on their federal income tax equal to 15% of their investment in such funds (up to a limit). Funds eligible for this tax credit can be invested in a Registered Retirement Savings Plan (RRSP), and so are also eligible for that tax deduction as well. Provinces often top up the federal credit generously. Ontario has recently discontinued its LSVCC credit on the basis of a cost-benefit analysis. British Columbia has introduced large tax credits for angel investors, allowing individual investors to claim personal tax credits of up to CAD 60 000 per year. The British Columbia government claims that each tax dollar of subsidies calls forth many more in the form of private investment and eventual new tax revenues (Hellman and Schure, 2010). This may be an overestimate, because the analysis does not consider all other government support received by these businesses or attempt to measure the incremental value added by the B.C. tax credit, and also because innovative firms typically employ people with good labour market opportunities.

The second form of support is through direct federal government involvement on the supply side of the risk-capital market via incubators, seed funding, loan guarantees and the like. The main government entities delivering such support are the Business Development Bank of Canada (BDC) and Export Development Canada (EDC). The BDC plays a leadership role in delivering financial and consulting services to Canadian small business, with a particular focus on technology and exporting. To take advantage of financial markets, the BDC increasingly co-finances specific projects alongside private VC firms and also invests in VC "funds of funds".

Altogether public funding (*i.e.* non-private independent, non-foreign) represents nearly half of the entire VC market in Canada. One-fifth is direct government investment (Figure 15). This is a very large share that does not seem to bode well for a sustainable market and exposes the government to financial risks, notwithstanding the supposed alignment of public and private incentives by way of design. There is evidence that it introduces distortions into the VC market. In the case of the LSVCCs, these distortions include: retail investing in VC funds for tax-planning purposes rather than for the long term; goals extending beyond making the best possible return for investors; poor governance structures (organised as perpetual corporations rather than as limited partnerships with 10-year lifespans as are most private VC funds); absence of strong incentives for managers, with inefficient constraints on investments; and a lack of transparency and effective performance review by retail investors, as institutional investors like pension funds potentially able to exercise effective oversight are excluded (MacIntosh, 2012; Cumming, 2007).

Such features typically give rise to negative returns net of management fees[13] and may crowd out private credit supply unable to compete with heavily subsidised credit, adding indirect costs of crowding out to the direct costs of tax subsidies (Cumming, 2007). That is, tax subsidies enable LSVCCs to outbid other VCs for investee companies, driving deal prices up and market returns down, in turn discouraging private entry. Insofar as the largest LSVCCs tend to serve non-commercial goals like regional development and fund only very little actual innovation (MacIntosh, 2012), this attenuates the actual extent of crowding out they cause, though they still distort capital allocation in the market as a whole. An empirical study of Canada's public venture capitalists has shown that they underperform private venture capitalists, and while this would not necessarily be worrying if the publicly funded investments are truly marginal, it may at least in part reflect the crowding out of more productive private capital (Brander *et al*., 2008). The BDC, for its part, as a crown corporation, is technically immune from political interference; however, it is ultimately accountable to Parliament and the Minister of Industry, and its activities reveal a strong regional bias, with poor returns for its subsidiary BDC Venture Capital (MacIntosh, 2012). Another study shows that government (and corporate) VC funding scores reasonably well in terms of fostering innovation in Canada (as proxied by patent applications by VC-funded firms), though institutional and private VC money perform best; retail (and bank) VC funding, on the other hand, scores quite poorly (Fancy, 2012).

Recognising the weak state of the VC market, the Jenkins report recommended boosting the resources of the BDC further to support the development of larger-scale, later-stage funds in support of the private VC and equity industry, thereby hoping to catalyse a "critical mass" that is necessary for the market's efficiency. The report also recommended BDC co-funding with angel investors on a "side-car" basis (*i.e.* where private partners make all the decisions). Following these recommendations, the 2012 federal budget made available an extra CAD 500 million in funding to VC support, including CAD 100 million through the BDC and an additional CAD 400 million in new funding (with details as to programme design and implementation to come, following a period of public consultation).

Stimulating the VC market will prove a challenge, especially as returns have been fairly low and the global financial crisis sharply cut investors' appetite for risk in the United States as well as Canada. Government can indeed help develop the market through co-investment funds in which private investors

13. There are a small number of professionally managed LSVCCs reporting positive net returns, nonetheless.

make the investment decisions, thus leveraging private capital and expertise. However, the risk remains that these funds will remain forever dependent on public support, so that the government's involvement should be on a strictly temporary basis, as in the case of the former Israeli Yozma fund. Such funds also need to partner, rather than compete, with private VC funds, while bridging the gap when the market fails due to structural impediments (Cumming, 2007). Following the examples of the successful US SBIR programme and the Israeli Yozma fund, the government's investment could be guaranteed a modest rate of return on the upside in exchange for sharing in the downside risks, thereby leveraging private returns. More critically, federal and remaining provincial tax credits to retail investors in the LSVCCs should be withdrawn and the entry of pension funds into the VC market encouraged. More could be done to attract US VC funds as well, which should find Canada attractive not least because proximity is important for monitoring by investors. In this respect, it should be noted that the federal government has removed major tax barriers to private equity (OECD, 2010c), including narrowing of the definition of taxable Canadian property which eliminated the need for tax reporting of dispositions by non-residents of many equity investments. Finally, national angel associations could benefit from some government support, but preferably non-financial insofar as these tend to be composed of wealthy individuals (OECD, 2011g).

Regulatory issues

Accounting rules that enhance investment transparency, notably by further improving the reporting of intangible investment valuations, would greatly facilitate institutional investment in VC (Cumming, 2007). Continuing improvements in financial reporting are likewise useful to enterprises engaged in innovative activity (OECD, 2010b). Government can assist this process by identifying and disseminating standards of best practice for the reporting of information on intellectual assets that can help investors assess future earnings and risks associated with investments in innovating firms. This would not only ease information asymmetries but also strengthen the exercise of ownership rights, subject management and boards to greater discipline and make intangibles valuation more efficient (OECD, 2012b).

The current structure of securities regulation remains fragmented and has been identified as giving rise to high transaction costs, inconsistent reporting and accountability standards, and patchy enforcement (FSB, 2012). Greater cross-provincial harmonisation and consistency in securities market regulation would therefore help to deepen capital markets, improve resource allocation, reduce duplication and unnecessary regulatory burdens, and improve the attractiveness of listing in Canada. It will be important to improve securities market regulation by implementing as comprehensive a securities regulator as possible, consistent with the Supreme Court decision upholding the jurisdiction of each level of government over some aspects of the regulation of securities (OECD, 2012d). The federal government has indicated that it will continue working with provinces and territories to move in this direction.

Skill needs of business

A critical question for policy makers is to what extent public support for research and innovation (public or private, grants or tax incentives) bids up researcher wages and entails wasteful duplication and/or non-productive research. How can wage premia that are necessary for signalling desired supply responses (in education and training systems) be distinguished from such wasteful forms of wage push? Jaumotte and Pain (2005) found that goals like raising R&D intensity were bound to fail unless bolstered by measures to increase the supply responsiveness of R&D skills. With large numbers of baby boomers nearing retirement and educational attainment not rising as rapidly as elsewhere (OECD, 2012d, Chapter 2), this becomes more of a risk, especially as governments are boosting R&D funding to remain competitive against innovating OECD and low cost non-OECD competitors alike.

What skill mix is required? On one count, there are four main functional skill levels: management, R&D, sales/marketing and production (Hanel, 2008). The relative importance of each type of skill depends on the nature of innovation (product, process, organisational or some mix; revolutionary or incremental, etc.), sector (manufacturing or services), firm size (small or large) and ownership (domestic or foreign). It is presumed that knowledge-worker skills will be mainly associated with the first three functions. Their wages comprise the bulk of innovation expenditures, together with investments in ICT and other capital with high technology content. Of these, R&D skills are perhaps the most portable and the most important for new-to-market innovations. Firms can obtain them by hiring recent university or college graduates with the latest technical knowledge, or by providing in-house training. Technology transfer is another way in which firms can access such skills, albeit indirectly, typically by purchasing other researchers' output via contracting, leasing rights to others' intellectual property (or else purchasing their patents outright), collaborating in research, or making efforts to benefit from knowledge externalities more broadly.

High-tech manufacturing and knowledge-intensive services are a relatively small part of Canada's total production. This is likely to curb the demand for R&D skills, implying smaller wage premia for R&D-related skills than in some other OECD countries (OECD, 2012d, Chapter 2). Indeed, notwithstanding the high quality of basic research and the magnitude of business-directed supports, employer demand for knowledge workers or purchases of their output appears disappointing. For instance, PhDs, of which there are proportionately fewer than in the United States, suffer unemployment rates three times as high as south of the border (OECD, 2010d). Surveys show that SMEs prefer a broader skill set than that offered by PhD graduates when hiring R&D employees. The science and technology share of total employment is relatively large, without producing correspondingly high innovation output, raising the possibility of underemployment of their skills. There is likewise still too little business collaboration with academics, despite multiplication in recent years of public grant programmes to encourage academic-business linkages. The SIBS showed that Canadian firms are significantly more likely to train workers in-house than to hire recent graduates of tertiary institutions or to collaborate with public research institutions. This suggests weak business demand also for the outputs of academic research, even while "supply-push" is being ramped up by various public outreach programmes (centres of excellence, incubators, student internships, etc.). Other disincentives or barriers appear to be at play.

Management is a key skill required for entrepreneurship, which plays a central role in stimulating firm entry and innovation (OECD, 2010a). Case studies of R&D-intensive firms that fail despite sound ideas and public support have pinpointed a lack of management and commercialisation skills as being most often the critical factor in their failure (Barber and Crelinsten, 2009). Thus, these can be suspected of being the key missing skills required for boosting innovation in Canada, as already noted. In part, this is because most innovators have a science and technology background. Indeed, in many smaller firms, notably innovative start-ups, one person (the inventor/innovator) will embody all four functions, all too often imperfectly. By the same token, they lack the knowledge of how even their excellent ideas can be commercialised. Finding the right contacts to line up financing and market interest is another critical feature of effective management.

Innovative workplace organisation is a function of management and worker skills alike and is very likely to be required to boost the creativity of the firm's workforce (OECD, 2011b). Research shows that Canadian manufacturing firms that were better able to adjust to the 2000s exchange-rate shock and maintained their production in the home market excelled chiefly in terms of flexible workplace management practices (Baldwin and Yan, 2010). The most important features appear to be staff training and granting them a high degree of autonomy, which encourages creative thinking, self-direction and responsibility. Motivated and engaged workers are the most productive.

Facilitating knowledge flows

Patent and copyrights

The non-rivalrous and intangible nature of knowledge (at least codified) makes it easy to copy and steal, and hard to value. This can be partly overcome by assigning legal property rights to it for example, via patents, trademarks and copyright. The main alternative to legally protecting IP is often secrecy, which may be socially less beneficial. The market for patents, in particular, has important efficiency aspects. One is that innovation is encouraged by enhancing creators' ability to appropriate commercial or other benefits flowing from IP. A second is that it allows a cleaner separation of R&D and commercialisation functions via trading, helping in this way to fill the management skills gap. In so-called vertical specialisation, an individual innovator or small start-up firm specialising in the generation of IP sells or leases the associated patents to a larger firm that is more adept at commercialisation.

There are well known tradeoffs involved with providing IP protection. One is the possibility that it will be abused so as to create monopolies, diminishing competitive intensity to the detriment of subsequent innovation. Empirical work by the OECD suggests that IP protection is nonetheless on balance favourable to innovation (Jaumotte and Pain, 2005). Another problem is the use of litigation to generate revenues from supposed infringements of IP by so-called patent trolls. In the high-profile case of Research in Motion, Canadian maker of the popular BlackBerry, patent trolls acquired patents relevant to its device, but never used them, and later sued RIM for a majority of its profits (Cummings, 2007). Such risks can be mitigated by carefully delineating the scope of the patent and the legal remedies available.

Canada appears to be falling behind in the international patent race. Canadian patent applications have languished since 2000, even as they have boomed in the United States, many countries in Europe and China (CIC, 2011). In terms of patent quality (adjusting by the number of citations by subsequent patent applications), Canada does much better (OECD, 2011f), though, as in many other countries, patent quality seems to have declined over the past decade, even if measurement is difficult. This widespread decline in patent quality reflects in part the exhaustion of earlier technological possibilities (notably in pharmaceutical research), and partly the rise of patent proliferation as a new form of competition.

Small firms are especially vulnerable to litigation risk once they attempt to market their IP, as larger incumbents with the means to do so may subject entrants to the immense cost of defending themselves against (sometimes frivolous) claims. Canadian start-ups have had some bad experiences in this regard when attempting to enter the US market (where the onus of proof is on defendants, and juries in some US states tend to heavily favour US claimants). The OECD recommends making intellectual property rights (IPR) systems in member countries more "SME-friendly" by diffusing knowledge and know-how about IPR, streamlining procedures and reducing application time, adequately structuring fees and costs, and improving litigation and enforcement mechanisms (OECD, 2011h). Canada might consider establishing a Patent Court or section of a court, as exist in many other countries, to deal with disputes (ICI, 2011). The OECD is also increasingly emphasising cross-licensing arrangements, open innovation and other forms of co-operation and collaboration as alternatives to litigation as a method of enforcing patent rights and diffusing knowledge (OECD, 2011e). These alternative methods rely much more on recognition of mutual benefits of knowledge sharing. They may be accelerated by the sheer technological difficulty of unravelling bundles of IP in areas like biotechnology. Canada's high level of social trust would seem to make it well suited for leadership in promoting such tendencies.

Copyright protection faces new challenges in the Internet age, where copying of music files, films, etc. is extremely cheap. Also, because network effects are integral to the business (and social) value of Internet services, exclusive rights to software and artistic output could inhibit this development if not carefully designed. The 2011 *Copyright Modernization Act* introduced new tools and exceptions to invest in IP and roll out cutting-edge business models in the digital era. Overzealous privacy protections could still have harmful effects, however, *e.g.* by blocking promising new sources of marketing to Internet advertisers, or by inhibiting the development of electronic medical records able to save lives through highly beneficial network effects. Policymakers must therefore weigh these real economic and social costs against the social benefit of privacy protection (Goldfarb and Tucker, 2011).

Technology transfer

The inability to capitalise on Canada's strong record in academic research leaves much potentially useful knowledge unexploited. The transfer of direct knowledge from academe to industry has always been the purview of the federal research granting councils. They fund placement programmes and research scholarships for university undergraduate, graduate and doctoral students who can then take their breakthrough research to industry and hope for commercial success, or at the very least gain a better understanding of how Canadian businesses operate. Internships, co-ops, and placement programmes have always been geared toward graduate-level students and newly minted university graduates, however, leaving substantial resources in colleges untapped by industry.

Investments in university research and technology transfer personnel have increased sharply since the early 2000s, while innovation output (as measured by patents and licenses for academic research) has risen far less dramatically. This suggests a low and declining productivity of technology transfer, especially in comparison with the United States where technology transfer surged over the same decade. Agrawal (2008) examines this "Canadian commercialisation discount" and attributes it chiefly to a weak commercialisation culture at universities, along with an overly bureaucratic mindset among technology transfer offices (TTOs) when it comes to deal making. The dearth of large high-tech firms acting as local demanders of innovation also plays a role, as may the lack of faculty superstars comparable to those found in the big US universities.

Policies have attempted to improve technology transfer in various ways. Public research is becoming more focused on issues of social relevance rather than purely curiosity-driven subjects. The marginal research dollar is increasingly tied to the needs of business. For example, academic grants may require signalling of their commercial relevance via co-funding by business. Community colleges are becoming proactive in directly meeting the needs of small business in areas of problem solving, process innovation and technical skills, even though they benefit from little taxpayer support via the granting councils. Students involved in such collaborations, *e.g.* via internships, view them as highly motivational learning experiences. Governments are also attempting to stimulate academic-business collaborations and knowledge transfers through networks of excellence, incubators and the like. While these methods may reduce informational asymmetries and transactions costs that stymie collaboration, and they have seen some marked successes in Canada, international experience shows that it is very difficult to create vibrant clusters of innovative activity, unless many conditions and incentives are present (Box 3).

Box 3. **Geographical clusters**

It is a well known fact that intensive innovative activity is more likely to take place within geographical clusters that are able to reap agglomeration economies – supply chain linkages, large labour pools and tacit knowledge diffusion – as epitomised by California's Silicon Valley, Singapore and Tel Aviv. Some research suggests that agglomeration effects are very limited in scope, not extending outwards by more than perhaps 10 km beyond a central zone (Baldwin *et al.*, 2008), so physical proximity is important for effective collaboration, despite all the advantages of modern communications. Investors in high-risk start-ups also like to be near their investments in order to monitor them. Innovation "hot spots" are few and far between, however (OECD, 2011f). They tend to arise somewhat spontaneously, often relying on a confluence of favourable factors such as a strong research university, or a public or corporate laboratory at its core, as well as urbanised social and artistic amenities and cultural diversity.

Government spending often plays a role as well, especially in promoting university hubs. For example, US military contracts with Stanford University helped to spur the development of Silicon Valley, as commercial ventures were spun off from the new silicon chip technology being developed for military purposes (Lerner, 2009). Famous firms like Intel got their start under the highly regarded US federal Small Business Innovation Research (SBIR) programme. Venture capitalists clustered in the region, setting up a virtuous cycle of funding and creativity. However, government support is not a sufficient condition. The darker side of the story is that governments everywhere have wasted large amounts of public money in attempting to artificially build the next great innovation cluster (Lerner, 2009). They should probably stay away from trying to do so and focus rather on creating the right framework conditions for innovation.

Canada has some notable hot spots in Montreal (aeronautics, operations research, video games), Waterloo (smart phones, ICT), and Toronto (life sciences), each based on very different approaches and models. Montreal has been significantly led by provincial government and universities, whereas Waterloo was more grass roots and business-oriented, reflecting perhaps the cultural heritage of the large German immigrant population that settled there (CCA, 2009).Toronto's MaRS Discovery District has benefited from strong public and private foundation support for hospital-based research and a number of excellent universities in close proximity within a diverse urban culture. There is a risk that some of these hotspots remain too close to academia and fail to develop their commercial dimensions.

The move toward more commercially and socially relevant academic research seems appropriate in light of Canada's weaknesses in this area. The peer review process for granting is dominated by academic insiders, however (Wheeldon and Gordon, 2011). Review panels for competitive awarding of federal research grants should include experienced business people. Preserving the right balance is also important, nevertheless: basic and applied research are essential parts of the innovation ecosystem and, as the private sector does not typically do much of either, the government has a special and irreplaceable role in funding them (MacIntosh, 2012). For example, three-quarters of the most important therapeutic drugs introduced world-wide between 1965 and 1992 had their origins in public research; almost all drugs coming out of biotechnology companies had their origin at universities (Stephan, 2012). Hence, pushing universities to become more business relevant in all areas risks a focus on short-term research with immediate applications and reducing projects that may have important long-term impacts on productivity and social welfare which are as yet hard to quantify or even envision. Business for its part should likewise strive to engage more with academics and be more aware of the commercial potential in academic research.

University TTOs have not been very efficient in their role – *i.e.* all too often holding out for top dollar in licensing fees or "hoarding" IP. Private markets of this sort may require a level of sophistication about IP and doing business that TTOs often lack. Universities need to overhaul TTOs to focus less on licensing fees and more on industry collaboration, infrastructure sharing and training (CIC, 2011). Provincial governments, which govern education, should send a clear signal to the universities to this effect.

The Competition Policy Review Panel suggested that Canada's tertiary education institutions could expedite the transfer of IP rights by moving to an "innovator ownership" model, learning the lessons of the University of Waterloo's extraordinary success in commercialising its faculty research (CPRP, 2008). The earlier Expert Panel on the Commercialization of University Research proposed a federal IP framework modelled on the 1980 US Bayh-Dole Act, which facilitated the interest of business in commercialising university inventions by strengthening private property rights to federally funded research, while imposing uniform patenting and licensing procedures across universities (Advisory Council on Science and Technology, 1999). Agrawal (2008), though, finds that the current mixed-model system in Canada mimics the property rights effects of the US legislation well enough, and that the causes of inefficient technology transfer lie elsewhere, much of it outside the purview of federal policy, as argued above.

Conclusions

Canada clearly has the potential to be a nation of innovators and seems to possess all the right fundamentals to be a major international player in IP. What seems to be holding it back is a certain dichotomy in policies: at the general level, they internalise virtually all of the OECD market-based best practices, yet selective government supports to sectors, firm sizes and ownership structures may have serious impacts on incentives to innovate, succeed and grow. Estimating the economic/social costs and benefits of these selective policies will be needed to overcome the political hurdles to eliminating the least efficient of them. By levelling the playing field and letting market forces run their full course, business innovation in Canada can be unleashed and high productivity growth achieved. Governments should also resist going too far toward discretionary R&D policies, just as other OECD countries are moving toward the Canadian model of heavier reliance on tax credits in their search for efficiency. The education system should supply more skills and knowledge serving business innovation needs. A list of recommendations to strengthen the policy framework for innovation, drawing on the above discussion, is provided in Box 4.

Box 4. **Recommendations for boosting business innovation**

Provide a stronger culture of competition, risk taking and customer orientation

- Increase competitive intensity in network sectors and professional services, in line with *Going for Growth* (OECD, 2012a) and *Compete to Win* (CPRP, 2008) recommendations. Fully implement the Agreement on Internal Trade to dismantle provincial barriers. Clarify the net benefit test for FDI and apply it narrowly.
- Promote efficient and deep financial markets by: improved accounting for intellectual assets, more vigorous competition in financial services, and consistent and high standards in provincial securities market regulation.
- Examine how institutions can better develop cognitive and social skills for entrepreneurship and risk-taking. Support and encourage risk-takers across the board, from high-tech *avant-garde* to skilled trades.

Better target fiscal supports to R&D

- Scale down SR&ED tax subsidies, reducing the small firm subsidy rate toward that of large firms while keeping the base broad (inclusive of capital) to avoid distortions in technology choice. Restore the 20% general SR&ED rate.
- Streamline fragmented federal granting programmes to boost business interest in collaborations with academics. As IRAP is expanded, consider partial cost recovery of pre-commercial business advice.
- Carefully design support to venture capital by means of temporary co-financing arrangements, giving private partners full management control and possibly capping government returns in order to leverage private returns. Eliminate tax credits to retail investors in LSVCC funds. Provide institutional support to angel funds.
- Co-operate with provinces to align their grants and tax credits to R&D and VC with federal government.
- Design low-budget-cost policies to foster market demand for innovations, including “green” technologies, *e.g.* consumer policies and getting prices right via carbon taxes. Public procurement is relevant here, though it needs to be carefully designed to focus on technology neutrality and performance to stimulate innovation.
- As the policy mix shifts toward more granting and procurement, design safeguards against the risks of: lack of capacity in the public sector to wisely choose projects; inefficient policies and market distortions (including at the international level) due to Canada-only provisions; and capture by vested interests.

Update institutional foundations of the “knowledge economy”

- Motivate technology transfer from academia by means of improved incentives for academics, *e.g.* by adopting a more open and inclusive research-granting process, and business vouchers for academic collaborations. Consider rationalisation of currently widespread distribution of research resources in order to promote Canadian “star” universities better able to command market interest for their research.

- Strengthen the IP system: *i)* modernise the relevant legislation/public agencies to enhance transparency and guidance to inventors; *ii)* establish national protocols for sharing/transfer of IP in academic-business collaborations; *iii)* provide IP management services to SMEs, *e.g.* within regional centres of excellence; *iv*) establish a specialised Patent Court or section of a court; and *v*) promote international IP collaboration.
- Build capacity to undertake comparative evaluations of fiscal supports to better guide funding allocations and programme design. This could be done by an arms-length Innovation Council as recommended by the Jenkins panel.
- Tailor privacy protections to minimise tradeoffs with knowledge diffusion and network benefits from the Internet and integrated electronic medical records.

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