Government Sponsored Venture Capital in Canada: Effects on Value Creation, Competition and Innovation

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Abstract:

This paper examines the role of government in the venture capital market. While previous studies focus mainly on investor returns, this paper focuses on three important public policy objectives: value-creation, competition, and innovation. We investigate the relative performance of enterprises backed by government-sponsored venture capitalists and private venture capitalists with respect to these three objectives. A number of novel data-collection methods, including web-crawlers, are used to assemble a near-comprehensive data set of Canadian venture-capital backed enterprises. The results indicate that enterprises financed by government-sponsored venture capitalists create less value (measured at the time of an IPO or acquisition) and are more likely to go out of business than are enterprises financed by private venture capitalists. Government-sponsored ventures also seem to be less innovative, generating fewer patents and operating less in high-technology industries. While the data does not allow for a definitive welfare analysis, the results cast at least some doubt on the desirability of government intervention in the venture capital market.

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1. Introduction

Entrepreneurship is frequently cited as an important force promoting economic growth. There are several possible reasons for such an effect, but perhaps the most significant is the relationship between entrepreneurship and innovation. We are all familiar with major corporations that began as small entrepreneurial firms but that ultimately had a major impact on the business environment and on our personal lives. Examples include such firms as Apple, Federal Express, Intel, and Microsoft. Start-up firms often innovate long before established rivals and therefore speed up economic growth. In the computer sector, for example, it seems that the personal computer, which has dramatically transformed many aspects of modern life, was due to innovative efforts of entrepreneurial firms such as Apple, Intel, and Microsoft. Presumably we would have had to wait much longer if the only sources of innovation had been large established firms like IBM, Sperry, Burroughs, and Digital (of which only IBM still exists). And we would perhaps still be waiting if we had to rely on the public sector for such innovation.

Despite this apparent link between entrepreneurial activity, innovation, and economic growth, most entrepreneurship is not particularly innovative and not particularly successful[3]. Firms such as Microsoft and Intel are interesting not because they are typical or representative of entrepreneurship, but because they are so atypical or unusual. It is not entrepreneurship in general that is so valuable for economic growth; it is a small sub-class of highly innovative entrepreneurial ventures that provide the most important contributions. This small sub-class of entrepreneurial firms is the particular focus of the venture capital industry. Venture capitalists try to seek out and invest in innovation-intensive entrepreneurial ventures.

It is perhaps not surprising that national governments and governments of sub-national political jurisdictions often seek to promote, support, and expand venture capital as a means of promoting innovation and economic growth. In particular, the Government of Canada and provincial governments within Canada have made significant efforts to expand venture capital activity through a variety of policies. The objective of this paper is to assess the record of governments within Canada in seeking to promote venture capital investment, focusing in particular on the effects on value creation, competition, and innovation.

From an economist's perspective, the case for government intervention in venture capital is far from clear. It is certainly not enough to say (as many politicians do) that intervention in venture capital is appropriate simply because venture capital might be important for economic growth. If economic importance were in itself a basis for government intervention this would justify significant government intervention in all major sectors and would suggest a return to government-controlled economic planning of the sort that has, on the basis of much evidence, been widely discredited. A reasonable economic rationale for interventionist policy in a particular market, such as the venture capital market, must rely on the existence of significant market failure that might reasonably be addressed by public policy.

There is a substantial body of research (discussed in more detail in the literature review) suggesting that problems arising from asymmetric information can lead to important market failures in the financing of early-stage entrepreneurial ventures – much more than in other parts of the financial sector. Specifically, one important characteristic of innovative early-stage technologies or business models is that investors, including venture capitalists, typically know much less about them than the innovator, creating a classic informational asymmetry of the "hidden characteristics" type. Furthermore, once investment in such ventures is undertaken it is difficult to monitor the activities of the innovator so as to infer whether appropriate decisions are being made and appropriate efforts undertaken, creating a classic informational asymmetry of the agency or "hidden action" type. In addition, new ventures typically lack the level of collateral and/or reputation that might be used to mitigate market failures arising from informational asymmetries.

[3] Baldwin et al (2000) find that, for all Canadian startups between 1984 and 1994, "failure rates among entrants are extremely high. Some 40% have exited [their output market] by their second birthday. About 75% die by their eighth birthday. On average, mean survival time is about six years, while the median length of life is approximately three years".

Despite these informational market failures, it is highly questionable as to whether government intervention can reasonably resolve the informational problems directly. Governments cannot readily reduce informational asymmetries. One approach to reducing informational asymmetries is to impose strengthened disclosure requirements (as with the much-discussed Sarbanes-Oxley legislation in the U.S.). However, such requirements impose costs and are of questionable merit even for large and established publicly traded corporations. In the entrepreneurial sector, imposing additional disclosure requirements would probably create an excessive and unworkable burden for many entrepreneurial ventures.

In addition to this market failure associated with financing innovation, the innovation process itself is subject to market failure of the externality type. Innovation, and the research and development underlying it, typically generate positive externalities. In the extreme, an innovation might be easily copied and therefore be almost like a public good. For example, once others observed the business models adopted by Federal Express or Wal-Mart it was fairly easy to copy them, and both firms have been widely (albeit imperfectly) imitated. Even patentable or copyright-protected innovations such as computer chips and computer software give other firms substantial new information that is useful for further innovation. For these reasons, it is plausible that innovation would be under-provided. The innovators can expect to receive only a modest share of the benefits from the innovation and would therefore lack sufficiently strong incentives to undertake the efficient level of investment in innovation. This potential under-provision of innovation is partially addressed by intellectual property policy, especially patent policy and copyright policy. However, much innovation is not covered by these policies, and protection remains imperfect for those innovations which are covered.

As both information-based and externality-based market failure would lead to inefficiently low levels of entrepreneurial innovation, one possible approach to dealing with this problem is to subsidize the venture capital sector. If the costs of finance in this sector were lowered and the supply of such finance were increased, this would increase entrepreneurial innovation and would therefore potentially offset the innovation-reducing effect of market failure problems. One argument for such an approach is that relying on venture capitalists to "pick winners" and make appropriate investments is likely to be more effective than having governments try to pick winners by subsidizing innovation directly.

On the other hand, critics argue that government intervention is itself subject to informational problems. The government still has to pick which venture capitalists to subsidize, and this process is prone to error. In addition, the incentives facing venture capitalists might well be distorted as such government programs are typically burdened with a variety of additional features or conditions that seek to promote other public policy (or political) objectives that might have significant economic costs. Government-subsidized venture capitalists might simply replicate market failures that would occur anyway and possibly add new ones. Informational problems might be amplified and government-sponsored venture capital might simply crowd out more efficient private venture capitalists. In any case, it is important to assess the impact and efficacy of government support to venture capital.

As will be discussed in our literature review, there has been only a modest amount of empirical research into the effectiveness of government-sponsored venture capital, and we hope to contribute to this literature. Our analysis focuses on the Canadian context, where several government interventions in venture capital markets have important effects on those markets. As described more fully in Section 3, the quantitatively most important government intervention in venture capital arises through the so-called "labour-sponsored" venture capital funds (LSVCCs).[4] This program provides what is, in effect, a subsidy to a particular group of venture capital funds. In addition a very large provider of venture capital in Canada is a public enterprise (or "crown corporation") known as the Business Development Bank of Canada (BDC). In addition, various provincial governments also provide subsidies through a variety of other programs. We refer to these collectively as government-sponsored venture capital (GVC) funds. We compare the GVCs against private venture capital funds, which we refer to as PVCs. The GVCs account for well over half of all venture capital under management in Canada.

[4] The name comes from the fact that in order to qualify for the program, the venture capital firm must find a labour organization (normally a union) to act as a formal sponsor. However, the labour organizations rarely play any significant role in the management of these funds.

The basic data on Canadian firms obtaining venture capital is surprisingly incomplete. One of the contributions of this paper is to introduce some novel data gathering techniques, including the use of web-crawlers. This allows us to identify more than twice as many venture-capital backed enterprises than reported in the official or commercially available data sources. For these firms, our data contains information on the number and type of investors, as well as some basic characteristics such as industry and founding date. We then augment the data by examining a variety of performance measure, related to the creation of value and innovation by these enterprises. However, the data also contains important limitations. Most notably, we are unable to measure the actual amount of funding provided by the various types of investors.

The GVCs, particularly the labour-sponsored funds, have generated a substantial controversy within Canada. One of the most frequently voiced criticisms concerns the relatively low rates of return generated by GVCs. We would argue that this criticism, while clearly relevant, is far from the whole story. The returns to the funds do not reflect the full social return on the investments. From a public policy perspective, it is far from clear that the objective of the program is to create profitable venture capital funds per se. The policy background to the legislation creating and amending GVCs includes a variety of objectives, of which generating reasonable returns for investors is only one. At the broadest level, the objective of the programs is to enhance overall economic performance, focusing particularly on the entrepreneurial sector. Investor returns are a component of economic performance but other performance measures are also very important. This paper provides an analysis of the performance of GVCs with respect to important outcome measures that have not been previously studied in this context.

To examine the impact of the GVCs we focus on three public policy goals. First, we examine value creation by entrepreneurial firms. The most direct goal of GVC programs is to develop and support entrepreneurial firms that will create significant value in the economy. Consistent with the venture capital literature we measure this as the value of the firm at either an initial public offering (IPO) or a third-party acquisition. Both of these events are associated with successful venture capital investment, as successful ventures normally either "go public" with an IPO or are acquired by a third party. Either of these so-called "exit" events signals the end of the firm's life as a stand-alone privately-held enterprise and allows venture capitalists and other early stage investors to obtain liquidity on their financial stakes, and possibly withdraw from any managerial functions in the enterprise.[5] Typically these successful exit events generate substantial earnings for venture capitalists, and possibly other early stage investors, as well as the founders and employees of the venture.

Unsuccessful ventures either go out of business (leading to a "write-off" by venture capitalists), are bought out by the management (usually at a loss to the venture capitalist), or simply continue as small private firms generating small returns, if any, to venture capitalists.

Value creation assessed at an exit event is related to the return to investors in venture capital funds. However, value creation is a more complete measure of performance than simply looking at the return to a particular group of investors (such as venture capital funds). For example, it is possible that labour-sponsored venture capital investment might provide the extra capital needed to turn potentially unsuccessful ventures into successful ventures, thereby increasing the returns to other investors, even if the return to venture capital investors themselves is modest. This value should be reflected in the overall value of the enterprise at IPO or upon acquisition. Accordingly, it is important to assess overall value creation – the full value of the firm at an exit event.

The second goal we focus on is a potential pro-competitive effect of venture capital. The basic point is that new enterprises supported by venture capital might or might not provide additional competition in the marketplace. Specifically, if a venture capitalist supports an enterprise that becomes successful, has an IPO, and continues to grow as independent competitor, this typically increases competition in the relevant marketplace. If, on the other hand, an acquisition by a potential or actual rival occurs, this could reduce competition in the market. Therefore, we

[5] Note that the term "exit" refers to exit of the venture capitalist and possibly other early stage investors. It does NOT refer to the exit of the firm itself from relevant output markets.

assess the relative record of GVCs in supporting the creation of new stand-alone business entities (thereby enhancing competition) compared with their role in contributing to acquisitions and thereby possibly reducing competition. In other words, we compare the relative incidence of exit by IPO with exit by acquisition for GVCs and compare it with the record of private venture capital (PVC) funds.

The third policy goal is perhaps the most important, although the hardest to measure. Specifically, we focus on the extent of innovation generated by entrepreneurial enterprises. For this, we compare the patent portfolios of firms financed by GVCs with the patent portfolios of otherwise comparable ventures financed by PVCs. While patents are an imperfect measure of innovation, they are certainly the best and most widely used single measure. Effects on patents are therefore the natural place to start in assessing the effect of venture capital on innovation, although we emphasize that it would desirable in future work to supplement patent information with other measures of innovation. As a first step in that direction we also examine to what extent GVCs invest in industries that can be classified as high technology. The underlying reason for this is that the brunt of innovative activity occurs in those high technology industries.

In summary, our analysis addresses the following specific questions:

a) Compared to PVCs, does GVC support tend to increase the likelihood of successful exit?
b) If a successful exit occurs, does GVC support tend to increase the value of the enterprise at exit?
c) Does GVC investment tend to increase the likelihood of enterprises emerging as independent firms that increase competition in the marketplace?
d) Does GVC investment tend to generate more patents than otherwise equivalent PVC investment?

The first two questions deal with value-creation; the other two deal with competitive effects and innovation respectively. We acknowledge that these policy objectives (value-creation, pro-competitive effects, and innovation) are not an exhaustive description of legitimate objectives of policy makers. However, we believe that an analysis of these normative public policy goals, as opposed to merely looking at fund returns, considerably advances the debate about the performance of government-sponsored venture capital.

Section 2 of this paper contains a literature review of related work, providing important background on which our analysis builds. Section 3 describes the venture capital market in Canada, including a review of relevant government policy. Section 4 provides an overview of our data and Section 5 is devoted to our empirical analysis and major results. Section 6 contains concluding remarks.

2. Literature Review

We take the view that the primary conceptual rationale for government intervention in entrepreneurial financed is based on asymmetric information. Informational asymmetries are particularly important in entrepreneurial finance and these asymmetries might cause significant "market failure" in the sense that markets would fail to achieve economic efficiency. The basic theory of asymmetric information was pioneered by Akerlof (1970), Arrow (1973), and Jensen and Meckling (1976), among others. Asymmetric information can lead to both "hidden characteristics" and the associated adverse selection problem and to "hidden action" and the associated agency problem. Early work on venture capital, including Sahlman (1990), and Amit, Glosten, and Muller (1990) emphasize the importance of both adverse selection and agency problems in venture capital finance and, by inference, in entrepreneurial finance more broadly. Amit, Brander, and Zott (1998) suggest that the venture capital exists as a specialized component of financial markets precisely because venture capitalists (VCs) have or acquire a comparative (and absolute) advantage in dealing with situations of asymmetric information. VCs devote significant effort to obtaining information about particular enterprises and technologies, and often have highly relevant technical background experience.

There is considerable evidence that venture capitalists provide a signal of the quality of firms under conditions of asymmetric information. This is highlighted in the extensive literature on the effect of venture capital

and underwriting on IPO pricing. See, in particular, Beatty and Ritter (1986), Booth and Smith (1986), Megginson and Weiss (1991), Barry, Muscarella, Peavy, and Vetsuypans (1990), Brav and Gompers (1997), and Jain and Kini (2000, 2006), among others. The literature on the role of venture capitalists in mitigating informational asymmetries in the acquisition process is much more modest. See Brander and Egan (2007). Notwithstanding the ability of venture capitalists to ease informational asymmetries, markets for entrepreneurial finance still have sufficient potential for market failure that there might be a case for government intervention on this basis. Specifically, we might expect informational asymmetries to imply undersupply of entrepreneurial finance relative to the efficient or "first-best" outcome.

Although we emphasize the importance of venture capitalists in mitigating informational asymmetries we recognize that VCs have other important functions. In particular, they provide managerial "value-added" to the firms in which they invest, often providing needed financial, marketing, human resource management, and operations management skills to entrepreneurial firms. Papers emphasizing and providing empirical support for this "value-added" view of venture capitalists include Brander, Amit, and Antweiler (2002) and Hellmann and Puri (2002). The role of venture capital in value creation has been explored in Hellmann, Egan and Brander (2005) and elsewhere, and is largely complementary to the literature on returns in venture capital, including, Kaplan and Schoar (2004), Jones and Rhodes-Kropf (2002), Ljungqvuist and Richardson (2003), Gompers and Lerner (1997), among others.

The second type of market failure that is relevant to government intervention in venture capital markets is the externality associated with R&D and innovation. There is an extensive literature on this subject that we cannot do justice to here. A valuable textbook treatment of this topic is provided by Tirole (1988, Ch. 10). The key point is that there is reason to believe that innovation might be underprovided because of the substantial positive externalities associated with innovation. Much effort has gone into estimating the extent of such externalities. One classic study of this type is Bresnahan (1986). See also Griliches (1992) and Jaffe (1996) for empirical evidence concerning the extent of R&D spillovers.

For our purposes, one important question concerns the relationship between venture capital and R&D. If there is under-provision of innovation, does venture capital act to partially offset this under-provision? The literature on this topic is not extensive, but we would draw attention to Kortum and Lerner (2000), Gans and Stern (2000), and Hellmann and Puri (2000), all which suggest that venture capital does tend to promote innovation. Accordingly, it is possible that a subsidy to venture capital might expand the supply of venture capital and might therefore boost innovation toward the efficient level, offsetting or at least mitigating the market failure associated with insufficient innovation.

The primary question we address concerns the effect of government subsidies to venture capital on economic performance in the form of value-creation, enhancement of competition, and innovation. We have found only a handful of papers that address the effects of government intervention on venture capital. Valuable papers in this category include Cumming and MacIntosh (2006) and Leleux and Surlemont (2003), both of which find significant "crowding out" of private venture capital by publicly supported venture capital. Such crowding out suggests very limited benefits to government subsidies of venture capital. On the other hand Lerner (1999, 2002) suggest some evidence of success for the U.S. Small Business Investment Research (SBIR) program. Anderson and Tian (2003) document the poor investor returns arising from the Canadian LSVCC program.

3. An Overview of the Canadian Venture Capital Market

As the Canadian economy is roughly 10% (actually closer to 9%) of the size of the U.S. economy, we might expect the venture capital markets in the two countries to be characterized by a similar 10 (or 11) to 1 ratio. In fact, however, size estimates vary considerably for both countries, depending in part on how broadly venture capital is defined. The Canadian Venture Capital and Private Equity Association (CVCA) reports that its members have over C$50 billion of venture capital under management in Canada in 2007. Presumably the full size of the

venture capital market including venture capital from non-CVCA members would be significantly larger. To keep things in perspective, we might note that Canadian GDP for 2007 will exceed C$1.2 trillion.

Relative to GDP, population, total R&D expenditure, or other suitable measures of economic size and activity, the Canadian venture capital market is usually reported as comparable to its U.S. counterpart. If anything Canadian venture capital markets might be slightly larger than the pro-rata 9% share suggested by relative GDP. See Brander, Egan and Boardman (2005) for a discussion of various metrics of this type.

Canadian venture capital data, whether reported by the CVCA, the Global Entrepreneurship Monitor (GEM), Industry Canada, the OECD, or academic papers comes largely (although not exclusively) from one commercial source: Thomson Financial Canada, also known as Thomson-Macdonald (formerly Macdonald & Associates Ltd.). While this is a valuable source, its survey methods necessarily yield incomplete coverage and the incompleteness appears to vary systematically by region within Canada and is particularly significant regarding non-Canadian venture capital investments in Canadian enterprises. The methods we use (described in the next section) allow for more complete coverage and should not be subject to biased regional coverage.

The Canadian venture capital market differs from its US counterpart with respect to two important structural characteristics. First, US venture capitalists appear to invest heavily in Canada, while the converse is not true. Industry Canada (2003) reported that US venture capital accounted for approximately one quarter of the total venture capital dollars invested in Canada between 2000 and 2002. While Canadian venture capitalists do invest in US firms, they probably accounted for on the order of one percent of the total dollars invested in the U.S. in the same period. If the U.S.-Canada border had no effect, and distance did not matter either, we might expect that 91% of the venture capital in Canada would come from the U.S. and 9% of the venture capital in the U.S. would come from Canada. Borders and distance do matter, so the actual proportions are much less. However, the shortfall is much greater in the direction from Canada to the U.S. rather than vice versa.

Second, there appears to be more government intervention in venture capital (and a larger net subsidy) in Canada than in the U.S., although it is hard to be definitive given the proliferation of state programs in the U.S. and corresponding provincial programs in Canada. At the federal level in Canada there are two major interventions. One is the Business Development Bank of Canada (BDC), a government-owned venture capitalist.[6] The other major federal initiative is the labour-sponsored fund program. The associated venture capital funds are often referred to as Labour Sponsored Venture Capital Corporations (LSVCCs) or as Labour Sponsored Investment Funds (LSIFs). The main feature of the program is that investors receive a 15% tax credit from the federal government on their investments, in effect providing a 15% subsidy to such funds. In addition some provincial governments add an additional tax credit, typically an additional 15%, making the total effective subsidy 30%. An individual investing $1000 would, after tax, in effect be getting $300 of the investment money from governments. These funds have been the subject of much study, including Ayayi (2002), Cumming and MacIntosh (2002, 2003a, 2003b, 2006), and Osborne and Sandler (1998). See Sandler (2004) for a very thorough account of LSVCCs and other subsidies to venture capital in Canada and the United States.

At the provincial level there are both provincially operated funds and the provincial equivalents of the LSVCC program. Provincially operated funds are particularly prevalent in Quebec[7], however, Ontario, Manitoba, New Brunswick, Nova Scotia, and Saskatchewan have all had provincially operated funds that were active in the 1994 to 2004 period.[8] Likewise, there are, or have been, provincial equivalents to the LSVCC program in Alberta, British Columbia, Manitoba, Ontario, Quebec, Nova Scotia, and Saskatchewan, and the remaining three provinces (as well as one territory, the Yukon), all have active direct investment tax credit programs. Collectively these

[6] Baygan (2003) states that BDC accounts for 2% of the domestic venture capital industry's capital under management Bourdeau (2004), in the BDC's annual reports, states that the 2004 carrying value of their venture capital portfolio was approximately $350m, expected to rise to $440m in 2005. See also Secrieru and Vigneault (2004).

[7] Of particular importance in Quebec are the various Quebec Innovatech Venture Capital Funds and the venture capital subsidiaries of the Caisse de dépôt et placement du Québec.

[8] Examples include the Innovation Ontario Corporation, the Manitoba Science and Technology Fund, the New Brunswick Innovation Foundation, the Nova Scotia First Fund, and the Saskatchewan Government Growth Fund, respectively.

provincial LSVCCs are often referred to as VCCs[9], although there is considerable heterogeneity in the corresponding policies. Typically these programs required a variety of conditions that correspond to other policy objectives in addition to simply increasing the supply of venture capital, such as job creation, rural development, economic diversification, increasing export sales, supporting women, aboriginal or other disadvantaged entrepreneurs, and promoting community integration**.**

In addition to government- sponsored funds, Canada also has the conventional private limited partnerships that characterize venture capital in the United States. These funds get much of their resource base from institutional investors such as pension funds, but these institutions have not been as aggressive in venture capital finance in Canada as in the United States. There are also some corporate venture capital funds, and there is some participation in the venture capital market by investment arms of commercial banks. In Canada, it is estimated that government-sponsored venture capital funds provide well over 50% of all venture capital invested in Canadian enterprises.

As is noted in Cumming (2006), the private limited partnerships and corporate venture capital funds are analogous to their US counterparts, which have been studied in Gompers and Lerner (1996, 1998a, 1998b and 1999), among others. This is important for two reasons: Gompers and Lerner (1999) found that US limited partnership contracts provide considerable performance incentives to private venture capitalists and change over time to adapt to new legislation and market conditions; and Kaplan, Martel and Stromberg (2003) found that non-US venture capitalists perform better when using US style investment contracts with their entrepreneurs. Cumming (2002) supports this latter finding but notes that the tax regime in Canada causes US venture capitalists to alter their contracting preferences towards Canadian entrepreneurs, and particularly to limit their use of convertible preferred shares.

In addition to the tax credits associated with LSVCCs, investors also receive capital gains tax relief, providing that they hold their investment for a suitable period, which is generally about 5 to 8 years. Although Cumming and MacIntosh (2003a) found that LSVCC returns are "extremely poor" and Brander, Amit, and Antweiler (2002) found that their "performance significantly lags" their private counterparts. LSVCCs are typically constrained to make investments within their province of registry, and sometimes face stage and industry investment requirements.

An interesting institutional feature is that Canada has an active lower-tier stock market segment, targeted at "early stage" ventures, called the TSX Ventures Exchange. It was formed from the merger of three provincial exchanges: The Montreal Exchange, the Alberta Stock Exchange, and the Vancouver Stock Exchange all became the Canadian Venture Exchange which in turn became the TSX Venture Exchange (TSX-VN). This segment of the stock market has lower listing and disclosure requirements than the main stock market segment (called the Toronto Stock Exchange or TSE). It also attracts less funding for firms and provides less liquidity to investors. A listing on the TSX-VN may thus be considered a somewhat less impressive exit event than a listing on the TSE, NYSE or NASDAQ.

4. Data Description

The unit of observation in our data is the enterprise (or "venture"). In principle, our data set consists of all Canadian enterprises in which one or more Canadian venture capital funds had an investment at any time in the 1996-2004 period. We use a fairly strict definition of venture capital, excluding so-called angel investments, mezzanine investments, buyout investments, private investments in public equity (PIPEs), and issuance of credit.

Figure 1 provides an overview of the data collection process. Although it is never possible to ascertain this with certainty, we believe that our data does capture practically all Canadian venture-capital backed firms. We

[9] Readers should note that VCCs are sometimes referred to as QBICs (Quebec), CBSFs (Ontario), CVCCs (Nova Scotia), EVCCs (BC prior to 1998), or SBECs (Alberta), depending on the province under study.

obtain data on these firms using an iterative search process. We started by compiling a list of Canadian venture capital funds from a variety of sources including the Canadian Venture Capital Association (CVCA), Réseau Capital and industry association membership lists, Pratt's guide, government websites, and legislative reports, as well as forum and network websites. We then supplemented this list using custom build web-bots[10] and a human review of search engine results. We identified the venture capital firm responsible for each fund, and for each venture capital firm we then obtained list of all the ventures in which the firm had investments from 1996 through 2004 by going through both their current website (if available) and their historic websites (using Internet archives, which are available back to 1996). We recorded, where possible, the year that a venture first appeared in a fund's portfolio, and any other information about the venture and its financing. We then searched on the internet for information about these ventures and their financing histories. These searches were conducted by both web-bots and human agents. The resulting information typically came the venture's website, press releases, news items or regulatory filings. From the information about each venture we obtained a list of additional investors (including American venture capital funds, angel investors, investment banks and so forth). We then obtained additional (Canadian) ventures from investment portfolio information about these additional funds. We iterated this process until convergence was reached. We believe that our data set is more comprehensive than other sources sometimes used. For example, for the 1996 to 2004 period, we identify 3,720 enterprises. This compares with 1,763 enterprises meeting our criteria identified by Thomson Financial for the same period.

Conveniently, it is relatively easy to classify venture capital funds into government-sponsored or private categories. Government-sponsored funds include all LSVCCs, the BDC, all VCCs and venture capital funds operated by provincial governments. We can therefore distinguish among enterprises receiving investments from private funds, from government-sponsored funds, or from both.

Given the list of venture-backed enterprises, we then identified IPOs and acquisitions for these enterprises. Documentation was taken from the System for Electronic Document Analysis and Retrieval (SEDAR) and Strategis in Canada and the Securities and Exchange Commission (SEC) in the U.S., as well as from press reports and other public disclosures (again gathered by web-bots), and cross-checked against data from the FP Advisor, Global New Issues and SDC Mergers and Acquisitions databases. In the case of multiple exits for a single enterprise, such as a listing on a junior exchange followed by an upgrade to a senior exchange, we took the first event where the venture capitalists had the opportunity to exit, unless there was evidence to suggest that they retained their holdings in the firm. For further information of the determination of our exit set see Hellmann, Egan and Brander (2005.

Venture founding year information and some address information was also taken from Strategis for those ventures that were federally incorporated. Furthermore, additional addresses and the operational status of the firms in 2006 were determined by custom data-mining software designed to work with the Canadian Yellow Pages, if this information was not evident from the firm's website. Investments from US venture capitalists into Canadian enterprises were recorded from Thomson VentureXpert. Canadian patent data was retrieved by custom data-mining software from the Canadian Intellectual Property Office's (CIPO) online repository. We searched for multiple variations on each firm name and matched the results back using proprietary name matching software. US patent data was obtained from the National Bureau of Economic Research patent data, as described in Hall, Jaffe and Trajtenberg (2001), and joined using name matching software. Measures of patent citations received and patent originality were averaged on a per firm basis.

[10] A 'web-bot' is a network software tool that consists of four components: a 'crawler' that retrieves pages from search engines and through hyperlinks; a 'parser' that extracts text from the HTML; a 'knowledge ontology' that is used as a reference framework for interpreting the text; and a 'reasoning system' that determines whether the text contains useful information, with respect to the ontology, and which also provides direction to the crawler. The information mined from the internet by our web-bots was validated against the original source by a human operator, who then entered the data into a database.

Table 1: Descriptive Statistics

	N	Mean	Median	St. Dev	Min	Max	N(Variable=1)
CVC Only	3,720	0.48	0	0.50	0	1	1,784
PVC-Only	3,720	0.32	0	0.47	0	1	1,208
Mixed investor types	3,720	0.20	0	0.40	0	1	728
GVC-Count	3,720	1.32	1	1.86	0	20	1,637
PVC-Count	3,720	0.85	1	1.46	0	20	1,464
Exit Event (IPO or M&A)	3,720	0.11	0	0.31	0	1	408
M&A	3,720	0.08	0	0.27	0	1	293
Insider Acquisition	3,720	0.02	0	0.14	0	1	71
Outsider Acquisition	3,720	0.06	0	0.24	0	1	222
IPO	3,720	0.03	0	0.17	0	1	115
IPO Senior	3,720	0.02	0	0.13	0	1	68
IPO Junior	3,720	0.01	0	0.11	0	1	47
Out of business	3,720	0.59	1	0.49	0	1	2,207
High Tech	2,832	0.47	0	0.50	0	1	1,318
Canadian Patents	3,720	0.16	0	0.37	0	1	611
US Patents	3,720	0.04	0	0.19	0	1	144
Received US VC	3,720	0.13	0	0.33	0	1	466
Exit Value (US$m)	335 [a]	74	21	143	1	1,240	-
IPO-S Exit Value (US$m)	68	176	94	224	4	1,240	-
IPO-J Exit Value (US$m)	47	17	10	20	2	109	-
M&A Exit Value (US$m)	220	55	16	108	1	656	-
# of Canadian Patents	3,720	0.86	0	7.21	0	297	-
# of US Patents	3,720	0.18	0	2.05	0	71	-
Ave. Cites per US Patent	144	2.78	1	4.71	0	30	-
US Patent Originality	141	0.42	0.45	0.21	0	1	-

[a] Although we have 408 exits, we have a disclosed exit value for only 335 of these 408 firms.

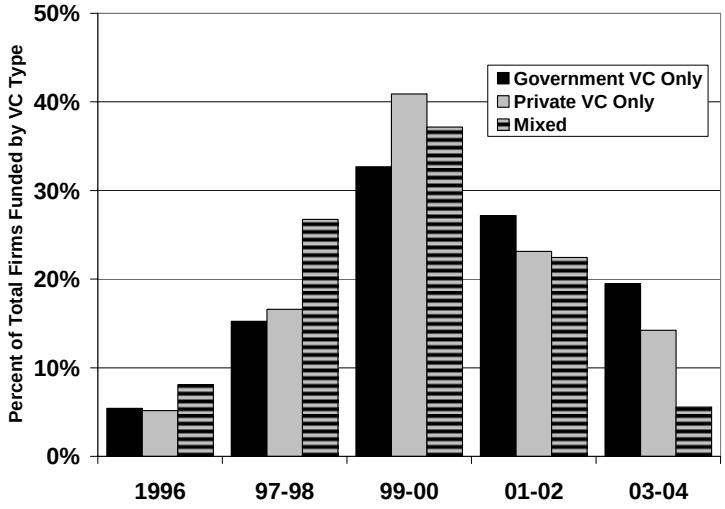
Table 1 shows the discrete or indicator variables first. The first row should be read as saying that we have an indicator variable called "GVC-Only". This is an indicator variable that takes on the value 1 for enterprises that received venture capital only from government-sponsored VC funds and 0 otherwise. There are 3720 enterprises in the data set overall. This variable takes on value 1 for 1784 (48%) of these, indicating that 1784 enterprises received venture capital only from government-sponsored funds. Similarly, the PVC-Only variable tells us that 1208 (32%) of the enterprises received venture capital only from private venture capital funds. Note that the remaining 728 (20%) of the enterprises received venture capital investments from both private and government-sponsored funds. This is important to remember, since the GVC-Only and PVC-Only variables identify the effect of *limiting* your investors to government-sponsored or private venture capitalist. The variables GVC-Count and PVC-Count measure the number of each investor type. We find that the average enterprise had 1.32 government-sponsored venture capitalist and 0.85 private venture capitalists.

To be in the data set, an enterprise simply needed to be in the investment portfolio of one of more venture capital funds at some time in the 1996-2004 period. This includes some enterprises that received investments prior to 1996. Of these 3720 enterprises, 408 (about 11%) had a "successful" exit event over the period studied. In future years more of these enterprises will of course have IPOs or be acquired by third parties. Our empirical analysis attempts to control for this censoring problem in a simple manner, namely by including founding year effects (see below).[11] Figure 2 show the frequency distribution of the ventures' founding year, over the sample period.

[11] To get an estimate of long run outcomes we might, for example, look at what happens by 5 years after first venture capital investment. This is not shown in the above table (which includes all enterprises). Applying such a metric to our data suggests that, as of five years after first investment, about 10% of venture-supported enterprises have an IPO, about 25% are acquired by a third party, about 45% go out of business, and the remainder either experience another type of venture capital exit or simply continue as a venture-supported privately held enterprise.

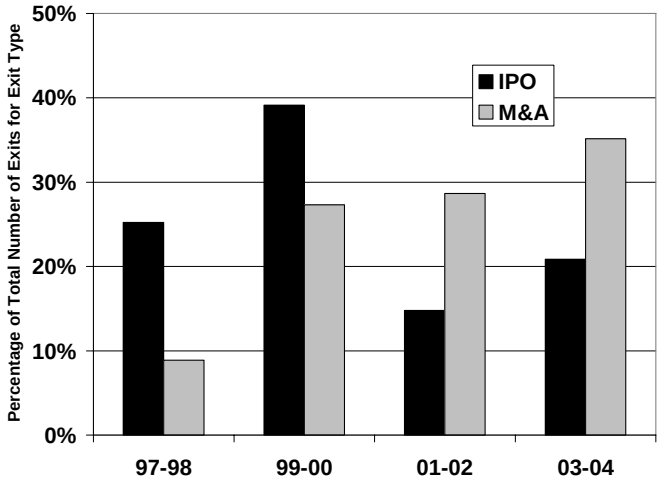
Consistent with previous observations of the venture capital market, the period 1999-2000 witnessed the largest number of venture-capital backed firm foundings.

Figure 2: Relative Frequency of venture capital investments by period and type.



The successful exits consist of 293 acquisitions (129 of which are by publicly traded U.S. firms) and 115 IPOs. The IPOs can be divided into "junior" and "senior" categories. Junior IPOs are IPOs on exchanges that specialize in small, relatively early stage IPOs, most of which are on the TSX Venture Exchange (or its predecessors). Senior IPOs are larger IPOs on larger exchanges, mostly the Toronto Stock Exchange (TSE). Some senior IPOs are on the NYSE or the NASDAQ. As can be seen in table 1, the median senior IPO is almost 10 times the size of the median junior IPO. However, some junior IPOs are larger than some senior IPOs, and the largest junior IPO is on the same order of magnitude as the median senior IPO. Figure 3 shows the frequency distribution of IPOs and M&As over the sample period. It shows that IPOs followed the familiar boom and bust cycle with a peak in the 1999-2000 period. Interestingly, M&As show a considerable smother path over time.

Figure 3: Frequency distribution of exits by IPO and M&A



An enterprise is defined as "out of business" if it had not had a successful exit and could no longer be found in the appropriate Yellow Pages as of 2006 or be found through other means. Using this definition, more than half the enterprises in the sample went out of business within the sample period (i.e. by 2006). This reflects an important reality associated with venture capital investment. Even though venture capitalists are highly specialized in selecting and mentoring innovative enterprises, most investments either lose money outright or earn less than what

would have been earned by investing in Government of Canada bonds or other very safe assets. Most of the return to venture capitalists comes from a relatively small number of enterprises that are successful enough to have IPOs or be acquired by a third party.

Probably the most striking aspect of the patent data is that relatively few firms obtain patents. A total of only 611 firms (about 16% of the sample) received one or more Canadian patents and only 144 (about 4%) received U.S. patents. Concerning the classification of high technology firms, we note that of the 3,720 enterprises, we have industry classifications (2-digit NAIC codes) for 2,832 (about 76%). Of these 2,832 enterprises, 1,318 (about 46%) are in what we describe as the "high-tech" sector, using the definition of "high-tech" based on NAIC codes suggested by Hecker (2005)[12]. Our regression analysis includes specifications with industry fixed effects, represented by 2-digit NAIC codes, as control variables. However, given the relatively small number of exits (and investments) in some industries, it is necessary to do some agglomeration. Specifically, we combine all 2-digit industries with fewer than 100 enterprises into a single category.[13]

For brevity, not all data is shown in table 1. We omit details about the individual industry dummies, as well as our founding date measure. This is a set of dummy variables that indicate the year of founding for the enterprise or, if that is not available, the earliest year in which the enterprise received venture capital. If this occurred before 1996 we do not have the exact year and code the enterprise with an indicator code meaning "before 1996." This year variable is sometimes used a control variable. As we recall, the period 1996–2004 covers a stock market (and IPO) boom in the first few years, a "crash" in 2000 – 2002 and a subsequent recovery. Accordingly, we might expect that simple timing might have a significant impact on exit valuations and on other performance measures. We would not want to attribute to a new venture-capital support program losses associated simply with this stock market cycle. We therefore condition on timing to avoid this problem. The founding date controls also help to account for the fact that exit events are right-censored.

Our data has several notable deficiencies. Most important, we were unable to gather any systematic information on the amount of capital invested by venture capitalists. Some of that information is available in the commercial database by Thomson Financial, but there are two major problems with that. First, some industry experts have argued that the data contains some inconsistencies and measurement errors. Second, as noted above, the Thomson Financial appears to have an incomplete and biased coverage of the population of Canadian venture-capital backed firms. We attempted to independently collect data on the investment amount, including for those enterprises not covered in Thomson Financial. However, this attempt failed because our alterative sources of information, such as web pages, do not contain systematic and reliable information on investment amounts. Similar problems also explain the lack of other data that would have been of interest to the analysis, such as the valuation of the venture capital investments, or the post-investment involvement of venture capitalists in the enterprise (e.g., board seats, control rights, etc…).

5. Analysis and Results

Our primary method of analysis is based on regression analysis as implemented by STATA 8. A typical regression structure is as follows:

$$PI = \alpha_0 + \alpha_G GVC + \alpha_P PVC + \beta X + \varepsilon \qquad (1)$$

where PI is a performance indicator, α_G and α_P are coefficients associated with government-sponsored venture capital funds and private venture capital funds, β is a vector of coefficients on control variables, X is a vector of

[12] Hecker (2005) provides a definition of high tech in terms of 4 digit NAIC codes, based on the employment of scientists, engineers and technicians within each industry segment, as follows: 1131, 1132, 2111, 2211, 3241, 3251, 3252, 3253, 3254, 3255, 3259, 3332, 3333, 3336, 3339, 3341, 3342, 3343, 3344, 3345, 3346, 3353, 3364, 3369, 4234, 4861, 4862, 4869, 5112, 5161, 5171, 5172, 5173, 5174, 5179, 5181, 5182, 5211, 5232, 5413, 5415, 5416, 5417, 5511, 5612, and 8112.

[13] Specifically we use two digit NAIC codes 21, 31, 32, 33, 51, 54, 62, and 99 as industry controls, where 99 indicates that either the industry classification is missing, or that the original two digit classification had fewer than 100 observations.

control variables, namely a complete set of founding year and industry fixed effects, and ε is a random error. In all cases we use the "robust" option, which corrects for heteroskedasticity using the Huber/White/sandwich adjustment. We report t or z statistics as is appropriate, along with their p-values.

In essence, we treat a given performance measure (such exit value) as a dependent variable and seek to "explain" this variable based on the presence of government-sponsored venture capital funds (GVCs) or private venture capital funds (PVCs) as independent variables. For each dependent variable, every table actually reports the results from four distinct specifications. The first specification omits the controls variables X and uses indicator variables for the investor types. Specifically, it estimates the model using the GVC-Only and PVC-Only indicator variables. Remember that the omitted category is firms that obtain funding from both types of investors, so that the estimated coefficients measure the effect of a firm *limiting* its investor to either type. The second specification also uses the GVC-Only and PVC-Only indicator variables but adds the control variables X. Note that the first and second specifications focus on different aspects of the investor comparison. The first specification shows us the unconditional effect of having only government-sponsored investors. We can think of this as a total effect, where investors can freely choose which industries to invest in, and when. The second specification shows us the effect conditional on investors having chosen the time and industry of their investments. The two specifications therefore provide complementary information. The third and fourth specifications again first omit and then add the controls variables X. The new aspect is that these specifications use the number of private and government-sponsored venture capitalists, PVC-Count and GVC-Count, as dependent variables. The coefficients thus measure the effect of a firm *adding* an investor of either type. Finally, note that in addition to being interested in the size and statistical significance of the coefficients α_P and α_G, we are also interested in their *relative* size. In each table we therefore report the results of testing the hypothesis that PVC - GVC= 0. This test therefore examines the effect substituting a private venture capitalist for a government-sponsored venture capitalist.

5.1 Effects on Value Creation

As noted in the introduction, one important measure of performance for early stage investors concerns whether the venture has a major valuation event – an IPO or a third party acquisition. A majority of enterprises in our sample did not have such a valuation event in the period studied. Therefore, one basic question concerns whether private venture capital or public venture capital funds were more likely to generate positive exit events. In table 2 we report regression results showing the effect of government-sponsored venture capital and private venture capital on the frequency of such successful valuation events. In this case the performance indicator is a categorical variable taking on value 1 if a successful exit occurred and value 0 if it did not. Accordingly, we use Probit regressions to estimate the effect of government-sponsored and private venture capital funds.

Table 2: The Effect of GVCs and PVCs on the Occurrence of Successful Exits
Dependent variable = indicator variable showing whether a successful exit occurred

Probit Regressions	**Specification 1**	**Specification 2**	**Specification 3**	**Specification 4**
GVC-Only	-0.525 (-7.47***)	-0.250 (-3.23***)	-	-
PVC-Only	-0.236 (-3.30***)	-0.044 (-0.55)	-	-
GVC-Count	-	-	0.031 (2.24**)	0.001 (0.08)
PVC-Count	-	-	0.138 (8.52***)	0.079 (4.76***)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	-0.926 (-17.0***)	-0.205 (-1.09)	-1.41 (-40.1***)	-0.45 (-2.48**)
Pseudo R-Squared	0.023	0.120	0.035	0.124
Observations	3720	3720	3720	3720
PVC - GVC	0.288 (4.49***)	0.206 (2.95***)	0.107 (4.43***)	0.078 (3.25***)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient.

As shown in the column labeled "Specification 1" enterprises supported only by GVCs were much less likely to have a successful exit than enterprises supported only by PVCs. This can be seen from the coefficients on GVC only and PVC only, and it can also be seen in the bottom row, which shows a z-test of the hypothesis that the coefficients are equal. As shown, PVC is significantly larger than GVC. In Specification 1, both GVC-only and PVC-only appear to have less likelihood of successful entry than enterprise that received both kinds of venture capital investment. This is not a surprise as, in general, receiving investment from more venture capitalists is a good predictor of success. However, once we control for industry and year, there is no significant difference between enterprises receiving investment from PVCs only and those receiving investment from both types. On the other hand, the enterprises funded strictly by GVCs continue to exhibit significantly worse performance as measured by the likelihood of successful exit.

The columns labeled Specification 3 and Specification 4 tell a similar story in that the number of PVCs is a significantly more positive indicator than the number of GVCs. Adding a PVC does a lot more for the likelihood of successful entry than adding a GVC. This is obvious from the coefficients themselves and is shown by the formal test in the bottom row of the table. This holds whether or not we control for industry and year fixed effects. In summary, to the extent that the probability of successful exit is an important performance measure, it seems that private venture capital significantly outperforms government-sponsored venture capital.

The next performance measure we consider is exit value. We use the natural log of exit value as the dependent variable. Table 2 shows that private venture capital is more likely to lead to successful exit. It is possible that this performance handicap for GVC financed enterprises might be offset by better performance (higher valuation) when successful exits do occur. However, as shown by table 3, enterprises financed by private venture capital generate higher value than enterprises financed by government-sponsored venture capital funds, albeit with only marginal statistical significance. Table 3 shows OLS regression results for the 335 observations for which we have exit values.

Table 3: The Conditional Effect of GVCs and PVCs on Exit Valuation
Dependent variable = log of value of the enterprise at the exit event (IPO or acquisition)

OLS regressions	**Specification 1**	**Specification 2**	**Specification 3**	**Specification 4**
GVC-Only	-0.467 (-2.20**)	-0.581 (-2.59**)	-	-
PVC-Only	-0.035 (-0.17)	-0.215 (-0.96)	-	-
GVC-Count	-	-	-0.026 (-0.71)	-0.004 (-0.10)
PVC-Count	-	-	0.072 (1.92*)	0.071 (1.78*)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	17.1 (122 ***)	17.9 (33.6***)	16.849 (149***)	17.484 (32.8***)
R-Squared	0.017	0.10	0.013	0.096
Observations	335	335	335	335
PVC - GVC	0.432 (1.96*)	0.367 (1.63)	0.098 (1.54)	0.075 (1.15)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the t-statistic is shown in parentheses beside the estimated coefficient

Table 2 shows the differential effect of government-sponsored and private venture capital on "selection" into the successful exit category. Table 3 shows the different effect of the two types of venture capital on the amount of success (represented by the exit value), conditional on being selected into the successful exit category. The full differential effect of GVC and PVC is a combination of these two effects. It is possible to combine the two effects using a "Tobit" regression rather a conditional OLS regression to explain the exit value, where the value of "non-exits" is set to zero. The results of this approach are shown in table 4.

Table 4: Full Effects of GVC and PVC on Exit Valuation

Dependent variable = value of the enterprise at the exit event (IPO or acquisition)

Tobit Regressions	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	-17.68 (-8.53***)	-9.49 (-4.37***)	-	-
PVC-Only	-8.89 (-4.12***)	-3.80 (-1.70*)	-	-
GVC-Count	-	-	0.80 (1.97**)	0.058 (0.15)
PVC-Count	-	-	3.78 (10.22***)	2.15 (5.76***)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	-29.6 (-14.4***)	-6.59 (-1.26)	-44.6 (-29.1***)	-15.4 (-3.04***)
Pseudo R^2	0.014	0.056	0.017	0.057
Observations	3647	3647	3647	3647
PVC - GVC	8.79 (4.28***)	5.687 (2.81***)	2.98 (4.59***)	2.09 (3.45***)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the t-statistic is shown in parentheses beside the estimated coefficient

As shown by table 4, the differential effect of GVC and PVC on exit valuation is strong once both the selection effect and any effects conditional on successful exit are combined as in a Tobit regression. Enterprises financed by private venture capital funds do better, on average, than enterprises financed by government-sponsored venture capital. A related measure of the performance of venture-backed enterprises is simply survival. Accordingly, table 5 shows the differential effect of GVC and PVC on whether the enterprise was out of business by 2006.

Table 5: Effects of GVC and PVC on Survival

Dependent variable = indicator variable showing whether the firm went out of business by 2006

Probit Regressions	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	0.319 (5.76***)	0.167 (2.74***)	-	-
PVC-Only	0.207 (3.50***)	0.102 (1.58)	-	-
GVC-Count	-	-	-0.030 (-2.53**)	-0.006 (-0.53)
PVC-Count	-	-	-0.076 (-4.95***)	-0.033 (-2.16**)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	0.017 (0.37)	-0.655 (-3.96***)	0.340 (12.4***)	-0.487 (-3.04***)
Pseudo R-Squared	0.007	0.079	0.008	0.079
No. Observations	3720	3720	3720	3720
PVC - GVC	-0.113 (-2.38**)	-0.064 (-1.27)	-0.046 (-2.20**)	-0.027 (-1.28)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

The effects shown in table 5 are of marginal statistical significance, but they do tend to show that enterprises financed differentially by private venture capitalists are more likely to survive than enterprises with more financing from government- sponsored venture capitalists. Finally, we have one other variable related to value creation. This is whether or not the enterprise received investment from U.S. sources. Arguably, attracting U.S. financing is both an indicator of the firm having good prospects and contributes directly to enhanced value. Results regarding whether or not the enterprise received investment from U.S. sources are shown in table 6.

Table 6: Effects of GVC and PVC on U.S. Investment

Dependent variable = indicator variable showing whether the firm received U.S. investment

Probit Regressions	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	-1.006 (-15.09***)	-0.744 (-10.19***)	-	-
PVC-Only	-0.786 (-11.37***)	-0.596 (-7.72***)	-	-
GVC-Count	-	-	0.141 (10.22***)	0.105 (7.65***)
PVC-Count	-	-	0.241 (8.82***)	0.178 (7.24***)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	-0.495 (-10.18***)	-0.648 (-2.68***)	-1.637 (-40.20***)	-1.569 (-6.46***)
Pseudo R-Squared	0.087	0.199	0.147	0.231
No. Observations	3720	3720	3720	3720
PVC – GVC	0.220 (3.28***)	0.147 (1.93*)	0.101 (3.04***)	0.072 (2.41**)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Table 6 shows that private venture capital finance is significantly more closely associated with obtaining U.S. funding than government-sponsored venture capital finance.

5.2 Effects on Competition

The analysis so far lumps together different types of exits that represent different ownership structures, which are likely to be correlated with different degrees of competitiveness. We first examine the breakdown of the three exit types. As mentioned above, the IPO market is divided into two segments, the senior exchanges which signal that an enterprise has achieved a certain maturity and viability, and the junior exchanges, which do not guarantee either maturity or viability of the enterprise. Mergers and acquisitions naturally represent the third type of exit. Table 7 considers a multinomial logit specification, where the omitted category contains those ventures that have not experienced an exit. The table then reports the effect of the two types of venture capital on the likelihood of obtaining each of the three exit events.

Table 7 contains several important results. Firms financed only by government-sponsored venture capitalists are significantly less likely to be acquired, whereas firms financed only by private venture capitalists are not significantly different from the firms financed by both types. Along similar lines the number of PVCs is highly significant for the probability of an M&A, whereas the number of GVCs is insignificant. The test for the difference between PVCs and GVCs is highly significant across all four specifications, suggesting that private venture capitalists generate significantly more mergers and acquisitions. This conclusion is essentially reversed for junior IPOs. Enterprises financed by GVCs are significantly more likely to experience a listing on the junior stock exchange. Moreover, enterprises limited to only one type of investor are significantly less likely to experience a listing on the senior stock exchange. Having more private venture capital significantly increases the probability of a senior IPO. The difference between the PVC and GVC coefficients is insignificant for the indicator specification, but positive and significant for the count specification. Overall, we note that government-sponsored venture capitalists are particularly likely to list enterprises on the junior exchanges, whereas private venture capitalists favor the senior exchanges, as well as M&A.

Table 7: The Effect of GVC and PVC on the Type of Exit Achieved

Dependent variable = a categorical variable containing the three main types of exit (M&A, Senior IPO and Junior IPO). The base category is firms that have not had an exit.

	Multinomial Logit	Specification 1	Specification 2	Specification 3	Specification 4
M&A	GVC-Only	-0.968 (-6.02***)	-0.392 (-2.27**)	-	-
	PVC-Only	-0.177 (-1.18)	0.245 (1.47)	-	-
	GVC-Count	-	-	0.017 (0.53)	-0.043 (-1.25)
	PVC-Count	-	-	0.245 (7.85***)	0.129 (3.90***)
	Constant	-1.976 (-16.87***)	-0.962 (-2.35**)	-2.708 (-34.55***)	-1.178 (-3.05***)
	PVC - GVC	0.791 (5.43***)	0.637 (4.12***)	0.228 (4.34***)	0.172 (3.38***)
Junior IPO	GVC-Only	-0.445 (-1.27)	-0.025 (-0.07)	-	-
	PVC-Only	-0.738 (-1.79*)	-0.329 (-0.70)	-	-
	GVC-Count	-	-	0.168 (3.95***)	0.112 (2.26**)
	PVC-Count	-	-	-0.063 (-0.66)	-0.130 (-1.24)
	Constant	-3.830 (-13.66***)	-2.509 (-3.11***)	-4.480 (-26.44***)	-2.685 (-3.21***)
	PVC - GVC	-0.293 (-0.80)	-0.304 (-0.80)	-0.231 (-1.94*)	-0.242 (-1.96*)
Senior IPO	GVC-Only	-1.467 (-5.18***)	-1.044 (-3.45***)	-	-
	PVC-Only	-1.428 (-4.42***)	-1.255 (-3.41***)	-	-
	GVC-Count	-	-	0.101 (2.73***)	0.061 (1.57)
	PVC-Count	-	-	0.297 (7.30***)	0.190 (4.71***)
	Constant	-2.899 (-16.21***)	-1.525 (-2.31**)	-4.422 (-27.87***)	-2.798 (-4.67***)
	PVC - GVC	0.039 (0.11)	-0.211 (-0.60)	0.196 (3.29***)	0.129 (2.06**)
	Industry F.E.	no	yes	no	yes
	Year F.E.	no	yes	no	yes
	Pseudo R^2	0.02464548	0.11821156	0.03279249	0.1185952
	Observations	3720	3720	3720	3720

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

The type of exit event is likely to be correlated with the firm's competitive impact. Firms that achieve the size and maturity of being able to undertake a senior stock market listing may probably be viewed as successful new entrants in their industries. This cannot be taken for granted for firms listing on the junior exchanges, where the fundamental market viability of the firm typically remains uncertain. Based on this, we define a measure of competitiveness that considers senior IPOs as pro-competitive and junior IPOs as less competitive. It is important to note, however, that this is not a direct measure of the competitive impact generated by these firms. Instead the measure consists of what might be considered a reasonable but imperfect interpretation of exit events. The measure is imperfect for two reasons. First, it only captures average tendencies, but there may by some junior-market listed firms that have a more pro-competitive impact than some of the senior-market listed firms. Second, we only measure the competitive impact at the time of exit, but a firm's status may subsequently change.

Probably the biggest challenge for our measure of competitive impact concerns mergers and acquisitions. In general it is difficult to say whether such an exit event increases or decreases competition, since this depends crucially on who the acquirer is. Conceptually we want to distinguish between acquisitions by industry insiders, which indicate a less competitive outcome, and acquisitions by industry outsiders, which signify entry of the acquirers into the target firms' industries, and can thus be thought of as pro-competitive. Empirically we attempt to distinguish insider and outsider M&As by comparing the industry classifications of the acquirer and target firms. For this analysis to be meaningful we need to choose an industry definition that is neither too wide nor too narrow, and we settle on the 5-digit NAIC definition for an industry.[14] Specifically, we classified an exit by M&A as less competitive when the acquirer had the same 5-digit NAIC code, and pro-competitive otherwise. Again, we consider

[14] As a robustness check we also run regressions with a definition based on 4-digit NAIC or 6-digit NAIC but found that this did not affect the main results.

this as an indirect and imperfect but useful proxy for measuring the competitive impact of the IPO or acquisition event. Table 8 reports the results of a multinomial logit regression where the omitted category is firms that have not exited, and the two reported categories are companies that have a less competitive or more competitive impact.

Table 8: The Effect of GVC and PVC on Competitiveness

Dependent variable = a categorical variable containing less and more competitive exit groups. The base category is firms that have not had an exit.

	Multinomial Logit	**Specification 1**	**Specification 2**	**Specification 3**	**Specification 4**
Less-competitive Exit	GVC-Only	-0.939 (-5.65***)	-0.393 (-2.19**)	-	-
	PVC-Only	-0.192 (-1.22)	0.223 (1.26)	-	-
	GVC-Count	-	-	0.033 (1.03)	-0.028 (-0.83)
	PVC-Count	-	-	0.216 (6.72***)	0.106 (2.96***)
	Constant	-2.065 (-16.95***)	-0.826 (-2.12**)	-2.776 (-34.94***)	-1.055 (-2.82***)
	PVC - GVC	0.747 (4.95***)	0.615 (3.88***)	0.183 (3.39***)	0.134 (2.45**)
More-competitive Exit	GVC-Only	-1.094 (-5.36***)	-0.584 (-2.69***)	-	-
	PVC-Only	-0.930 (-4.22***)	-0.626 (-2.59**)	-	-
	GVC-Count	-	-	0.088 (2.88***)	0.042 (1.31)
	PVC-Count	-	-	0.263 (7.44***)	0.164 (4.73***)
	Constant	-2.425 (-16.92***)	-1.193 (-2.30**)	-3.611 (-32.02***)	-1.978 (-4.21***)
	PVC - GVC	0.163 (0.74)	-0.042 (-0.18)	0.174 (3.39***)	0.122 (2.42**)
	Industry F.E.	no	yes	no	yes
	Year F.E.	no	yes	no	yes
	Pseudo R^2	0.02168992	0.11028798	0.02971498	0.11115155
	Observations	3720	3720	3720	3720

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Table 8 shows that private venture capitalists are clearly more likely to generate exit events of the less competitive type. While the difference between PVC and GVC is insignificant in the indicator variable specifications, the count variable specifications show that private venture capitalists also generate significantly more exits events that can be classified as more competitive.

The analysis of tables 7 and 8 uses the enterprises with no exit as the control group. An alternative perspective is to limit the analysis to those enterprises that actually experienced an exit. When conditioning on exit, we need to specify a new omitted category, so we choose M&A for that. Tables 9 and 10 thus report the regressions that condition on exit.

Tables 9 and 10 show that the preference of GVCs to list ventures on the junior exchange continues to hold. However, the result that PVCs favor senior listing no longer holds if we condition on exit. In the indicator variable specifications, PVCs are even less likely to achieve a senior IPO, although the difference between PVCs and GVCs becomes clearly insignificant in the count variable specifications. The key intuition is that PVCs have a strong propensity to generate M&As. Along similar lines, we find that ventures that limit themselves to PVCs tend to have less competitive exits than those that limit themselves to GVCs, although again this result does not generalize to the count specification models.

Table 9: The Effect of GVC and PVC on the Type of Exit Achieved, conditional on having an exit
Dependent variable = a categorical variable containing the two types of IPO (Senior IPO and Junior IPO). The omitted category is M&A.

	Multinomial Logit	Specification 1	Specification 2	Specification 3	Specification 4
Junior IPO	GVC-Only	0.523 (1.38)	0.435 (1.05)	-	-
	PVC-Only	-0.560 (-1.29)	-0.426 (-0.88)	-	-
	GVC-Count	-	-	0.155 (2.48**)	0.136 (2.00**)
	PVC-Count	-	-	-0.384 (-3.14***)	-0.303 (-2.56**)
	Constant	-1.854 (-6.21***)	-1.834 (-1.85*)	-1.696 (-8.16***)	-1.624 (-1.56)
	PVC - GVC	-1.084 (-2.76***)	-0.861 (-2.08**)	-0.539 (-3.63***)	-0.438 (-2.97***)
Senior IPO	GVC-Only	-0.499 (-1.56)	-0.578 (-1.65)	-	-
	PVC-Only	-1.251 (-3.58***)	-1.307 (-3.36***)	-	-
	GVC-Count	-	-	0.085 (1.78*)	0.072 (1.37)
	PVC-Count	-	-	0.059 (1.29)	0.049 (0.99)
	Constant	-0.922 (-4.48***)	-0.651 (-0.83)	-1.731 (-9.77***)	-1.493 (-2.03**)
	PVC - GVC	-0.752 (-2.02**)	-0.728 (-1.82*)	-0.026 (-0.35)	-0.024 (-0.28)
	Industry F.E.	no	yes	no	yes
	Year F.E.	no	yes	no	yes
	Pseudo R^2	0.03298589	0.10036347	0.03224705	0.0939805
	Observations	408	408	408	408

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Table 10: The Effect of GVC and PVC on Competitiveness, conditional on having an exit
Dependent variable = a categorical variable equal to one if the firm experienced a more competitive exit, and equal to zero (the base category) if the firm experienced a less competitive exit.

	Logit	Specification 1	Specification 2	Specification 3	Specification 4
More-competitive Exit	GVC-Only	-0.154 (-0.61)	-0.254 (-0.91)	-	-
	PVC-Only	-0.738 (-2.83***)	-0.912 (-3.29***)	-	-
	GVC-Count	-	-	0.057 (1.39)	0.069 (1.59)
	PVC-Count	-	-	0.055 (1.25)	0.058 (1.18)
	Constant	-0.360 (-2.01**)	-0.113 (-0.18)	-0.853 (-6.21***)	-0.711 (-1.17)
	PVC - GVC	-0.584 (-2.23**)	-0.658 (-2.37**)	-0.002 (-0.02)	-0.011 (-0.15)
	Industry F.E.	no	yes	no	yes
	Year F.E.	no	yes	no	yes
	Pseudo R^2	0.01737262	0.06339773	0.00988507	0.05179178
	Observations	408	408	408	408

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Overall, if we look at the entire spectrum of outcomes, enterprises that are financed by private venture capitalist experience more senior IPOs, less junior IPOs and more M&A, and the pattern of exits suggests that these firms have a positive impact on competitiveness. However, if we condition on a successful exit, we find that PVC-backed firms mainly experience M&As, so that conditional on exit, the impact on competitiveness is less clear cut.

5.3 Effects on Innovation

The potential effect of venture capital on innovation is perhaps the most important effect considered here. The most commonly used measure of innovation is based on the number of patents held by an enterprise. Given that this is a count variable, we use a negative binominal regression framework, although we also verified that our

results continue to hold in a Poisson model, as well as in zero-inflated negative binominal regressions. We gathered data on both the Canadian and US patents of our Canadian ventures, and report the results in table 11 and 12.

Table 11: The Effect of GVC and PVC on Canadian Patents

Dependent variable = a count variable equal to the number of Canadian patents obtained by the enterprise

Negative Binomial	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	-1.077 (-4.19***)	-0.921 (-5.16***)	-	-
PVC-Only	-0.470 (-1.42)	-0.247 (-0.92)	-	-
GVC-Count	-	-	0.064 (1.42)	0.009 (0.25)
PVC-Count	-	-	0.344 (2.53**)	0.300 (2.59**)
Industry F.E.	no	Yes	no	yes
Year F.E.	no	Yes	no	yes
Constant	0.430 (3.84***)	-0.599 (-0.99)	-0.628 (-3.15***)	-1.392 (-2.25**)
Pseudo R-Squared	0.007	0.034	0.008	0.033
No. Observations	3720	3720	3720	3720
PVC - GVC	0.607 (1.57)	0.675 (2.38**)	0.280 (1.72*)	0.291 (2.16**)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Table 12: The Effect of GVC and PVC on U.S. Patents

Dependent variable = a count variable equal to the number of U.S. patents obtained by the enterprise

Negative Binomial	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	-0.452 (-0.97)	-0.044 (-0.14)	-	-
PVC-Only	-0.287 (-0.61)	0.223 (0.60)	-	-
GVC-Count	-	-	0.001 (0.01)	-0.078 (-1.52)
PVC-Count	-	-	0.147 (1.35)	0.073 (0.74)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	-1.403 (-3.94***)	-3.460 (-4.38***)	-1.844 (-7.39***)	-3.345 (-4.58***)
Pseudo R-Squared	0.00086751	0.05335451	0.00114425	0.05372003
No. Observations	3720	3720	3720	3720
PVC - GVC	0.166 (0.39)	0.266 (0.72)	0.146 (0.98)	0.151 (1.12)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Tables 11 and 12 provide some evidence that private venture capitalists promote more patent activity than government-sponsored venture capital funds. For the Canadian patent the difference between the PVC and GVC coefficients is positive and significant in three out of four specifications. For U.S. patents the coefficient is also always positive, albeit statistically not significant.

The US data also contains citation information, which allows us to consider standard measures of patent quality. Table 13 reports forward citations and table 14 reports results for the patent originality measure. Note that only a relatively small number of enterprises actually register US patents, severely limiting the sample size for the regressions.

Table 13: The Effect of GVC and PVC on the Mean Citations Received by U.S. Patents
Dependent variable = the mean citations received on U.S. patents obtained by the enterprise

Conditional OLS	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	0.661 (0.94)	0.168 (0.23)	-	-
PVC-Only	1.835 (1.49)	1.268 (1.12)	-	-
GVC-Count	-	-	-0.275 (-2.87***)	-0.231 (-2.54**)
PVC-Count	-	-	-0.120 (-1.31)	-0.050 (-0.51)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	2.025 (4.01***)	-0.434 (-0.21)	3.532 (6.48***)	0.547 (0.33)
Pseudo R-Squared	0.02208785	0.181626	0.04160764	0.19211682
No. Observations	144	144	144	144
PVC - GVC	1.174 (0.96)	1.100 (0.96)	0.155 (0.99)	0.181 (1.25)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Table 14: The Effect of GVC and PVC on the Mean Originality of U.S. Patents
Dependent variable = the mean originality of U.S. patents obtained by the enterprise, as in Hall et al. (2001)

Conditional OLS	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	-0.079 (-1.83*)	-0.075 (-1.54)	-	-
PVC-Only	-0.029 (-0.64)	-0.029 (-0.60)	-	-
GVC-Count	-	-	-0.005 (-0.83)	-0.005 (-0.66)
PVC-Count	-	-	0.019 (2.76***)	0.019 (2.51**)
Industry F.E.	no	yes	no	yes
Year F.E.	no	yes	no	yes
Constant	0.461 (14.55***)	0.594 (4.73***)	0.405 (18.06***)	0.545 (4.68***)
Pseudo R-Squared	0.02585492	0.13748196	0.03089462	0.14313344
No. Observations	141	141	141	141
PVC - GVC	0.050 (1.15)	0.046 (1.05)	0.024 (2.13**)	0.023 (1.96*)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Tables 13 and 14 are consistent with the notion that enterprises financed by private venture capitalists generate higher quality patents. The difference between PVC and GVC is positive and insignificant for the forward citation measure. The same is true for the originality measure, except that the count specification also generates statistically significant higher coefficients. These results provide some evidence that enterprises financed by private venture capitalists generate higher quality patents. At the minimum, we can safely reject the opposite claim that enterprises financed by government-sponsored venture capitalists generate higher quality patents.

Another possible indicator of innovation is based on industry classification. Using the classification system of Hecker (2005), we divide the group of firms into two general groups – "high-tech" and "other". We then treat "high-tech" as a dependent variable to be explained by the presence or absence of PVC and GVC. Note that our definition of high technology firms occurs at a much finer level of aggregation than our industry controls. Most of our two-digit industry definitions are such that they include both high technology and other groups. As a consequence we are able to retain the specifications with industry fixed effects.[15]

[15] To be specific, two of our two-digit industries, namely codes 31 and 62 are entirely composed of high technology group. We therefore amalgamated those observations with code 99.

Table 15: Support of "High-Tech" Enterprises

Dependent variable = indicator variable taking on the value 1 for "High-Tech" enterprises

Probit	Specification 1	Specification 2	Specification 3	Specification 4
GVC-Only	-0.513 (-8.52***)	-0.528 (-7.42***)	-	-
PVC-Only	-0.175 (-2.74***)	-0.219 (-2.82***)	-	-
GVC-Count	-	-	0.039 (3.16***)	0.043 (3.03***)
PVC-Count	-	-	0.120 (5.70***)	0.092 (4.19***)
Industry F.E.	no	Yes	no	yes
Year F.E.	no	Yes	no	yes
Constant	0.193 (4.01***)	-0.892 (-4.23***)	-0.263 (-7.50***)	-1.411 (-6.88***)
Pseudo R-Squared	0.021	0.352	0.022	0.348
No. Observations	2832	2832	2832	2832
PVC - GVC	0.338 (6.11***)	0.309 (4.52***)	0.081 (3.34***)	0.050 (1.72*)

***, **, and * indicate statistical significance at the .01 level, .05 level, and .1 level respectively.
In each cell the z-score is shown in parentheses beside the estimated coefficient

Table 15 shows that private venture capitalists are more closely associated with "high tech" ventures than government-sponsored venture capitalists. This provides further evidence that private venture capital is more closely associated with measurable innovation outcomes than government-sponsored venture capital.

6. Concluding Remarks

In this paper we assess the relative performance of private venture capital and government-sponsored venture capital in Canada. We focus on three general areas of performance: value creation, competitive effects, and innovation. We do not undertake a full welfare analysis but, presumably, these three proximate objectives are all closely associated with economic welfare. Overall, it appears that there is a consistent pattern of superior performance for private venture capitalists. Specifically, enterprises supported by private venture capital are more likely to have successful exits (IPOs or third-party acquisitions) and tend to generate higher value conditional on successful exit. Overall, the expected commercial value of an enterprise financed by private venture capital (PVC) is significantly higher than for an enterprise financed by government-sponsored venture capital (GVC). In addition, PVC financed enterprises are less likely to go out of business over relevant time horizons and are more likely to attract U.S. investment.

The effects on competition are less conclusive. On the one hand there is clear evidence that private venture capitalists are associated with a greater likelihood of an IPO on a senior exchange (the TSE, NYSE, or NASDAQ), and government-sponsored venture capitalists with IPOs on junior exchanges (mainly the TSX-VN). This suggests that private venture capitalists may generate more competitiveness. However, private venture capitalists are also associated with more mergers and acquisitions, including by industry insiders, which may be considered as less competitive outcomes.

There also appears to be some evidence of differential impacts on innovation. Relative to government-sponsored venture capitalists, enterprises funded by private venture capitalist finance operate more often in high-technology industries. They also show a greater propensity to patent (at least in Canada) and a higher quality of patents (in the US).

Putting these three areas together – value creation, competition, and innovation, it appears that enterprises supported by private venture capital have an overall superior performance. These results are significant even though it is difficult to obtain sufficient data at a precise enough level to draw strong inferences. In seeking to identify the effect of private as opposed to government-sponsored venture capital we use two primary measures of the relative importance of private venture capital. First, we divide the sample of venture-backed enterprises into three categories: those that received finance only from private venture capital funds (32%), those that received finance

only from government-sponsored venture capital funds (48%), and those that received finance from both (20%). We are therefore able to make a direct comparison of enterprises financed only by PVCs with those backed only by GVCs. In addition, we also have a count of the number of private venture capital funds and government-sponsored venture capital funds that provide finance for each enterprise. Using the number of such venture capitalists as an indicator of the relative importance of each type, this variable can also be used to draw inferences about differential effects of PVCs and GVCs. In principle, it would be desirable to have data about the actual investment provided to each venture by PVCs and GVCs and use this to represent the relative importance of each type of investor, but insufficient information of this type is available. Given the available information, we find our results to be strongly suggestive, albeit far from definitive.

If we accept the apparent fact that enterprises financed by private venture capital exhibit better performance, on average, than enterprises financed by government-sponsored venture capital, the next question concerns policy implications. It does not follow from our analysis that government support for venture capital has been unsuccessful. One crucial issue is whether government-sponsored venture capital is additional venture capital that would not otherwise be in the market, or whether it displaces or "crowds out" private venture capital. If crowding out does not occur, more venture capital in the form of government-sponsored venture capital finance might still be good, even if it is not as good as private venture capital. Thus estimates of crowding out are an essential complement to our analysis if policy conclusions are to be reached. If crowding out does occur, then there is clearly a problem with government-sponsored venture capital.

Even if government-sponsored venture capital does not cause much crowding out and is primarily additional venture capital, that it is still not the whole story. It would still be important to assess whether the benefits of such investment exceed the costs. Given the market failures associated with venture capital finance and with innovation, it is quite possible that government subsidies to venture capital to offset these market failures are important, but a full rate of return or cost-benefit assessment of such subsidies would need to be undertaken. We would view our analysis as step in the direction of a full policy analysis and would suggest that the data we have provides some cautionary notes in assessing the value of government-sponsored venture capital.

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