Impediments to the Commercialization of Canadian Innovation

Submitted to Industry Canada by Randall Morck, July 7th 2005.

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Executive Summary

Real economic impediments retard both innovation its commercialization in Canada. Drawing on the extensive academic literatures on the venture capital industry, taxation, and finance, this report highlights key economic issues and suggests directions for further policy exploration. The major recommendations are:

- Individual knowledge workers have few alternative employment possibilities in typical Canadian cities. In contrast, American cities often feature multiple universities, research institutes, research hospitals, and research oriented firms. Skilled individuals whose Canadian jobs do not work out must often move to continue their careers. In the United States, other opportunities are usually available nearby. This makes Canada unattractive to individual researchers. This, in turn, hampers innovators intent on commercialization who need skilled employees, reducing the scale of viable commercialization activity in Canada..
- This reduced scale, together with the dearth of skilled technology experts, raises the cost of running a discerning Canadian VC fund. VC funds require in house technology and business expertise to discern sound from unsound ventures. If their scale does not permit them to retain such expertise, VC funds fail to offer more attractive financing to better projects and end up specializing in worse ones.
- Canadian personal income tax rates need to be lower than those in the United States, all else equal, to overcome the disadvantages inherent in a smaller economy. However, by providing better value for tax dollar, Canadian governments might be able to avoid such a direct comparison, as with the *Alberta Advantage* program in that province. Nevertheless, lower personal income taxes should be explored as a way to create the deeper labour markets for skilled technology workers needed by discerning venture capital firms as well as by entrepreneurs undertaking commercialization.
- Canada's initial capital gains exemption followed by relatively high capital gains taxes contrasts unfavourably with the low flat rate imposed by the United States. Canada's system favours small scale commercialization, while the America system is relatively more favourable to large scale commercialization. At present, capital gains tax differences encourage innovators withy truly large scale commercialization plans to move south.

- Canada's more highly regulated economy is necessarily more vulnerable to regulatory capture – the almost inevitable process whereby regulators change from government representatives affecting an industry into industry representatives affecting government. Appreciating the costs of regulatory capture should lead to a more parsimonious use of overt regulation.
- Subsidies to business should be used cautiously if at all. Subsidies are a *success tax* because manifestly successful businesses' higher taxes subsidize whatever mixture of failures and potential successes attract the subsidies. Taxing success is a poor strategy for spurring commercialization. Subsidies that artificially prolong the lives of old, misgoverned businesses are especially pernicious because this can impede the new, better managed firms that might have arisen instead.
- A key danger in any system of grants to industry, especially in a smaller country where business and political leaders are more likely to have personal connections, is that it encourages *rent-seekers*, false entrepreneurs whose expertise is solely in extracting *rents*, or *unearned income*, from the government. We suggest some filtering rules that might minimize rent seeking in any programs to subsidize commercialization.
- Ongoing government revenues from natural resources royalties and jobs in natural resources industries free both governments and voters from the immediate consequences of bad policies. Canada may be slower to correct policy errors because its natural resources wealth cushions it. One consequence is that financial market regulation flaws, tax policy flaws, university governance problems, and other innovation and commercialization retardants are corrected too slowly.
- The economics literature does not justify policies requiring university researchers to obtain matching funds from industry. Such policies are likely to encourage rent seekers from both domains and fund little research of real value to either.
- The government should finance research that the private sector will not. This includes both basic research and applied research in out-of-fashion fields.
- Canadian universities, their commercialization arms, and their local VC partners may be too rapacious in appropriating returns to commercialization be university researchers. More generous policies towards individual researchers would likely increase commercialization rates smartly, and might even increase universities' revenues from commercialization. We recommend that actual and potential commercializers of university research be surveyed to improve university governance.
- Recent work finds a highly significant correlation between a university's academic *prestige* and technology commercialization in the adjacent area. Prestige entails attracting and keeping star researchers, who attract other researchers and so deepen the local labour market.
- Government spending on research could broaden and deepen labour markets for skilled knowledge workers by supporting basic research at universities and by funding freestanding research institutes. These might be used to overcome rigidities and ideological barriers that prevent Canadian universities from attracting and retaining star researchers in the sciences, engineering, medicine, and business.
- William Gates, the father of Microsoft founder Bill Gates, Warren Buffett and George Soros persuasively argue the desirability of inheritance taxes as ways to induce

private benefactors to establish and fund such institutes. Perhaps Canada should tax inheritances more and income and capital gains less.

- Improved transparency and governance standards in financial markets cause IPOs to fetch higher valuations, and so increase the returns to commercialization. Canadian securities markets probably pay too much heed to established issuers who prefer low compliance costs and too little to investors and prospective issuers, including innovators considering commercialization, who prefer higher valuations.
- Canada's program of tax advantaged labour union run venture capital funds should be terminated. A vibrant venture capital is an important policy objective in and of itself. The VC industry should not be a bone thrown to special interests like labour unions

Introduction

As per the instructions, comments on each set of issues are broken out into the suggested categories. Policy priorities in each category are summarized at the end of the document.

We are better qualified to answer some of the queries you pose than others, and will therefore devote more space to the former. Some studies suffer from greater conceptual or econometric problems, in our opinion, than others, and are therefore given less weight. Innovation fits into economic theory as a key determinant of growth over the long run – measured in decades rather than years. This makes studies of short episodes of economic history useful, but uncertain guides to policy. Finally, venture capital is the subject of on-going research throughout the world, and new findings may alter some of the conclusions drawn below. The thoughts recounted below reflect our current understanding of the issues and evidence.

Preliminary Points

To make our reasoning in responding to the specific questions clear, we first explain current thinking regarding the policy dimensions into which you indicate you wish us to group those responses

The Innovator's Perspective

To understand why innovators decide to commercialize an innovation or not, policy makers should put themselves in the position of the innovator. The innovator's economic advantage from commercialization is the present discounted value of economic value added she receives from commercialization each year over the commercial life of the innovation. One simple expression captures this, and therefore all the different points advanced below about what encourages or discouraged commercialization. The benefit of commercialization to the innovator, *v*, is

$$[1] \qquad v = b_0 - c_0 + \frac{b_1 - c_1}{1+r} + \frac{b_2 - c_2}{(1+r)^2} + \ldots + \frac{b_t - c_t}{(1+r)^t} + \ldots$$

where the economic value added in year t is the innovator's expected economic benefits, or cash inflows, b_t, less her expected costs, or cash outflows, c_t, during the same year.[1] Since future cash inflows and outflows are uncertain, basic microeconomics requires that they be discounted at a rate r equal to the economy's base interest rate plus a risk premium.

Public policies that encourage commercialization must raise the innovators expected benefits, the b_t, lower her expected costs, the c_t, or lower the risk premium, r. Public policies that discourage do the opposite: lowering the b_t, raising the c_t, or raising r. Of course, it is possible for a public policy to have mixed effects, raising some parameters and lowering others. In such cases, the policy encourages commercialization if the net effect is to raise v and discourages commercialization if the net effect is to lower v.

Macroeconomic and microeconomic framework policies

In an empirical study of the growth of venture capital financing in the United States from 1972 though 1994, Gompers and Lerner (1998) find that the most important factors were tax rates, pension fund regulations, and real growth in gross domestic product. The also note a relationship between R&D spending in states and VC activity.

Personal Income Taxes Matter

Their data indicate a clear linkage between reductions in personal capital gains tax rates and increases in venture capital activity. The effect seems to be on the 'demand side', in that lower capital gains taxes induce more people to establish the sorts of entrepreneurial businesses that require VC financing, and which would generate substantial person capital gains income for them. In contrast, the data do not reveal a clear link between capital gains taxes and investors willingness to commit their savings to VC investments.

This finding is potentially important, as past tax reforms in Canada have concentrated on reducing corporate income taxes. These finding suggest that personal taxes, in this case on capital gains, are more macroeconomically important relative to corporate taxes than many mainstream tax economists realize.

It is also likely that high person income taxes deter the commercialization of innovation. This is an indirect effect, arising from the need for pools of highly skilled individuals in high tech clusters, which we explain below.

By leaving more income for the innovator, lower capital gains taxes and lower income taxes increase the benefits the innovator gains from commercialization. By encouraging pools of high income technology workers in Canada, lower income taxes reduce the innovator's costs of commercialization by making a pool of skilled labor more readily available.

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[1] This is a simplified example of *economic value analysis* or EVA, in which the *net present value* of an investment is $v = \max_{\boldsymbol{\varphi}} \int_0^{\infty} [b(t,\boldsymbol{\varphi},\boldsymbol{\psi}) - c(t,\boldsymbol{\varphi},\boldsymbol{\psi})] e^{-r(\boldsymbol{\varphi},\boldsymbol{\psi})t} dt - \boldsymbol{\lambda} \cdot \mathbf{f}(t,\boldsymbol{\varphi},\boldsymbol{\psi})$ where $\boldsymbol{\varphi}$ is a vector of the innovator's decision variables, $\boldsymbol{\psi}$ is a vector of public policy variables, and $\mathbf{f}$ is a vector of constraint differential equations that bound both the investor's actions and public policy. This degree of formalism is not necessary to make the basic intuitive points that follow.

Rules Governing Institutional Investors Matter

The US Labor Department's 'clarification' of its 'prudent man' investment policy rule for pension funds significantly increased the supply of capital available to VC funds. This was controversial at the time, as it meant exposing workers' pensions to higher risks. However, this concern seems misplaced. To my knowledge, none of the underfunded pension plan problems currently confronting the Pension Benefit Guarantee Corporation in the US are due to VC funds. The freedom of Canadian pension funds to invest in VC funds is thus important.

By permitting pension funds and other institutional investors to fund commercialization efforts, public policy can reduce the innovator's cost of capital, and so make commercialization more attractive

General Economic Conditions Matter

Finally, economic prosperity in general seems correlated with entrepreneurial activity and VC financing. This suggests that VC policy should be nested within broader policies that promote economic prosperity, such as sound monetary and fiscal policies and the lowest taxes and lightest regulatory burdens consistent with good government.

General economic prosperity has been shown to encourage commercialization. This means any adverse effects due to higher costs or wages in periods of prosperity are more than offset by better market conditions for applying the innovation and by lower costs of capital and lower levels of risk.

Financing

It is very clear that an absence of financing can impede entrepreneurship and that well developed financial markets and institutions can, in part at least, overcome these constraints.[2] Financial systems suffer from three well-understood market failure problems, and modern institutions have evolved to minimize these problems.

Discernment

One problem, called *information asymmetry* or the *lemons problem*, arises because providers of capital cannot always distinguish sounder ventures from less sound ones.[3] To see how this distorts venture capital financing, consider two VC funds – Fund A's managers can distinguish sound ventures from unsound ones, but Fund B's managers cannot. Fund A therefore advances funds to entrepreneurs with sound ventures funds at a modest interest rate and rejects entrepreneurs with unsound ventures. Fund B advances funds to all entrepreneurs at a high interest rate so that losses from unsound ventures can be offset by higher returns from sound ones. Of course, Fund A gets all the entrepreneurs

[2] Evans and Jovanovic (1989) show that individuals typically must rely on accumulated personal wealth to start their own businesses. Holtz-Eakin, Joulfaian, and Rosen (1994b) show that individuals who inherit wealth are more likely to become sole business proprietors. Holtz-Eakin, Joulfaian, and Rosen (1994a) show that inheritances raise entrepreneurs' business survival and performance rates. These results do not justify reducing taxes on estates or other measures to encourage larger inheritances because Morck *et al.* (2000), Perez-Gonzales (200x), Villalonga (200x) and others show that established heir-run businesses do not perform especially well. Rather, they underscore the importance of making capital available to anyone, regardless of parental wealth, with sound ideas, for example via a developed venture capital industry.

[3] See Stiglitz and Weiss (1981) and others for a discussion of this in the context of funds provision. For the general economic principles involved, see Akerlof (1970).

with sound ventures, who resent paying the higher interest Fund B demands. Fund B is then left with all the unsound ventures – the "lemons".[4] Our problem in Canada is that American VC funds are better at being Fund A and Canadian funds end up like Fund B.

Venture capital funds in the United States deal with the lemons problem by retaining highly paid specialized business and technical expertise.[5] Business expertise is needed because many technologically sound ideas do not fill real market needs. Technological expertise is needed to understand the challenges surrounding new ventures operating on the frontiers of science and engineering. Both are critical to a VC fund's success in emulating Fund A. Funds lacking such expertise end up like Fund B.

This expensive and rare expertise is the substance that makes the American VC industry what it is. Too many Canadian efforts to establish VC-like funds failed to appreciate this, and imitated the form of American VC funds, rather than the substance. It seems likely that Canada's government subsidized labour-union sponsored VC funds, for example, failed to provide an effective VC sector because they could not distinguish sound from unsound ventures, and so failed to offer the sound ones better terms and vet the unsound ones.[6] They thus end up unintentionally specializing in unsound ventures.

To some extent, this might look like a problem of too much public participation in VC financing. But the underlying problem is the fund managers' inability to tell technologically and economically sound from unsound ventures. Of course, political or other bureaucratic distortions of funding decisions can worsen these problems.

Good Governance Matters

The second major financial market failure that afflicts venture capital funding is called an *agency problem*.[7] When an entrepreneur takes money from a VC fund, she is expected to work competently and diligently to provide it with a fair return. If she does not, she fails in her duty to act as a faithful *agent* for the VC fund. Similarly, a VC fund's managers are expected to work diligently to provide its outside investors a fair return. Otherwise, they too fail in their duty to act as faithful *agents* for the outside investors.

Venture capital funds in the United States minimize agency problems between themselves and entrepreneurs by providing funding in *stages*, and by having their financial and technical experts monitor each entrepreneur's progress.[8] That way, if agency problems arise, a decision can be made about whether further investment is warranted. Again, highly specialized expertise is needed to make this work, for the fund must be able to distinguish ill faith by the entrepreneur from genuine marketing or

[4] This is a special case of the formulation in Myers and Majluf (1984).

[5] Gompers and Lerner (200X)

[6] For example, see "How the Bloom Came Off Crocus" by Paul Waldie on p. B1 of the Globe and Mail, July 4, 2005 and "How Crocus Lost its Bloom" by Carie Tait on p. FP1 of the National Post, July 4 2005. Both articles detail these sorts of problems in the labour-run Crocus VC fund.

[7] This is a special case of a market failure economists refer to as a *moral hazard*. Such problems arise because wherever cannot make credible commitments about their future actions. Kaplan and Stromberg. (2004) demonstrate empirically the first order importance of agency problems, including *hold up problems*, where one party refuses to cooperate to advance the venture until the other agrees to renegotiate the contract.

[8] Gompers and Lerner (1996) also note the use of legal covenants where potential agency problems are of great concern, especially when suppliers of capital have better bargaining power. Gompers and Lerner (1999) detail the oversight process typical in the United States. Cummings (2005) especially stresses the importance of agency problems in the Canadian context.

technological challenges. Where competence rather than ethics is the perceived problem, VC funds sometimes impose the needed expertise upon the ventures they fund. For example, a technologically sound venture whose principals lack serious business expertise might be forced to accept a business manager of the VC fund's choosing as a condition for obtaining financing.[9]

American VC funds minimize agency problems between themselves and outside investors by building and jealously safeguarding reputations. Funds with long track records of success attract investors. Newer funds, or funds with more mixed records, have greater trouble raising funds from investors, and so must offer better terms. This necessarily requires lower profits for the VC fund and, sometimes, less competitive financing offers to entrepreneurs.[10] Established VC funds that repeatedly serve their investors well thus accumulate ever increasing advantages over unproven funds.

Investor Behaviour Matters

The third major problem afflicting financial markets is investor *herding*, or what Federal Reserve Chairman Alan Greenspan famously called *irrational exuberance*. Analyzing companies and industries to determine fundamental values is expensive and time consuming.[11] Consequently, public investors, from day traders to pension fund managers, rationally watch each other for clues about what other people's analyses have revealed. Most of the time, this strategy is socially useful, as it magnifies the flow of capital into firms or industries that an analyst feels have growth opportunities. However, occasionally this behaviour causes bubbles, where too much capital flows into the favoured companies, elevating their stock prices and inducing unprofitable overinvestment.[12]

All of these problems mean that even the most successful venture capital funds must build a high failure rate into their calculations. Successful VC funds earn high enough returns on the minority of their ventures that succeed that they can consistently provide their own investors with competitive returns.[13]

Skills

Perhaps the most obvious common feature of high technology clusters is their large pools of highly skilled individuals.[14] High tech clusters – like Silicon Valley in California, Route 128 in Massachusetts, and the Research Triangle in North Carolina – all contain many research intensive universities, institutes, and businesses. This creates unusually low-risk environments for highly skilled individuals.

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[9] Lerner (2002).

[10] For example, Gompers (1996) shows that younger VC funds take companies public earlier and at bigger discounts to establish good reputations among investors. This makes the financing they provide more expensive to entrepreneurs.

[11] See Shiller (2000) for a highly cogent nontechnical explanation.

[12] See Kindelberger (1976) for historical examples. See Lerner (2002) for details on the recent boom and bust, and for economic reasons for VC financing to be especially susceptible to such fluctuations. Kaplan (2004) finds that VC funds formed during "booms" have abnormally weak performance.

[13] See Gompers (1995).

[14] Jaffe, Trajtenberg, and Henderson (1993) show that U.S. patent tend to cite patents of other geographically proximate innovators. Arora *et al.* (2004), Jacobs (19xx) and others show that the geographical clustering of innovative activity is a recurring historical theme.

Knowledge Workers' Career Risk Matters

To see why, consider that a specialized science PhD graduate from a top university who locates in such an area is not bound to a single employer. If the first employer doesn't work out, there are many others in the area. In contrast, a typical Canadian city might have one, or at most two such prospective employers, and changing jobs usually means changing cities.[15] It is not hard to see why the graduate would prefer moving to the high tech cluster, rather than the typical Canadian city. Absent personal geographical preferences, a substantial salary premium would be needed to attract the graduate to Saskatoon or Quebec City.

Existing Pools of Skilled Workers Lower Hiring Costs

These pools of skilled labour also attract high-tech employers. An entrepreneur who locates in Massachusetts can draw talent away from local universities, institutes, and businesses without paying the exorbitant relocation costs that would be needed to woo those same people to Saskatoon or Quebec City. This reduced innovators hiring costs and so encourages commercialization.

Existing Pools of Skilled Workers Lower Capital Costs

Finally, the pools of skilled labour also make running a venture capital more cost effective. As indicated above, successful VC funds need their own experts to evaluate the technological prospects of the projects they consider funding, and to monitor the progress of the entrepreneurs they back.

Historically, the pools of skilled technology workers came first and the VC clusters developed around them. The San Francisco area, Massachusetts, and North Carolina are similar in containing many research universities and institutes concentrated in relatively small geographic areas. It seems likely that these concentrations of career opportunities made these areas attractive for highly skilled technology workers. Entrepreneurial technology firms and VC funds seem to have followed the skilled people.

Entrepreneurs who know they have sound venture proposals realize that they should be able to get financing on good terms. If Canadian VC funds are less able to distinguish sound from unsound proposals, and offer financing on average terms to both, the best projects will obtain funding elsewhere. If entrepreneurs come to realize this, those with the best projects rationally decide to save time by not bothering with Canadian finance providers in the first place. To Canadian venture capital providers, this might well look like a dearth of interesting projects to finance. But that interpretation would miss the underlying problem.

Science and Technology Policy

Sound science and technology policy should likewise avoid creating socially undesirable skills. One key danger of any system of grants to industry, especially in a smaller country where business and political leaders are more likely to have personal

[15] Lerner (1995) shows that, when American VC funds finance geographically distant ventures, they are represented on the board more frequently, especially around critical decisions like CEO succession. Presumably, such formal participation is less necessary in geographically more proximate ventures.

connections, is that it encourages *rent-seeking*, where entrepreneurs invest in expertise useful solely for extracting *rents*, or *unearned income*, from the government.

Competition from Grant Mills Matters

Canada needs to avoid encouraging people to become experts in the grant application process, rather than in science and technology commercialization. Gompers and Lerner (2001) highlight the danger of science and technology policies fostering rent seeking expertise – encouraging "entrepreneurs" adept at extracting public funds from grants agencies, but hopeless at both research and commercialization.

Competition from rent-seekers lowers the likelihood of a genuine innovator gaining a government grant to aid commercialization. This reduces the innovator's expected future benefits and therefore deters commercialization.

Avoiding Regulator Capture Matters

University of Chicago economist George Stigler won the Nobel Prize for his theory of *captive regulators*. The basic intuition is that virtually all government regulators begin life as effective tools of government policy regulating economic actors, but over time slowly transform into highly effective tools through which energetic rent-seekers extract preferential treatment from governments. That is, the regulators are captured by rent-seekers amid the firms they set out to regulate. This happens because, once a regulator becomes economically important, influencing the regulators becomes a worthwhile investment for the regulated firms. The more powerful the regulator, the higher the return to investing in political influence, that is, in rent-seeking.

Genuine entrepreneurs, considering commercialization, can be deterred from even applying for government grants if the grant application has been *captured* by grant mills, large established firms, or other special interests.[16]

The Cost of Intellectual Property Rights Matters

One example of regulatory capture is the intellectual property rights system. This was initially designed to protect innovators' ideas from copycats. However, Jaffe and Lerner (2004) make a persuasive argument that intellectual property rights law firms and large established technology firms have captured this regulatory system. They demonstrate that intellectual property law is increasingly being redesigned to maximize lawyers' profits and to shield established firms from competition by upstarts.

High costs of protecting intellectual property rights raises the expected costs innovators must pay and therefore discourages commercialization

Specific Issues

We now turn to the specific issues raised and consider public policy options given the basic economic considerations developed above.

[16] See Krueger (1997) and also Stigler (19xx), who discusses the economics of regulator capture in great detail. The basic intuition is that virtually all government regulators begin life as effective tools of government policy regulating economic actors, but over time slowly transform into highly effective tools through which energetic rent-seekers extract preferential treatment from governments. Stigler's work on this topic earned him a Nobel Prize.

First Set of Issues

- *Is the training or experience of managers, analysts in financial institutions or venture capitalists (VCs) in Canada lagging that of similar positions in the U.S. and impeding commercialization in Canada?*
- *Are projects requiring VC in Canada less interesting from a commercialization point of view?*
- *Is the financing of innovation in Canada more reliant on public than private sources of funds than in the U.S.? If so, why and what is the effect on commercialization outcomes?*

General Issues

Canadian universities rank well internationally, and produce graduates who could readily go into the venture capital business. They could surely do much better with better funding and management, but we feel the opportunities available to university graduates in Canada constitute the main bottleneck.

The general points above indicate that a deep labour market for skilled individuals, offering ample career options, is a distinctive feature of high technology clusters in the United States where commercialization is concentrated. Basic economics suggests that sucha labor market makes sense as a fundamental precursor to a high pace of innovation and commercializaation.

Consequently, many of the specific suggestions below focus on making Canada a more attractive place for highly skilled technology workers to foster similar pools of skilled technology experts here.

Macroeconomic and microeconomic framework policies

1. The considerations raised above suggest that Canada should consider lowering personal income tax rates to make the country more attractive to the sorts of moderately high income technology workers whose skills underlie successful high technology clusters in the United States. Lower taxes raise innovators' returns. But probably more importantly, by attracting large pools of such workers, lower income taxes reduce the hiring costs innovators considering commercialization must pay.

   Canadian fiscal policy needs to recognize that a degree of income inequality is desirable, not a necessary evil. Exceptional incomes that arise from innovation are part of a dynamic growing economy.

   Concern about inequality is laudable, might be more usefully directed at forms of inequality not as intricately related to the economy's growth, such as large inheritances and other purer windfalls.
2. Canada might also consider its capital gains tax regime. Federal capital gains taxes in the United States have now been lowered to a flat rate of 15%. While the large initial exemption in Canadian tax law is doubtless attractive to innovators, those who feel they have innovations with truly outstanding commercialization potential should view a lower flat rate as more attractive than Canada's initial exemption and then higher and progressive capital gains tax rate.

   The current differences between the Canadian and United States tax regimes encourage innovators with ideas with limited commercialization potential

to remain in Canada, but those whose ideas have larger commercialization potential to move to the United States.

Canada might consider adjusting its personal capital gains taxes to resemble those of the United States.

3. Institutional investors should be free to invest in the commercialization of innovations. Pension funds probably do not have the internal expertise to discern sound from unsound high technology ventures, however they should be free to invest in VC funds that do. It might be useful to survey institutional investors to ascertain what, if any, barriers limit their funding of the commercialization of innovations.
4. The government should adopt policies that foster sustained economic growth in general. Low taxes, monetary and fiscal stability, economic openness, and respect for the role of free markets all qualify in this regard. Direct interventionist regulations should be avoided because empirical work shows such policies to be much more vulnerable to rent-seeking.[17] The commercialization of innovations is best spurred by overall policies supportive of a robust economy.

Financing

1. Sound public policy should aim at minimizing information asymmetry problems. American VC funds do this by tapping pools of technological and financial expertise to aid them in distinguishing sound from unsound ventures and in offering more attractive financing to sounder commercialization ventures.

   Economists' standard public policy advice here is to improve transparency by mandating high standards of disclosure. This advice is problematic as regards VC financing because our current dysfunctional intellectual property rights system often forces innovators to keep their work secret to safeguard their intellectual property. The American VC industry therefore primarily taps private equity – wealthy individuals and institutions willing to forego the protection offered by securities law and invest on the basis of the reputation of the VC fund. These investors are protected from fraud or incompetence by corporate law, bankruptcy law, and contact law. To earn these investors' trust, the VC funds invested heavily in developing expertise to build reputations for identifying and nurturing winning innovations, and for writing effective corporate governance contracts that let innovators and investors both earn legitimate returns.

   An efficient and low cost judicial system for settling disputes in these areas is therefore sound public policy. Lowering investors' costs of potential litigation in the event of problems permits VC funds (and their investors) to offer capital on more generous terms, reducing innovators costs of capital and so encouraging commercialization.

   Later stage commercialization typically involves IPOs – selling stock in the venture to public investors in financial markets. IPOs that fetch higher prices enable the venture to raise funds with less dilution of the innovators' stake, increasing the share of future revenues she retains. This raises her expected benefits from commercialization.

[17] See Stigler (1964, 1971, 1986), Krueger (1997), Beck *et al.*(2004) La Porta *et al.* (2004), and many others.

Valuations are higher in stock markets that provide investors with sound property rights protection by mandating high standards of disclosure, restricting managers to prevent the abuse of public investors, and restricting controlling shareholders to prevent such abuse.

Canadian courts have consistently refrained from creating a fiduciary duty of corporate insiders to act in the interests of shareholders, as American corporate insiders must. Although the *oppression remedy* in the Canada Business Corporations Act and its provincial analogs mitigate this to some extent by creating duties of controlling shareholders towards public shareholders, this lacuna makes Canadian stocks less attractive to investors than they otherwise would be. Attention might be directed to clarifying that the officers and directors of a listed corporations have a primary fiduciary duty to act for public shareholders.

The increasing importance of income trusts in Canada provides an opportunity in this regard. The directors and top managers of listed income trusts should have a clear fiduciary duty to act in the interests of public unit holders. This should be accomplished through explicit legislation for both joint stock companies and income trusts, as the courts seem unwilling to take this step. .

Ultimately, what is required is the overturning of generations of complacency about corporate governance in Canada. A high degree of tolerance for uncertain, and even inept or dishonest governance of our large corporations is itself detrimental to Canada's economy and the return Canadians earn on their savings portfolios. However, uncertain governance has another more insidious cost. It makes investors shy of backing new ventures with offbeat ideas. This makes the Canadian Venture Exchange, which specializes in mining and oil stocks, especially susceptible to booms and busts as successive new generations of investors buy in and are burned.

A broad framework of policies to make Canadian listed securities more attractive, lift valuations, and stabilize markets raises innovators expected benefits from commercialization and so lowers innovators costs of capital. This encourages more commercialization.

2. Sound public policy requires minimizing agency problems; that is, maintaining high standards of corporate governance. To the extent that VC funds use private equity, they can tailor governance arrangements to their needs.[18] However, once again, VC commercialization generally entertains eventual public listing. Higher standards of corporate governance raise equity valuations, and therefore raise innovators' eventual returns from commercialization

   At present, corporate governance activist groups, like the Canadian Coalition for Good Governance, are advancing proposals for raising standards of corporate governance in Canada.[19] These include, for example, letting outside investors nominate directors, control CEO hiring and firing, handle relations with auditors, and take charge of other general aspects of corporate governance quality control. These initiatives should also be embraced as promoting

[18] See Kaplan and Stromberg. (2003). For detailed examples.
[19] See Jarislowsky (2005) for a critique of Canadian corporate governance.

commercialization by raising valuations and therefore innovators' probable payoffs from IPOs.

3. Sound public policy requires recognizing that episodes of irrational exuberance occasionally distort stock markets, and that this can distort commercialization decisions. The venture capital industry has yet to address effectively the resulting *boom and bust cycle* in VC financing, though tapping mainly private equity during market downturns and taking ventures to public markets during periods of market exuberance mitigates the problem somewhat.[20]

   Gompers and Lerner (2001) propose that government VC funds might mitigate such market failures by backing technologically and commercially viable ideas in out-of-fashion firms and industries, and in periods when VC financing as a whole is out-of-fashion. They caution that government funds too often actually do the opposite, pouring taxpayers' money onto already overheated sectors.

Skills

1. Canadian personal income tax rates remain substantially higher than in the United States, especially in that top marginal rates apply at much lower levels of income here. My own experiences in hiring at the University of Alberta suggests that after tax income is very important to new PhDs, although prospective hires usually dislike voicing this. While better public services go some way towards offsetting this disadvantage, highly skilled technology workers and others with uncommonly valuable talents or education understandably find the United States more attractive. Each time this happens, it reduces our pool or talented individuals a little and worsens all of the problems enumerated above that stem from too few skilled individuals.

   This leads to an insidious destructive spiral. Our tax policy encourages many of our most productive innovators to commercialize their innovations south of the border and discourages foreigners from relocating here to commercialize their innovations. This shrinks the pool of talent in Canada, further reducing Canada's ability to support innovation and commercialization in the future.

   This could be reversed. Lower personal taxes aimed at both retaining Canadians and attracting foreigners with commercialization plans, we could steadily grow our pools of talent, gradually building up critical masses of skilled knowledge workers to create high technology economies across Canada.

Science and Technology Policy

1. Others are in better positions to debate the reliability of figures regarding public versus private financing of innovation in the two countries.
2. Subsidies to business should be used cautiously if at all. Subsidies must be paid for with higher taxes, and thus amount to a general *success tax*. Successful businesses pay higher taxes to contribute to whatever mixture of failures and potential successes attract the subsidies.

   If the bureaucrats administering the subsidy program are successful at picking winners that would not have attracted private financing anyway, the program may be judged a success. Lerner (1999) and Toole and Czarnitzki

[20] See Lerner (1994). See also Morck *et al.* (1990) for evidence on IPO timings.

(2005) find that grants from the largest American government funded program to finance small firms, the Small Business Innovation Research program, grew significantly faster than matched firms over a decade and were more likely to attract venture financing. However, these findings should not be taken as ringing endorsements of subsidies to small business. First, the counterfactual is unclear, in that many of these ventures might have attracted private financing in the absence of the public program and succeeded anyway. Second, there is no accounting of the cost in terms of jobs lost, investments not undertaken, etc. by the firms that paid higher taxes to finance the subsidy program. And if Canada were to subsidize such a program out of higher personal income taxes, this has the detrimental effect of penalizing skilled individuals and raising subsidized and unsubsidized innovators' commercialization costs alike.

However, as explained above, distinguishing technologically and economically sound from unsound ventures requires expensive expertise in private sector VC funds. It seems unlikely that the civil servants charged with administering subsidies generally possess such expertise.

Subsidies to businesses should be understood as success taxes and employed rarely if at all. Government would better focus on funding basic research and fostering high technology labour markets.

3. Public funding need not be a drag on innovation, but often is because politics and bureaucratic inertia guide funding. The advantage of private VC funds in the United States is that they seem to have done a good job of guiding capital to its best uses. This permits areas of the United States possessing deep pools of technological and/or business expertise to flourish as their residents help guide and use this capital. Science and technology policy in Canada should aim at fostering pools of skilled knowledge workers – perhaps by promoting well governed research institutes and foundations to complement our universities and hospitals.

   Canadian government funded research might fail to lead to commercialized innovations for several reasons related to the points raised above. Canadian universities are often isolated institutions, situated in cities and towns with overall low densities of knowledge workers. This makes risky undertakings potentially expensive for young academics, as failure to gain tenure necessitates a costly move to another city. The same low density also makes local commercialization difficult for successful academic innovators because of the dearth of local talent to hire. The overall low density of knowledge workers makes it harder for venture capital funds to hire and retain the experts they need to assure themselves of the innovation's viability.

   Government policy might help correct this by phasing out subsidies to high-tech businesses, and instead aiming to broaden and deepen labour markets for skilled knowledge workers by supporting basic research at universities and by funding research institutes.

   Canadian science and technology policy should aim to create solid career opportunities for highly skilled technology experts so as to build up pools of skilled people similar to those in American high-tech clusters. Ideally, highly skilled individuals should see Canadian cities as places with many opportunities

for career advancement, not as places with only one or two prospective employers.

One possibility is to fund public research institutes with mandates that both serve the public and create such career opportunities. For example, publicly financed research institutes with pure science or medicine mandates might help expand the pools of skilled individuals in strategically chosen parts of the country. This would subsidize local high technology firms by making their localities more attractive to the sorts of employees they need – and without the attendant problems of direct subsidies to industry.

Institutions other than universities provide do this quite effectively in parts of the United States.[21] Research institutes, research hospitals, and other government funded organizations might accomplish this here by providing career opportunities for more Canadian knowledge workers. While Canada cannot afford to create research institutes on the scale of the National Institutes of Health or NASA, more government funded institutes might be established to tackle specific medical or technological problems important to Canada. A higher density of such establishments would complement our universities and provide more career security for technology workers by making more employment options available to them in typical Canadian cities.

The governance of these institutes would have to be at a high standard. They might be created around active researchers at established universities with established track records and supervised by boards of distinguished researchers in similar fields in the United States. Or they might be organized by interest groups, such as lobby groups pressing for funding to cure certain diseases. Regardless, the key to good governance in such institutes is a system of informed outside oversight.

Such institutes might be established entirely with direct government funding, or partially by creating tax incentives for wealthy individuals and families to endow such institutions. In the United bequests by wealthy individuals seeking to pre-empt that country's previously quite high inheritance taxes were critical to the success of many research institutes. Perhaps attention might be given to imposing higher estate taxes to induce such bequests in Canada. Some activists and economists argue that high estate taxes deter entrepreneurship because entrepreneurs often dream of founding dynastic family corporations. But this explains the current situation in America poorly. Bill Gates and many other high tech entrepreneurs show no signs of grooming their sons to succeed them. In fact, these are the grounds on which William Gates, the father of Microsoft founder Bill Gates, argues vociferously against President George W. Bush's policies of reducing or eliminating 'death taxes' in the United States, and entrepreneurs with less high tech pedigrees, like Warren E. Buffett and George

[21] Jaffe and Lerner (2001) report that US national laboratories patenting has attained parity with research universities in patents per R&D dollar. Unlike universities, laboratory patent quality has remained constant or even increased despite this growth. Success is associated with avoiding technological diversification and with having a university lab manager.

Soros concur.[22] If we have to raise taxes, perhaps better inheritance taxes than any others. Even if we don't, we might consider a revenue neutral increase in inheritance taxes and offsetting reduction in income taxes.

4. Perhaps equally important, Canadian science and technology policy should avoid creating socially destructive skills. Public funding attracts rent-seekers – individuals or firms expert at manipulating the grant application process, but hopeless at innovation or commercialization.

   Government funded research might be more vulnerable to rent-seeking than privately funded research. Government agencies necessarily need to allocate funds without huge expenses, and this may attract what Lerner (2002) calls *grant mills* - companies or individuals expert in manipulating the grant application process but hopeless at actual innovation or commercialization. If political interference in the grant adjudication process, or even simple bureaucratic inertia, directs funding down unprofitable paths, the situation is worsened.

   Gompers and Lerner (2001) argue that relatively simple filtering rules can help here. Genuine applicants tend to apply for a single grant – and then develop and commercialize a product. Rent-seekers tend to apply for grant after grant from various government agencies, amid assurances of promising outcomes just around the corner.

   Granting agencies can filter out rent-seekers by blacklisting serial applicants with no record of success, taking into consideration that the same individual may apply using different partners or corporate entities.[23] Gompers and Lerner (2001) also advise that all government granting agencies share the same blacklist so that one agency can learn from another's mistakes. They report that serial rent-seekers in the United States often start fresh with their next granting agency after exhausting their opportunities with their previous one.

   In passing, Lerner (2002) notes that underachieving ventures can also be culled by checking for factors outside the scope of the normal applications process. For example, they suggest that applicants be asked to disclose recent and ongoing legal troubles. Such problems may or may not be an indicator of ill faith, but public funds should probably not be invested in lawsuit-prone firms that may end up turning the money over to plaintiffs.

   Private VC funds in the United States avoid such problems by subjecting applicants for funding to rigorous technological scrutiny by their in-house experts and by using *staged financing*. In staged financing, the VC fund and the entrepreneur being financed predefine 'goalposts' that must be passed in sequence as the product is developed and then commercialized. Successfully passing each goalpost releases funding to finance the next stage. Failure to reach a goalpost cuts funding unless the entrepreneur can explain to the VC funds technological experts why a change in the sequence of goalposts is needed.

[22] See "Dozens of the Wealthy Join to Fight Estate Tax Repeal" by David Kay Johnston, *New York Times*, Wednesday, February 14, 2001.

[23] Lerner 91999) shows that multiple awards from government granting agencies in the United States do not improve the subsidized venture's performance, suggesting that repeat applicants are not superior investments.

5. A degree of intelligent flexibility on the part of the granting agency or VC fund is clearly warranted here. Obviously, if a drug developed to combat one disease suddenly shows major promise in fighting another, or if the entrepreneur jumps over intermediate goalposts, such a change is warranted. If market conditions change abruptly, or if advances in other fields create new opportunities for the use of the venture's technology, the entrepreneur needs to be able to act quickly; and it is clearly in the investors' financial interest to encourage this.

   Lerner (2002) shows that government run and government subsidized VC investments in the United States are subject to worse inflexibility problems than private sector funds. He documents, for example, an instance of a venture reaching predetermined goalposts ahead of schedule and being starved of funding by the government agency at the next stage of commercialization for deviating from the planned schedule.

   Intelligent flexibility in any publicly funded or publicly subsidized VC funds reduces innovators uncertainty and increases their expected future benefits. Both should render commercialization more attractive.
6. Repeated delays that merely lengthen the road to commercialization because of 'unforeseen complications' are usually viewed as evidence that the entrepreneur didn't know what she was doing, and usually lead the VC fund to abandon the project. A like willingness to abandon unprofitable ventures, especially those run by entrepreneurs with rent-seeking expertise or political influence, is imperative in any public VC fund.

   This recapitulates the old lesson of *writing off sunk costs* from Introductory Economics. Findings in behavioural economics show that human nature makes us averse to realizing our losses.[24] We offer second, third, and n^{th} chances to people with whom we develop personal relationships. Sound financial management of a public or private sector VC fund requires a focus on justifying the intangible but essential trust of taxpayers and public investors.

   VC funds cut off funding where results are absent. Failing to do this eventually compromises their ability to raise funds from private investors and taints the politics of further public subsidies. Either outcome raises the costs of capital innovators confront when considering commercialization.

Second Set of Issues

- *Does the scale of Canadian markets reduce the expected rate-of-return on new products or processes?*
- *Do small markets affect the level of sophistication of buyers or the extent of rivalry?*
- *Are there firm-level size effects that promote or hinder the commercialization of innovation and knowledge?*

General Issues

Economies of scale are clearly important in making innovation viable. Innovation usually has big up-front costs, as with drug development or software. Once the innovation is developed and commercialized, applying it on a larger scale is usually

[24] See Shleifer (200x)

relatively easy. For example, physically producing additional pills or CDs of software is quite cheap. This means access to a larger market can often be the critical determinant of whether an innovation is commercially viable or not.

It is hard to overstate the importance of this consideration. Econometric evidence suggests that even the United States is too small an economy from this perspective, and that a substantial part of the multinational expansion of US firms stems from a need to achieve larger economies of scale for innovations.[25] However, developed economies that are thoroughly integrated into world markets are able to overcome the constraints not only of the small scale of their domestic economies but also of minor domestic institutional deficiencies.[26]

Macro-economic and micro-economic framework policies

1. Free trade with the United States was an important step towards expanding the markets in which innovative Canadian firms can operate. Unhindered access to larger foreign markets makes Canada a more attractive place for innovators to commercialize their ideas.
2. Potential new businesses arising and replacing old ones sustains economic growth.[27] However, by dint of being 'potential', these businesses have little voice in political debates. We must therefore infer their needs and preferences from the decisions of past successful new business entrants here and elsewhere, and how a smaller economy like Canada might better satisfy them. This means that lobbying by established businesses should not be taken as representing the interests of potential new businesses. Surveys of recent commercializers and innovators in the process of commercializing innovations might be undertaken.
3. For decades, the United States served as a magnet for highly skilled financial and technology experts. This seems to reflect, in part, the draws of large pre-existing pools of like talent in America's great financial centers and research universities. To build like pools in Canada would require making this country even more attractive to such people, so as to overcome the disadvantage of having smaller pre-existing pools of business and scientific talent.

   We reiterate that lowering taxes might help in this regard. Canadian personal income taxes, especially when augmented by provincial sales taxes and the GST, result in much higher effective tax burdens than in the United States on the sorts of moderately high income earners that compose that country's deeper pools of financial and technological talent. The much rarer entrepreneurs, who actually found and build new ventures, draw skilled employees from these pools as their ventures grow, and so would benefit indirectly from lower personal income tax rates for these individuals. The entrepreneurs' personal wealth, and

[25] See Caves (198x), Morck and Yeung (1992, 1993, 1994, 199X), and others.

[26] Desai, Gompers, and Lerner (2003) show that differences in local regulations, judicial systems, and other economy characteristics are important determinants of entrepreneurial activity in Eastern and Central European countries, but not in the more advanced countries of Western Europe.
Institutions matter a lot in Eastern Europe, but not much in Western Europe.

[27] For evidence, see Fogel *et al.* (2005) and many others.

that of investors in VC funds, is mainly affected by capital gains taxes, and lowering these has been shown to stimulate VC activity in the United States.[28]

To overcome the disadvantage of smaller pre-existing pools of business and scientific talent, it would seem Canada might arguably need to levy even lower individual taxes than the United States. However, taxes are clearly not the sole draw for such individuals. For the states in which they accumulate, like California and Massachusetts for technology experts, or New York for finance experts, are relatively high tax states. The lower tax burdens in southern states fail to attract if the cost is weak schools, poor public infrastructure, and mismanaged public sectors.

It seems that 'value for money' in taxes might be the draw. This recalls the *Alberta Advantage* program to restructure that province's public sector in the 1990s. The program was partly a response to scandals involving the perceived misuse of provincial money to support well-connected businesses in the 1980s, and sought to counter a populist push for *smaller government* with a counterproposal for *more cost-effective government*.

Perhaps a similar *Canada Advantage* might be developed. Canada should lower personal tax rates as much as possible, for example, by improving public sector governance across the board and by eliminating all or most business subsidies.[29] We then might tout Canada as giving taxpayers the public services they want (and not the others) at the best value for money, and attract high income skilled knowledge workers with 'value for tax dollars' rather than low taxes. Of course, higher actual standards of public management would have to back up such a campaign.

Financing

1. Stock market size does not seem to be the primary determinant of how efficiently stocks are priced, or of how well the stock market allocates an economy's capital.[30] Other more important factors include the quality of a country's regulatory environment and the transparency of financial statements.[31]

   Canada scores well on most such criteria. However, Bris (2003) finds that Canadian stock markets are worse afflicted with insider trading than those of any other major developed country. This is a serious shortcoming, for small investors and institutional investors alike will pay less for a stock at its initial public offering if they anticipate that insiders will buy and sell strategically to the disadvantage of public investors. Lower IPO prices make start-up financing more expensive. Attention should be given to making insider trading more effectively policed and prosecuted.
2. The provinces seem to be failing badly in this important dimension of regulation and show little sign of improvement. For example, the major actions against

[28] See Lerner (2002), who also points out that the stimulus often drew more money into sectors already targeted by private VC funds, and did little to stimulate VC investment in new sectors – at least initially.
[29] Alberta actually has eliminated all business subsidies. The threatened mass exodus of businesses never materialized.
[30] See Morck, Yeung and Yu. (2000), Wurgler (2000), Durnev, Morck and Yeung (2004), Li and Meyers (2005), and others.
[31] Ibid.

Conrad Black are occurring in the United States, and the OSC seems relegated to watching from the sidelines. It seems likely that provincial securities regulators are paying too much attention to the concerns of past issuers and too little to those of potential issuers and investors.[32] From the regulators' perspective, this is rational since past issuers can threaten to relist to other markets. The result is an apparent *race to the bottom* with different Canadian jurisdictions striving to be the most toothless. The S.E.C. in the United States may well impose unnecessarily burdensome regulations on US issuers, but that has not stopped American stock markets from greatly exceeding Canadian ones in market capitalization relative to GDP. It may soon be time for the federal government to take a hand in securities regulation.

3. At pre-IPO stages of financing, American venture capital funds need access to a large enough pool of investment opportunities to justify the cost of acquiring the high level of expertise needed to distinguish sound from unsound ventures. That is, a smaller pool of investments reduces the fun's size, lessens its ability to pay for the highly skilled experts, and increases its uncertainty about the quality of its investment opportunities. As explained above, this uncertainty drives away the soundest projects and leaves the fund holding less sound investments. Successful Canadian based venture capital funds may well have to operate on a North American scale to succeed. Nationalistic limitations on foreign content in portfolios are thus unnameable to commercialization because they limit the scale on which VC funds based here can operate.
4. Even the US economy is too small in some ways. American VC funds have to be highly specialized technologically to vet their different investment opportunities. This extreme specialization makes their portfolios quite undiversified and hence quite risky.[33] To reduce their portfolio risk, American VC funds typically form consortiums. A single VC fund often provides the first stage of funding for an entrepreneur working in the technological sub-discipline in which it has special expertise. If the initial stages prove the worth of the innovation, the first VC fund often brings in other VC funds that specialize in other areas to form a syndicate to fund later stages. The other funds rely on the first to certify the technological and commercial viability of the venture and to monitor the entrepreneur. This strategy lets VC funds reduce risk by diversifying their portfolio of investments across fields while letting each fund specialize in a highly focused subfield of technology. Successful Canadian venture capital funds will have to engage in such syndicates, and should be free to cooperate with American funds. Again, nationalistic foreign content rules discourage commercialization by limiting Canadian VC funds' ability to diversify.

[32] See Jarislowsky (2005).

[33] Cantillon (1755) emphasizes that entrepreneurs specialize in handling risk. Gentry and Hubbard (2001) and Moskowitz and Vissing-Jorgensen (2002) show that entrepreneurs are unusually tolerant of sustained high levels of risk. Perhaps explaining this, Evans and Leighton (1989) find that entrepreneurs are unusually likely to believe that their success largely depends on their own actions. Puri and Robinson (2004) use U.S. survey data to show that entrepreneurs are abnormally risk-loving and optimistic. To channel funds from ordinary investors into such risky ventures, VC funds partially deflect these risks by, for example, forming syndicates to increase their diversification.

5. This syndication strategy suggests a possible role for private-public partnerships. The herding problem alluded to above causes private sector VC funds to over-invest in 'hot' fields and ignore viable ventures elsewhere. A public sector fund that specialized in first stage financing for ventures in out-of-fashion fields might be able to provide private-sector VC funds with welcome diversification opportunities by offering them later stage syndicated investment opportunities. This might even dampen private VC funds' herding by highlighting viable ventures in out-of-fashion fields and so improve the efficiency of the overall VC financing process.

Skills

1. The United States experience suggests that Canada needs concentrated pools of highly skilled individuals from which to draw both entrepreneurs and technological expertise for VC funds. Past Canadian policies, such as Canada's Labour Sponsored VC funds, miss the critical importance of the latter use of expertise. A recent widely respected overview of the venture capital industry by Harvard Business School Professors Paul Gompers and Joshua Lerner is scathing in condemning these policies, writing

> *"The Canadian government, seeking to encourage venture capital, established in 1993 a series of labor funds with total capital of over CAD$3 billion – more than the entire independent sector. Investors received exceedingly generous tax credits for investing in these funds, which were managed by labor unions and other organizations that were quite unfamiliar with the venture process and had compensation schemes very different from traditional independent partnerships.*
>
> *While the program sought to encourage Canadian the venture industry, the effect was quite the opposite. The relatively few independent Canadian venture funds found themselves competing against uninformed investors who, in many cases, were willing to commit capital at huge valuations. Man y of the independent groups, convinced that they could not generate profitable returns in the Canadian market, shifted to investing in the United States instead."*[34]

That is, unskilled managers of the labour-sponsored funds poured capital into sound and unsound ventures alike on very generous terms. This deprived private VC funds of the sound investments they would have funded in any event and poured capital into unsound ventures that should not have been funded. When the poor performance of these funds became apparent, investors withheld their money depriving sound and unsound ventures alike of capital.

By encouraging private Canadian VC funds to focus on American ventures, Canada's labour sponsored funds also left us with fewer skilled VC fund managers working to commercialize innovation in Canada than we would otherwise have had. This likely retarded the development of the Canadian VC sector by several years.

[34] Gompers and Lerner (2001), p. 172.

The venture capital industry is too economically important to be treated as a toy for special interests like labor unions. Existing and future labour sponsored VC funds should enjoy no special tax status or other special advantages. This misbegotten policy makes Canada a laughingstock among VC experts and practitioners elsewhere. It has also genuinely harmed the Canadian economy and actively impeded commercialization.

2. Any state subsidized VC initiatives should complement, not compete with, private funds. As emphasized above, sound policy requires that venture capital be directed where and when private funds are not. This would help build up pools of expertise in out-of-the-way fields with latent promise, and to sustain those in more mainstream fields when private VC funding grows bearish. Also, any state subsidized initiatives need individuals with technological expertise as well as financial and business experts.

Science and Technology Policy

1. Government subsidies to industry, often effected through science and technology policies, seem aimed at stabilizing large and politically influential corporations or corporate groups. However, recent work shows that a highly stable large corporate sector is undesirable in that it correlates with slow total factor productivity growth.[35] Countries whose lists of leading corporations change little over a generation show significantly depressed productivity growth.

   This finding supports the early theories of Schumpeter (1912) and more recent work in *endogenous growth theory* by Agion and Howitt (1998). These economic theorists argue that productivity growth occurs when creative upstart firms arise quickly, destroying stagnant established firms – and creating more jobs and wealth overall than they destroy. This *creative destruction* view of economic growth is now widely accepted as of first order importance.

   Empirical studies on US data show large established firms to be particularly poor at the promotion and commercialization of innovation and knowledge.[36] VC programs, formal and informal, run by large established corporations, are statistically significantly less successful than independent VC funds.[37] A variety of reasons might explain this, from established firms not wanting to finance products than might erode markets for their existing lines to human resources problems associated with fitting venture capitalists into their corporate hierarchies.[38] It seems that many genuinely innovative products need to be commercialized by a new firm.[39] Of course, there are obvious exceptions to this, such as 'big pharma' drug makers (until recently) and others. Also, later

[35] Fogel, Morck, and Yeung (2005).
[36] Gompers and Lerner (2000).
[37] Ibid and Baumol (2005).
[38] Gompers and Lerner (2000).
[39] Kummerle (2005) argues that large established firms have difficulty supporting radical innovation because of solid Bayesian priors about that validity of their current technology, problems guaranteeing innovators' individual property rights *vis à vis* other employees and the firm, solidly established routines, and steep adjustment costs. However, Klepper (2004) and others note the importance of large established firms as training grounds for future entrepreneurs.

stages can be turned over to a mature firm as, for example, when General Electric buys a clearly viable product from its inventors and takes charge of marketing it.

If government science and technology policy, or other subsidy programs, prolong the lives of stagnant firms, this process of creative destruction is delayed and productivity growth slows. Governments should therefore be especially wary of subsidies to large, troubled firms designed to bail out their current managers and controlling shareholders. Mitigating damage to the careers of such a firm's employees is a legitimate public policy goal, and might best be advanced by fostering deep labour markets that make the survival of any particular employer less critical. Since large established firms often invest in political influence, politicians and civil servants often find this more easily said than done. Nonetheless, the effort should be made.

2. Smaller firms, especially highly innovative upstarts, are often vulnerable in many ways. They are more dependent on simple cost-effective regulations, for they are less able to bear unnecessarily large compliance costs. Smaller firms, especially innovative upstarts, are more dependent on external financing, and so can be hurt disproportionately by policies that dampen financial markets. And smaller firms are often less able to defend their intellectual property rights in court against deep-pocketed adversaries.

   Simple regulations, vibrant financial markets, and unambiguous intellectual property rights all work to the advantage of upstarts.

Third Set of Issues

a. Does the industrial composition of production (e.g. resource-based) affect negatively the commercialization performance of Canada? If so, how?

General Issues

Influential work by Rodriguez and Sachs (1999) and Sachs and Warner (2001) shows that countries with greater natural resources wealth tend to have a lower quality of public sector governance. They attribute this to their governments having reliable sources of revenue from natural resources royalties that render them impervious to the detrimental effects of bad policies on their overall economies. In contrast, the government of resource poor countries need vibrant industrial and commercial sectors to generate tax revenues. While these studies primarily focus on this problem among developing economies, we wonder if revenues from natural resources industries might make Canadian governments and voters more tolerant of policies that would be more immediately disastrous elsewhere.

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Macro-economic and micro-economic framework policies

1. As Canada grows less dependent on simple natural resources extraction, its government will need to be quicker at revising unsound policies. This should be good for the commercialization prospects of innovations by reducing the expected burdens of ill-conceived public policies on innovators.

   To speed this along, attention might be given to attaching sunset clauses to major policy initiatives and devising standard procedures for reviewing the costs and benefits of public policies in a timely manner.

2. Resource-based economies are subject to boom and bust cycles, as commodity prices fluctuate. Entrepreneurial activity is less in emerging economies with more extensive macroeconomic volatility.[40] However, volatility is much less related to entrepreneurial activity in developed economies than in emerging markets.[41] This suggests that most developed economies have reduced their macroeconomic volatilities to ranges that do not impede entrepreneurship. Nonetheless, earlier decades in Canadian economic history, such as the Trudeau era of double digit inflation, may have attained levels of macroeconomic volatility that discouraged entrepreneurship.[42] And regional economies within Canada that depend on undiversified natural resources production may be sufficiently volatile to discourage innovation.
3. In a detailed study of the economic histories of cities, Jacobs (1985) shows that the proximity of unrelated industries is an important source of innovation. She argues that pools of skilled workers matter in vertically related, and even previously unrelated, lines of business spur innovation. These human resources mean entrepreneurs need not know everything, but can rely on established local expertise. This lowers innovators costs of commercialization. The proximity of experts also lets entrepreneurs transfer ideas from one field to another easily, and also combine ideas from different fields. Glaeser et al (1992) provide convincing empirical evidence supporting the first order importance of such technological cross-pollination. An economy with a more diversified industrial base is thus capable of more evenly sustained economic growth.

   Various Canadian government initiatives have sought to diversify regional economies of Canada. However, these initiatives seem to have drawn rent seekers too often, and are now increasingly politically suspect. Jacobs (1985) shows that many parts of the United States developed highly diversified economies spontaneously, often building on a temporarily booming natural resource economy. This was done without government direction. The pools of talented people built processing mills, service industries, consumer goods companies, and ultimately new exportable goods to replace dwindling resources revenues. The key to economic diversification, according to Jacobs (1985) is a concentrated population of talented and skilled people doing different things and able to learn from each other.

   Thus the public policies needed to encourage diversification are the same as those needed to encourage pools of skilled knowledge workers: delivering the public goods and services taxpayers want with maximum quality for minimal taxes stands out especially.

Financing

1. Canada's resource based economy has produced stock markets that are uniquely oriented towards financing small companies. TSX Venture stock exchange is a unique institution where companies issue public equity at much earlier stages than

[40] Macmillan and Woodruff (2002).
[41] Fogel *et al.* (2005).
[42] Morck, Percy, Tian, and Yeung (2005) show that old money family controlled business groups surged in importance relative to other types of business during the Trudeau era.

would typically happen elsewhere. Mainly used for issuing penny mining and petroleum stocks, it has an embarrassingly colourful history in its prior incarnations as the Alberta, Calgary, Edmonton, and Vancouver stock exchanges.[43]

Chan *et al.* (1990), Hall (1993), and others show that stock market investors have an appetite for research and development plays and assign a reasonable value to such long-term investments. Perhaps attention should be turned to remaking the TSX Venture Exchange, in part, into a market for venture capital. Exchange-based early stage venture capital financing might solve some of the problems associated with private equity backed VC in the United States. Lerner and Schoar (2004) argue that the illiquidity of typical US venture capital investments serves a purpose by pres-electing investors who have deep pockets and will not be tempted to withdraw their funding precipitously. If current investors withdraw their funds suddenly, new investors have difficulty telling whether the fund is in trouble or the investors simply have sudden cash needs. They show that funds with track records impose fewer liquidity restrictions, presumably because these funds can better convince new investors of their health. If rounds of VC financing were raised on exchanges, cold-footed early investors could sell out at any time by disposing of their shares in the market.

This would be facilitated by greater transparency and better governance standards, which might be resisted by the mining and oil stock issuers and underwriters, who are generally content with the market as is. Established issuers who do not plan to return to the market are typically more concerned with compliance cost minimization than with transparency or governance, which benefit investors and potential new issuers. Excessive opacity and uncertain governance heighten all three financial market problems discussed above, including worse boom and bust cycles. Of course, compliance costs should be kept as low as possible while enhancing transparency and governance.

However, complete transparency may not be desried by innovative start ups. VC projects are based on ideas – and so require secrecy until patent protection is available, and usually afterwards too. The TSX Venture Exchange would need to provide enough disclosure to reassure investors but not enough to compromise intellectual property rights.

Successful American VC funds have built up their reputations over the years not only among investors but also among innovators. VC funds that have solid reputations for preserving innovators intellectual property rights are better able to attract projects from the ablest innovators. Listed Canadian VC funds might build up such reputations over time too, given the expertise to become efficient discerners of the technological and economic viability of ventures as well, even in a somewhat opaque stock market. However, a more modest use of the Venture Exchange, consistent with improved transparency, might be for private VC funds to float IPOs of later stage ventures. Higher IPO prices due to better transparency and better governance would raise VC funds returns and permit them to offer cheaper financing to innovators, spurring commercialization.

[43] See Armstrong (1987).

Skills

1. Natural resources industries are now highly technology dependent. Oil and mining companies use some of the most advanced technology anywhere, and require highly skilled engineers, scientists, and technical experts; as well as top flight financial experts. These are precisely the sorts of people needed to build high technology clusters.
2. One issue associated with natural resource economies is that financing often takes the form of foreign direct investment – with foreign multinationals establishing subsidiaries in Canada. While populists decry the presence of multinationals here, they are probably good for innovation and its commercialization. Multinationals set whole pools of expert individuals down in Canada, creating one of the precursors to innovation-based economic growth. They also provide financing via trade credit and indirect channels though which local innovators can connect with world markets.[44] Overall, resource based firms and multinationals seem particularly capable of helping build the deep pools of skilled knowledge workers the analysis above suggests we need.

Science and Technology Policy:

1. Large resource based firms are increasingly dependent on technology for their competitive advantages in global markets. It makes sense for such firms to innovate to enhance such advantages, and to keep the innovation proprietary to preserve them. However, such innovation is best undertaken in thier current industries or closely ones. Research using United States data shows that diversification *per se* by established firms generally destroys value. Consequently, established resource firms should not be encouraged to enter 'hot' fields unrelated to their managers' expertise.[45]
2. Fogel *et al.* (2004) show that greater stability of a country's large corporate sector is associated with lower total factor productivity growth. This does not mean that government policy should aim at destabilizing large established firms, but it does suggest that heroic government efforts to 'save' large established firms is unwarranted. Subsidizing evident failures with taxes on successful firms and individuals is not within the purview of good government.
3. Fogel *et al.* (2005) document negative relationships between entrepreneurship and both the dominance of large firms (Herfindahl) and the importance of old family firms in an economy. This accords with previous work by e.g. Landes (1949) on the detrimental role of family firms on French economic history and Morck, Stangeland and Yeung (2000), who argue that old families' control of much of Canada's large corporate sector adversely affect public policy in a number of dimensions by creating a bias towards preserving the *status quo* in business lobbying. This bias might retard economic diversification by slowing Canada's entry into new high technology sectors by making government unduly attentive to protecting the stability of established businesses and the *status quo* in general. Attention might be given to lessening the importance of old family wealth, perhaps by raising inheritance taxes and reducing income taxes. Attention should

[44] See Acs *et al.* (1997).
[45] See Morck, Shleifer and Vishny (1990) and others.

also be given to making securities markets more attractive to potential new issuers, who are likely to be mainly concerned about high valuations, rather than past issuers, who are likely to be concerned about compliance costs.

4. Related to the previous point, Jacobs (1985), Glaezer *et al.* (1992),Fogel *et al.* (2005), and others show that more industrially diversified economies are more conducive to the commercialization of innovation. Morck *et al.* (1989) and others show that encouraging existing firms to diversify is unlikely to be an effective policy to diversify the economy. Instead, the emergence and rapid growth of new firms in new industries is likely to be more conducive to growth. These considerations underscore the recommendations in the previous point.
5. La Porta *et al.* (1997, 1998, 2004) and Fogel *et al.* (2005) show that countries whose capital markets are better regulated and freer generate more small entrepreneurial start-ups. .
6. Fogel *et al.* (2005) find that entrepreneurial entry is more extensive in economies whose populations are better educated. Provincial governments should be encouraged to raise general standards of education.

Fourth Set of Issues

- *What are the major impediments to the commercialization of university research?*
- *Is there less information available in Canada than in the U.S. about the opportunities of commercialization?*

General issues

The high tech clusters that generate innovative new firms in the United States and that attract most of that country's successful venture capital investment are all centered around clusters of universities. Why some universities are better at generating high-tech ventures is a subject of ongoing research. Some patterns are now becoming clear.

Macro-economic and micro-economic framework policies

1. University patenting responds to the general health of the economy. University patents slumped during the 1970s and early 1980s, and then resurged in the mid 1980s.[46] This corresponds to a slump and recovery in the overall United States economy, and to other measures of industrial activity such as merger and acquisition activity.

   The commercialization of university research is encouraged by public policies that promote general prosperity.

Financing

1. Canadian universities generally restrict the terms on which their faculty and staff finance the commercialization of innovations in their standard employment contracts. Typical contracts mandate that the university is entitled to a minimum share of all royalties from any innovations developed university employees. These provisions are designed to force faculty and staff, who use university labs to develop innovations, to share the proceeds of those innovations with the rest of the university community.

[46] Henderson, Jaffe, and Trajtenberg (1998).

As with any tax, too high a rate discourages effort. Di Gregorio and Shane (2002) present statistical evidence of an academic *Laffer curve*, illustrated in Figure 1. They find that many universities's policies are too far to the right, in that they take too a high fraction of the returns to an innovation and so see fewer innovations commercialized. These universities might actually increase their revenues from commercialization by reducing their cut and letting individual researchers keep a larger fraction of royalties. Or, equivalently, they might take equity stakes in start-ups in lieu of royalties, leaving more money in the hands of individual researchers and significantly increasing both the generation high technology start-up firms. Effective financing must not only be available to the start-up firm, but must offer attractive returns to the individual researchers involved.

Our informal survey suggests that Canadian universities typically take half to three-quarters of the returns to any innovation. Their commercialization arms typically have an industrial partner pick up the tab for IP protection for a substantial equity stake – often as much as 95%. This is perhaps because they need higher returns on successful ventures to compensate for a high failure rate. That American private VC fund deals usually take a standard 80% stake suggests a better weeding out of unsound ventures, permitting better terms to innovators with sound proposals.[47]

Thus, if a product is successfully commercialized at a Canadian university, 95% might go to the commercialization arm's industrial partner, and the remaining 5% might be split ¾ to the university and ¼ to the researcher. The researcher's personal wealth ends up as 1.25% of the commercialized product's earnings. After federal and provincial personal taxes, this works out to 0.625% - often to be divided up among all the researchers in the lab.

Commercialization puts a heavy workload on the researcher, who not only does the research and manages the research staff, but also applies for the patents, responds to patent office actions, writes the grant reports, and writes any manuscripts for publication. This workload substantially exceeds what is normally required of tenured faculty. Yet the actual monetary returns to the innovator can end up being miniscule, even from an innovation with substantial economic prospects.

Jensen and Marie Thursby (1998) and others argue convincingly that universities ought to be able to gain revenues from research undertaken on their premises. The Bah-Dole Act in the United States, which let universities licence such innovations, led to a spurt of commercialization. However, the continued meaningful financial participation of the individual researchers, who are ultimately responsible for commercialization decisions, is also important.

Universities intent on spurring commercialization should permit innovators to retain economically substantial fractions of the returns to their innovations. They should also reconsider their relationships with industrial partners who demand too high a cut.

[47] Gompers and Lerner (200x).

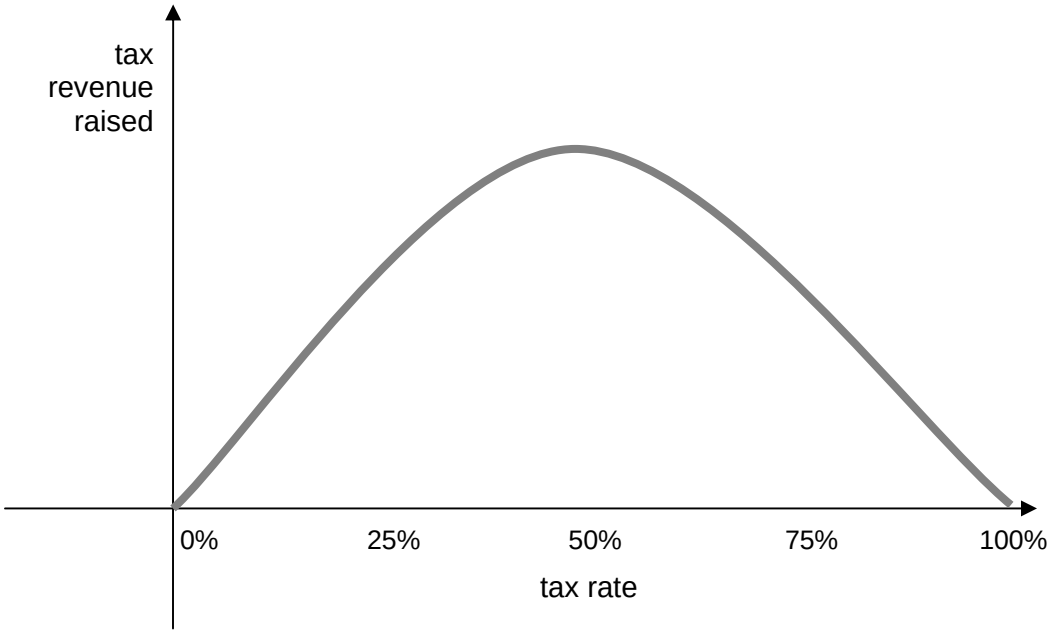
A rigorous survey of university innovators and prospective innovators might be useful to determine whether Canadian universities are unduly rapacious towards their researchers when innovations are commercialized.

2. Di Gregorio and Shane (2002) find no link between a local VC industry and start-ups after controlling for these other factors. This result cannot be interpreted as negating the importance of access to venture financing. But, it suggests that a university need not use the local VC industry partner to underwrite commercialization.

   Rather, the critical factor is likely a VC firm with access to a pool of highly skilled individuals capable of distinguishing sound from unsound ventures. Universities should seek financing that provides more generous returns to individual innovators with technologically and economically sound ideas. If local VC firms want universities' business, they should be forced to compete and, in so doing, hire their own technological and financial experts. This would have the side benefit to universities of creating new employment opportunities for their science, engineering, and business graduates. But private industry partners should be forced to compete for university commercialisations on an ongoing basis.

Figure 1: The Laffer Curve

If the business tax rate is zero, the government takes in no tax revenue. If the tax rate is 100%, the government also takes in no tax revenue because no-one operates a business under these conditions. The tax rate that maximizes tax revenue is therefore somewhere between zero and 100%, depending on the exact shape of the curve. This reasoning suggests that universities can discourage their researchers from commercialization by overtaxing researchers; that is, by taking too large a fraction of the returns.



Skills

1. While Di Gregorio and Shane (2002) demonstrate the clear importance of universities' licensing policies, they also find a highly significant correlation between a university's academic *prestige* and the number of local high technology start-up. Highly prestigious graduate programs correlate with more technology commercialization in the adjacent area.
2. Again, this finding is consistent with the critical importance of attracting and retaining a pool of highly skilled individuals. Jaffe (1989) shows that spillovers from university research stimulate the economy; and Zucker *et al.* (1998) show that the local economy benefits especially. Canadian politicians, and even many university administrators, too often view academic prestige as ornamental, rather than as a practical investment. Governments should realize that spending aimed at increasing their local universities' prestige is a worthwhile investment with real regional economic returns.
3. American universities often pay scientists, engineers, physicians, and medical researchers in hot fields salaries many times greater than in fields like comparative literature, philosophy, classics, and the like, which suffer from chronic excess production of PhDs. Canadian universities appear to have more egalitarian pay scales than American universities. This means Canadian universities can often out-recruit American ones in the arts and humanities, but lose out in the sciences, engineering, and medicine. These inflexible and often blindly equalitarian approaches can diminish our universities' research productivity in precisely the fields most likely to generate exiting commercialization opportunities.

   American universities also pay their faculty for only nine months per year, though the total for that period usually exceeds Canadian professors 12 month salaries in the sciences, engineering, medicine, and business. American universities then award *summer support*, a supplement to regular salaries usually equal to 2/11 of the nine month salary, only to more productive faculty. This lets them retain more productive researchers and can be used to disgruntle less productive ones in hopes they might move elsewhere. American universities are also often surrounded by a host of independent or quasi-independent institutes and research centers that often pay productive researchers summer support and other incremental compensation. This flexibility is in stark contrast to most Canadian universities, which pay all professors quite similar salaries regardless of productivity. This more rigid compensation system encourages star researchers to move to the United States and less productive professors to settle in.

   This is another likely reason for low commercialization rates in Canada; for Zucker and Darby (1995) show that universities with research stars in biotechnology are especially successful at commercialization. They propose that individuals capable of both research and commercialization are sufficiently rare that their individual effects are evident in the data. There is no reason to think other fields in science and engineering should be different. Intriguingly, their data show not only that Canada has fewer than half as many such stars *per capita* as

the United States, but that their emigration of such stars from Canada are exceedingly high.

Reforming university governance so that Canadian universities are more willing to hire and retain science, medicine, and engineering stars is probably impossible, because of unionized faculties and institutional rigidities in university governance; however public policy might counteract these problems by funding specialized research institutes near major universities and allowing researchers in high demand fields to draw supplementary salaries. Lower personal income taxes and capital gains taxes as well as more skilled venture capital providers would doubtless also help stem the outflow.

The university officials charged with commercialization often seem unfamiliar with basic economics, such as the disincentive effects of excessive taxes in Figure 1. Attention should be directed to ensuring that university policies regarding the commercialization of innovation are not overly influenced by academic romanticists, let alone dogmatic leftists.[48] The dominance of arts and humanities faculties in many Canadian universities raises the disturbing possibility that universities' commercialization policies might, to some extent at least, actually be designed by people ideologically opposed to entrepreneurship.

Universities should be encouraged to professionalize their commercialization arms fully. One possibility is to outsource commercialization to independent private sector venture capital funds run by financial and technological experts unaffiliated with the university. This could be done by making non-arm's length commercialization arms compromise universities' tax exempt status, but should leave universities able to earn tax exempt revenues from the commercialization of their researchers' innovations by independent VC funds.

4. Universities' patent attorneys are very concerned about their investment in IP protection and can apparently quite intrusive in limiting what researchers may publish, as can private sector partners. This means a researcher must be very secure in her career to consider commercialization as well as pure research. Universities require a steady stream of publications for tenure, promotion, and annual appraisals. Many professors hear stories about suppressed publications and opt to stay away from commercialization[49]. Those who successfully manage a commercialization often must give up their academic appointments.

   Such behaviour on the part of industrial research sponsors, such as drug companies, raises the concern that research with findings detrimental to a drug's commercialization prospects might be suppressed. This concern gives rise to calls that all research done at universities be published, or at least released to the public.

   These problems reduce academic researchers' ability to gain academic recognition for their work and possibly even compromise academic integrity; and surely count as costs of going for commercialization. Better intellectual property rights protection that permits faster publication of results and standardized

[48] Argyres and Liebeskind (1998) argue that policies encouraging commercialization are resisted by university administrators and academics attentive to universities' social commitment to an "intellectual commons" to benefit of society at large.

[49] See Blumenthal *et al.* (1997) for a survey evidence on the growing importance of such concerns.

university rules mandating publication or release of results both merit consideration. Perhaps researchers might be surveyed to ascertain the importance of these issues.

Science and Technology Policy

1. A substantial body of empirical work in economics attests to the importance of property rights protection in fostering economic growth.[50] Yet many Canadian universities still consider any innovation developed by their researchers to be the property of the university. Attention might be given to encouraging Canadian universities to consider the *Stanford Model* and permit the individual researchers to own their innovations.

   University officials may respond that profit sharing agreements can leave the researcher with a similar stream of cash flows. In the Stanford model, the researcher owns the innovation but contracts with the university to obtain commercialization support for a fraction of future revenues. In the alternative model, the university owns the innovation, but grants the researcher a fraction of future revenues. However, the two can be different in important ways. If the university insists on ownership, researchers with promising ideas can be locked into employment with that university. Researchers with promising ideas and intent on retaining a degree of career mobility should rationally seek employment at another university before developing and commercializing the idea.

   Granting individual innovators surer property rights over their innovations, as opposed to granting universities such rights, reduces the risks confronting the innovator Researchers might be surveyed to ascertain the importance of these issues.

2. Most investment projects that well governed firms undertake are necessarily somewhat conservative so as to protect their shareholders wealth. These projects are unlikely to excite the genuinely innovative entrepreneurs that make a high tech cluster viable. Truly innovative projects are unlikely to past muster in the corporate finance departments of large established firms.[51] Mandating that university based researchers obtain matching funds from industry sponsors runs the danger of discouraging the commercialization of genuinely innovative researchers attract mainly rent-seekers from both academia and industry.

   Consistent with this, Di Gregorio and Shane (2002) find no link with start-up activity, perhaps because such policies weed out genuinely innovative ideas. In retrospect, this should not be surprising, for Gompers and Lerner (2000) find that venture capital pools operated by established firms perform poorly, and attribute this to the established firms' fears of creating competition for their existing lines of business and to stark cultural differences between established firms and new ventures.

   Requiring academic researchers to partner with industry in applying for grants is not justified by the economics literature as likely to increase the pace of commercialization.

[50] See Morck, Yeung, and Wolfenzon (2005).
[51] For empirical evidence, see Gompers and Lerner (2000).

4. Most university researchers have insufficiently deep pockets to fight intellectual property rights battles in the courts, and so rely on their universities or their commercialization arms for upfront IP protection. This means the researchers are quite literally forced to work with their universities, even for ideas not created or developed in university laboratories. The researcher usually signs away 50% to 75% of all future royalties for this protection – and signs away 100% until the cost of the initial IP protection is paid.

   Attention might be given to simplifying the process of gaining intellectual property rights protection so as to reduce the fees and other costs involved. The cost of obtaining up front intellectual property rights protection prior to commercialization can easily run to several hundred thousand dollars, and this is beyond the means of most individual Canadians, including university professors. A simpler and more user friendly process, less dependent on legal gatekeepers, might be explored. Again, a survey of researchers and commercializers might be useful here.

4. The impediments to commercialization detailed above indicate to us that the pace of commercialization in Canada is constrained by much more than simple lack of information. Indeed, given these constraints, fuller information might well discourage optimistic, but ill informed innovators, and actually depress the pace of commercialization.

   Initiatives aimed only at providing better information to researchers about commercialization are unlikely to have any substantial effect absent real reforms to lower the very real economic barriers to commercialization in Canada. We therefore recommend against the establishment of a public-private commercialization advisory council at present. This would better follow effective measures that bring real changes to the underlying costs, benefits, and risks confronting innovators warrant attention.

Fifth Set of Issues

- *Do regulatory barriers or investment restrictions reduce commercialization activities in Canada? For example, can the regulations of the air transportation, telecommunication, and broadcasting industries hamper commercialization opportunities in those industries?*
- *Could rivalry or competition levels in Canada explain the lagging performance?*

General Issues

Canada has a venerable tradition of regulating industries to protect them from competition. Institutions such as the CRTC are textbook examples of Stigler's (1964, 1971, 1986) *captive regulators*, defined above. Recall that regulatory capture is the economics driven process whereby regulators almost inevitably switch from representing the government in industry decisions to representing the industry in government decisions. The CRTC was originally established to promote Canadian culture. It now operates primarily to protect the operating revenues of established firms in 'cultural' industries. For example, the main criterion the CRTC uses in considering new

broadcasting or cable licensees is reputedly that any negative impact on the profits of existing broadcasters be minimal.[52]

Successful regulatory capture frees an industry of the need to invest in innovation and productivity improvement. It is plausible that the greater penchant of the Canadian government to regulate makes regulatory capture more commonplace here, and thus makes innovation and its commercialization less imperative to companies in regulated industries.

Macro-economic and micro-economic framework policies

1. Regulatory capture can occur so slowly than neither politicians nor civil servants recognize it. Attention should be given to the periodic comparison of the actual effects of regulatory systems compared with their initial public policy purposes. Any regulatory bodies that displays evidence of capture should be reorganized to restore its initial public policy purpose if that remains valid, and eliminated otherwise.

   To facilitate this, civil servants' careers should not depend on the continued existence of any given regulatory body.
2. Competition between innovators is important. Lerner (1997) shows that technology races are a critical driver of innovation in the United States, where the most intense innovators are typically firms that trail the industry leader. A lack of competition from trailing firms thus translates into a lower level of innovation and commercialization.

   Competition to innovate can be spurred by making Canadian industries more competitive and by opening Canadian markets further to competition from innovators abroad.

Financing

1. The greater the problems upstarts confront in raising financing, the less the level of effective competition.[53] Such financing problems deter commercialization by making upstarts vulnerable to predatory pricing by incumbents. For example, Lerner (1995) shows that incumbents in disk drive production in the 1980s underpriced products if the competition was relatively thinly capitalized. This consideration underscores the importance of the issues raised above pertaining to the financing of upstart commercialization ventures.
2. There is an important role for government to play in fostering commercialization, for efficient markets require good government. Recent research is providing a much better guide to regulators about what constitutes good government. For example, research on corporate governance and banking suggests that sound regulations should focus on creating transparency that lets investors make informed choices and launch legal challenges themselves when wrongdoing occurs.[54] The same work suggests that regulations should avoid giving regulators

[52] The situation in the United States is also problematic. For example, Jaffe and Kanter (1990) show that the cable television industry collected substantial monopoly rents in many parts of the United States as recently as 1989.

[53] La Porta *et al.* (1997, 1998).

[54] See Beck *et al.* (2004), Krueger (1993, 1997), La Porta *et al.* (2004), and Stigler (1964, 1971, 1986)

direct power to intervene and dictate corporate policies because this places policy makers and regulators in rent seekers' sights. This can be broadly conceived as creating a framework for democratic market while keeping civil servants and politicians free of pressure from rent seekers.

Government policies should concentrate on creating conditions in which competition creates the supporting institutions needed to spur commercialization. Competition for investors' savings, not government management or guidance, lies behind the success of American VC funds in this regard. Over the years, competition culled those funds that were least able to deal with these problems, and this gradually raised the industry average ability to discern sound from unsound ventures.

The American government's role in this success was critical, but its *enabling* role was probably more important than any direct subsidy programs.. Capital markets regulation, disclosure standards, and the like in the United States consistently serve investors and new issuers, both of whom benefit from a high degree of transparency and severe penalties for malfeasance. Canadian provincial regulators and securities markets seem more intent on lightening the ongoing compliance costs of established firms that have already issued their equity securities and anticipate issuing no more. These established issuers understandably favour unobtrusive disclosure standards and forgiving enforcement.

Some developments in Canadian securities markets suggest better times may be coming. The Canadian Coalition for Good Governance is advocating many sensible reforms. Income trusts are also gaining popularity, and with their emphasis on higher payout ratios, they will likely force established firms to make greater use of seasoned unit offerings.so as to raise valuations for these offerings. These developments should let initial public offerings in non-traditional industries fetch higher valuations. This, in turn, should make the provision of private equity in earlier stages of VC funding more attractive to investors if Canadian VC funds are able to deal more effectively with the challenges of discerning sound from unsound ventures, ensuring good governance, and overcoming the boom and bust problems in the Canadian Venture Exchange

As these events unfold, governments should refrain from direct subsidies or directions and focus instead on making Canadian financial markets attractive to investors and new issuers.

Skills

1. A more regulated economy makes regulator capture more lucrative and thus encourages established firms to invest in political influence rather than innovation and commercialization. This puts the premium on the wrong sorts of skills if public policy aims to foster increased commercialization of innovations. Canada should encourage science, engineering, and business expertise, not expertise in political influence.

   Canadian governments should refrain from putting civil servants and politicians in positions where they are likely to be subject to pressure from rent

seekers. This means governments should avoid subsidy programs and direct interventions such as the regulatory systems mentioned in this set of issues.

2. Regulation makes innovation less necessary. Successful regulatory capture enhances incumbents' profits, locks out upstarts, and thus obviates the need to innovate, let alone to commercialize innovations.

Science and Technology Policy

1. Public policy can induce increased competition to innovate. For example, Finkelstein (2003) shows that changes in American government policy regarding the vaccination of infants, Medicare coverage of influenza vaccination, and the indemnification of vaccine manufacturers against lawsuits for adverse reactions all increased the pace of vaccine development in the United States. By increasing innovators returns, these policies spurred the commercialization of new vaccines.

   Canada may be too small a market for domestic policies of this sort to have a major impact on the returns to commercialization in most cases. However, policies regarding agricultural vaccines, Medicare coverage, and the like probably do affect innovators' commercialization decisions on the margin.

   Certainly, Canada could use its voice in international organizations to press for the widespread adoption of products stemming from Canadian research.

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