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Government Sponsored versus Private Venture Capital
Canadian Evidence

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9.1 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. 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) or the public sector.

Despite this apparent link between entrepreneurial activity, innovation, and economic growth, most entrepreneurship is not particularly innova-

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tive and not particularly successful.[1] 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 subclass of highly innovative entrepreneurial ventures that provide the most important contributions. This small subclass of entrepreneurial firms is the particular focus of the venture capital industry. Most venture capital activity consists of seeking out, investing in, and contributing to innovation-intensive entrepreneurial ventures.

It is perhaps not surprising that national governments and governments of subnational political jurisdictions often seek to promote, support, and expand venture capital as a means of promoting innovation and economic growth. From an economist's perspective, however, 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 then there would be a case for significant government intervention in all major sectors. This would suggest a return to government-controlled economic planning of the sort that many previous studies have suggested is ineffective. One argument that is often made for interventionist policy in a particular market, such as the venture capital market, is the existence of significant market failures that might reasonably be addressed by public policy.

This chapter has two primary objectives. First, we seek to describe the conceptual foundations of government intervention in the venture capital sector. We ask what we would expect to observe if government policy were well-structured according to appropriate normative principles. We then turn our attention to an empirical analysis using Canadian data. The government of Canada and provincial governments within Canada have made significant efforts to expand venture capital activity through a variety of policies. Our second primary objective is therefore 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.

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 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 tech-

1. 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" (67).

nologies 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.

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 United States). 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. 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 underprovided. 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 underprovision 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 that 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-sponsored venture capitalists (GVCs henceforth) might replicate market failures that would occur anyway and possibly add new ones. Informational problems might be amplified and GVCs might simply crowd out more efficient private venture capitalists (PVCs henceforth). 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 9.3, the quantitatively most important government intervention in venture capital arises through the so-called "labor-sponsored" venture capital funds (LSVCCs).[2] 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). Furthermore, various provincial governments also provide subsidies through a variety of other programs. We refer to these programs collectively as government-sponsored venture capital (GVC) funds and compare them with private venture funds (PVCs). The GVCs account for well over half of all venture capital under management in Canada.

The basic data on Canadian firms obtaining venture capital is surprisingly incomplete. One of the contributions of this chapter 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 are reported in 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 measures related to the creation of value and innovation by these enterprises. However, the data also contains important limitations. Most notably, we are

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

unable to measure the actual amount of funding provided by the various types of investors.

The GVCs, particularly the labor-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 such objective. At the broadest level, the ultimate 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 chapter provides an analysis of the performance of GVCs with respect to important outcome measures that have not been previously studied in this context.

One 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.[3] Typically these successful exit events generate substantial earnings for venture capitalists, and possibly other early stage investors, as well as for the founders and employees of the venture.[4] On the other hand, going out of business is typically considered as an unsuccessful outcome. In between those two outcomes (successful exits and going out of business) are firms that remain privately-held. Therefore, we can reasonably consider successful

3. 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.

4. 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 GVCs 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 GVCs 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.

exits as an indicator of success, or we could consider "survival" (successful exits plus continuing as a privately-held enterprise) as an alternative measure. We investigate both.

A second important goal of GVC programs is to promote innovation, although it is hard to measure. 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 be desirable in future work to supplement patent information with other measures of innovation. As a small first step in that direction, we examine research and development (R&D) spending for ventures that went public, noting that these are the only companies for which R&D data is systematically available. Yet another interesting aspect is the choice of industry, especially whether the investments pertain to high versus low technology industries.

A third goal of GVC programs relates to the promotion of competition and of a more "entrepreneurial" economy. 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 an 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 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 PVCs.

A fourth frequently-mentioned goal of GVC programs is employment creation, although economists normally express reservations about whether employment promotion is appropriately addressed by such policies. In any case, we do seek to assess the employment creation record of GVCs. The biggest challenge for our analysis is unavailability of data. In particular, our analysis of employment creation is limited to the subset of ventures that went public, which is a small and unrepresentative sample.

In summary, our analysis examines the empirical relationship between the receipt of government-sponsored venture capital funding and the likelihood and size of a successful exit event, the enterprises' innovation activities, as well as measures of competition and employment. To provide a brief overview of the main results, we find that enterprises funded by GVCs tend to underperform on most outcome measures. They are less likely to have successful exits and, in particular, are much less likely to have IPOs on major exchanges. Furthermore, they generate lower exit values when they do have a successful exit. The GVCs invest less in high technology industries, and their enterprises generate fewer patents (even after controlling for industry selection). Our results provide no evidence that GVCs increase employment or competition.

We recognize that government-sponsored venture capital might be worthwhile even if the associated enterprises are less successful than enterprises funded by private venture capitalists. If the problem is that the private sector would not provide enough venture capital, then we would want the public sector to expand the pool, picking the "next best" set of enterprises who would, presumably, not be quite as good as the set selected by the private sector in the absence of government support.

It is therefore very important to ask whether publicly supported venture capital does add to the pool of supported enterprises or whether it simply displaces or "crowds out" private investment. A complete answer to this question would require consideration of counterfactuals of what would have happened in the absence of government intervention, something that we cannot do here. Nonetheless, we examine some indirect evidence that suggests there is considerable crowding out but that crowding out is not complete. Government VC support might therefore promote modest market expansion.

One important issue relates to "endogeneity." If we observe that enterprises supported by PVCs are better than enterprises supported by GVCs, this might arise for one of two reasons. Either the PVCs might select better enterprises or the PVCs might provide more useful value added to the enterprises and might therefore create more success for a given pool of enterprises than GVCs. These two effects can be thought of as the "selection effect" and the "treatment effect."

From an econometric point of view, to estimate the "treatment effect" we would want to (exogenously) assign venture capitalists to enterprises on a random basis and observe the performance of the enterprises. This is not how the observations are generated, as the PVCs select the enterprises they want to invest in. Therefore, as an explanatory variable for performance, a PVC indicator is actually endogenous in the sense that we expect PVCs to choose enterprises with good potential to perform well. If we are interested in the selection effect, the resulting estimates are interesting. However, if we wish to identify the treatment effect then standard ordinary least squares (OLS) is compromised by a classic endogeneity problem generated by the selection effect.

The normal solution to such endogeneity problems is to use instrumental variables, if good instruments can be found. In this case we have a very interesting and, in our view, very useful instrument that can be used for this purpose. This instrument is based on the exogenous variation in the political leadership of provincial governments, as explained more fully later. We find that the funding by GVCs is related to having left-leaning provincial governments. Moreover, the negative effect of GVC funding on the various outcomes measures becomes even stronger in the instrumental variable specifications. These results are at least suggestive of a significant treatment effect for private venture capital relative to government-sponsored venture capital.

Section 9.2 of this chapter contains a literature review of related work. Section 9.3 provides a conceptual framework for our analysis. Section 9.4 describes the venture capital market in Canada, including a review of relevant government policy. Section 9.5 provides an overview of our data and section 9.6 is devoted to our empirical analysis and major results. Section 9.7 contains concluding remarks.

9.2 Literature Review

We take the view that the primary conceptual rationale for government intervention in entrepreneurial finance 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]) emphasizes 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 market 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. The 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 (2001), Barry et al. (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 (2005), Jones and Rhodes-Kropf (2002), Ljungqvuist and Richardson (2003), and Gompers and Lerner (1997), among others. Anderson and Tian (2003) document the poor investor returns arising from the Canadian LSVCC program.

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 it. 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 underprovision of innovation, does venture capital act to partially offset this underprovision? The literature on this topic is not extensive, but we would draw attention to Kortum and Lerner (2000), Gans and Stern (2003), and Hellmann and Puri (2000), which all 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), Leleux and Surlemont (2003), and Wallsten (2000), all of which find significant "crowding out" of private venture capital by publicly supported venture capital. Such crowding out suggests very limited effects from government subsidies of venture capital. On the other hand, Lerner (1999, 2002) and Gans and Stern (2003) provide some evidence of success for the US Small Business Investment Research (SBIR) program.

9.3 Conceptual Framework

One important question for our purposes concerns what we would expect to see arising from a successful government program. We can then compare what we do observe with such expectations. The first important point is that we should not be surprised if GVC-supported enterprises earn lower returns than PVC-supported enterprises. Consider the following very useful diagram, suggested by Scott Stern. (See also Gans and Stern [2003].) The diagram provides a simplified view of the venture capital market. The private venture capitalists have a private upward-sloping (marginal) cost of finance shown in the diagram. There is also an expected private marginal return to venture capital, given by the lower of the two downward-sloping curves. We would expect the private market outcome to yield investment level V^P. However, there are external benefits or "positive externalities" associated with venture capital. Accordingly, the marginal social value of venture capital finance is given by the upper downward-sloping line. At the private outcome, V^P, the equilibrium level of venture capital investment is less than the socially efficient outcome given by V^*, where the (private) marginal cost is just equal to the social marginal benefit. An appropriate subsidy, provided through GVCs, could increase the equilibrium quantity of venture capital investment to the socially efficient level, as shown in figure 9.1.

An effective program would leave intact the "inframarginal" projects to the left of point A on the private (marginal) value schedule and would have the effect of adding the "extensive margin"—consisting of projects in the range A to B along the schedule. Private VCs would continue to support the inframarginal projects and GVCs would support the projects in the extensive margin.

If the program worked in this way then the private value or return arising from the GVC enterprises (i.e., drawn from the segment AB) would be lower than the private value associated with inframarginal projects funded by PVCs. On the other hand, there is no reason to expect the external value, given by the difference between the upper and lower downward sloping lines, to be lower for GVC-funded enterprises than for PVC-funded enterprises. As drawn, this external value is constant. In general, there could be any relationship between private and social value for GVC enterprises. It could be higher, lower, or the same. The principle of insufficient reason suggests that similar value would be the appropriate "null hypothesis."

The diagram also clarifies the crowding out point. A good program would add an extensive margin, as shown by AB. However, it is possible that GVCs

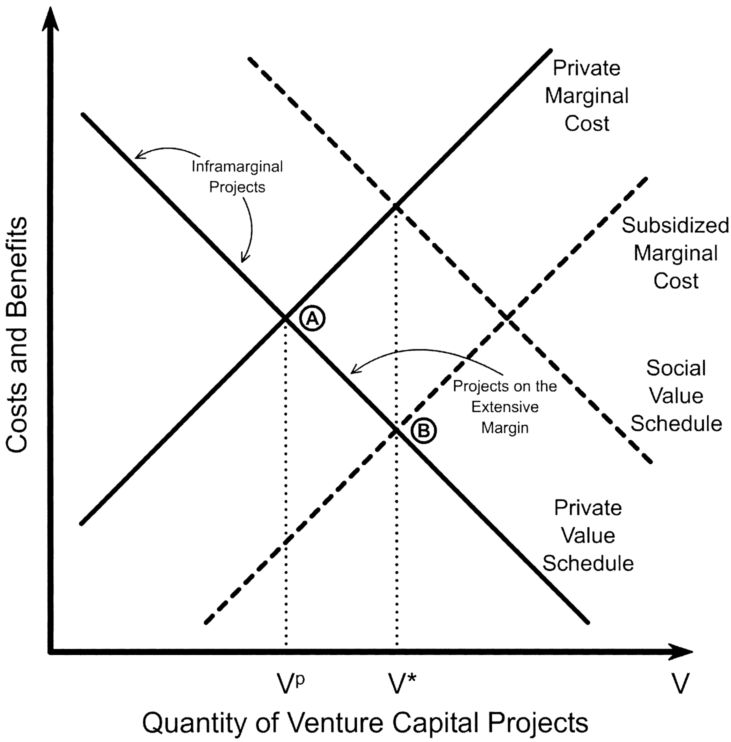

Fig. 9.1 Marginal costs and marginal values for venture capital

do not add any extensive margin but simply compete for inframarginal projects—those to the left of point A on the private value schedule. In the extreme there might be no additional enterprises funded. This would be a negative outcome, as it would imply that GVC programs create a transfer of resources from taxpayers to participants in the market with no corresponding additional social benefit.

This diagram also implies that there is no "treatment effect" associated with GVCs. As drawn, the private and social value of an enterprise is not affected by whether the enterprise is funded by GVCs or PVCs. The difference in return or private value simply arises from a selection effect: PVCs select higher quality projects as is consistent with their higher (i.e., unsubsidized) return threshold. This implies that any value added provided to an enterprise (either private or social) is provided equally by both PVCs and GVCs. However, it is possible that GVCs might have a less positive "mentoring" effect on enterprises than PVCs. If so, this would be an important negative effect of GVC programs, particularly if crowding out occurs. With crowding out and a negative treatment effect GVC programs would replace PVC investment and, in addition, reduce the (private and social) value of the enterprise.

The key inferences to be drawn from the conceptual framework for interpreting our results are as follows:

1. We should not be surprised or alarmed if GVC-supported enterprises exhibit lower private performance than PVC-supported enterprises. This would be expected under a well-designed program.
2. We should be concerned if the external (i.e., nonprivate) effects of GVC-supported enterprises fall short of PVC-supported enterprises.
3. The extent of crowding out is very important. If GVCs appear to be crowding out private venture capital, this would be a negative finding.
4. If GVCs have weaker private performance than PVCs this could be due to either selection or treatment (or both). To the extent the effect is due to selection, this is consistent with a good GVC program: PVCs would simply have a higher threshold for returns, as we would expect of unsubsidized funds. However, if weaker performance is due to a "treatment effect"—less effective mentoring—then this would be a negative finding. Therefore, it is very important to see what happens when we "correct for" the selection effect and focus only on the treatment effect. A poor program would be characterized by a large negative treatment effect and a small selection effect. The small selection effect would suggest crowding out—that GVCs were competing with PVCs for projects that would be funded in any case, and it would suggest that GVCs generate lower values when they do replace PVCs.

All four of these points can be assessed empirically.

9.4 An Overview of the Canadian Venture Capital Market

As the Canadian economy is roughly 10 percent of the size of the US economy, we might expect the venture capital markets in the two countries to be characterized by a similar ten to one 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 had 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 gross domestic product (GDP) for 2007 exceeded 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 US counterpart. If anything, Canadian venture capital markets might be slightly larger than the pro rata 10 percent 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 Organization for Economic Cooperation and Development (OECD), or academic papers comes largely (although not exclusively) from one commercial source: Thomson Financial Canada, also known as Thomson-Macdonald (formerly Macdonald and 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. This incompleteness particularly applies to 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 (2004) 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 1 percent of the total dollars invested in the United States in the same period. If the US-Canada border had no effect, and distance did not matter either, we might expect that about 90 percent of the venture capital in Canada would come from the United States and about 10 percent of the venture capital in the United States 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 United States 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 United States, although it is hard to be definitive given the proliferation of state programs in the United States 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.[5] The other major federal initiative is the labor-sponsored fund program. The associated venture capital funds are often referred to as Labor Sponsored Venture Capital Corporations (LSVCCs) or as Labor Sponsored Investment Funds (LSIFs). The main feature of the program is that investors receive a 15 percent tax credit from the federal government on their investments, in effect providing a 15 percent subsidy to such funds. In addition, some provincial governments add an additional tax credit, typically an additional 15 percent, making the total effective subsidy 30 percent. An individual investing $1,000 would, after tax, in effect be getting $300 of

5. Baygan (2003) states that BDC accounts for 2 percent 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 $350 million, expected to rise to $440 million in 2005. See also Secrieru and Vigneault (2004).

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;[6] however, Ontario, Manitoba, New Brunswick, Nova Scotia, and Saskatchewan have all had provincially operated funds that were active in the 1994 to 2004 period.[7] 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 provincial programs are often referred to as VCCs,[8] although there is considerable heterogeneity in the corresponding policies. Typically these programs require 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 over 50 percent of all venture capital invested in Canadian enterprises. As a point of comparison, we estimate that the corresponding GVC policy interventions in the United States account for approximately 5 percent of the total invested capital.

Cumming (2006) finds that the Canadian 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) and elsewhere. Gompers and Lerner (1999) found that US limited

6. 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.

7. 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.

8. 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.

partnership contracts provide considerable performance incentives to PVCs 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 toward 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 five to eight 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). The 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. They 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 is therefore a less impressive exit event than a listing on the TSE, New York Stock Exchange (NYSE), or National Association of Securities Dealers Automated Quotations (NASDAQ).

9.5 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 to 2004 period. We use a fairly strict definition of venture capital, excluding so-called angel investments, mezzanine investments, buyout investments, private investments in public entities (PIPEs), and issuance of credit.

Figure 9.2 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 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

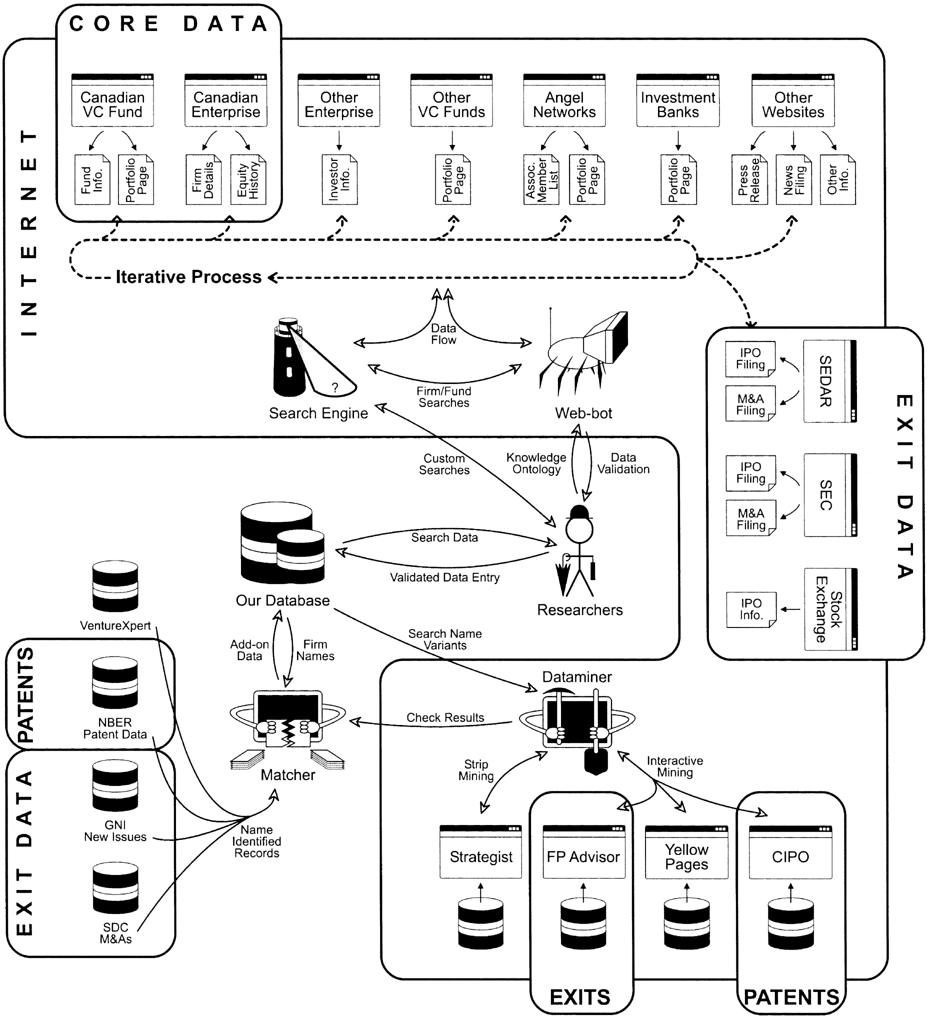

Fig. 9.2 Data collection overview

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 built web-bots[9] and a human review

9. 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.

of search engine results. We identified the venture capital firm responsible for each fund, and for each venture capital firm we then obtained a 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 from 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 Strategies in Canada and the Securities and Exchange Commission (SEC) in the United States, 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. The 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.

Table 9.1 shows the discrete or indicator variables first. The first row should be read as saying that we have an indicator variable called "PVC." This is an indicator variable that takes on the value 1 for enterprises that received venture capital only from private VC funds and 0 otherwise. There are 3,720 enterprises in the data set overall. This variable takes on value 1 for 1,208 (32 percent) of these, indicating that 1,208 enterprises received venture capital only from private funds. Similarly, the GVC variable tells us that 1,784 (48 percent) of the enterprises received venture capital only from government-sponsored venture capital funds. The remaining 728 (20 percent) of the enterprises received venture capital investments from both private and government-sponsored funds. We call these MVC, meaning that the company has a mix of private and government-sponsored venture funds. The variables number of PVC and number of GVC measure the number of each investor type participating in a venture. We find that the average venture had 1.32 GVCs and 0.85 PVCs. The variable number of VC simply measures the total number of investors for a given enterprise. Finally, for the analysis it will be useful to work with the fraction of venture funds that are government-sponsored, as measured by fraction of GVC, which is obtained as the ratio of number of GVC over number of VC.

To be in the data set, an enterprise simply needed to be in the investment portfolio of one or more venture capital funds at some time in the 1996 to 2004 period. This includes some enterprises that received investments prior to 1996. Of these 3,720 enterprises, 408 (about 11 percent) 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 the following).[10] Figure 9.3

10. To get an estimate of long-run outcomes we might, for example, look at what happens by five years after first venture capital investment. This is not shown in table 9.1 (which includes all enterprises). Applying such a metric to our data suggests that, as of five years after first investment, about 10 percent of venture-supported enterprises have an IPO, about 25 percent are acquired by a third party, about 45 percent 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.

Table 9.1 Descriptive statistics

Variable	*N*	Mean	Standard deviation	Min	Max	PVC subsample	GVC[a] subsample	MVC[b] subsample
PVC	3,720	0.325	0.468	0	1	—	—	—
GVC	3,720	0.48	0.5	0	1	—	—	—
MVC	3,720	0.196	0.397	0	1	—	—	—
Number of GVC	3,720	0.852	1.461	0	20	—	—	—
Number of PVC	3,720	1.317	1.858	0	20	—	—	—
Number of VC	3,720	2.169	2.575	1	30	—	—	—
Fraction of GVC	3,720	0.591	0.447	0	1	—	—	—
Exited	3,720	0.110	0.313	0	1	0.123	0.073***	0.177***
Exited M&A	3,720	0.079	0.269	0	1	0.102	0.049***	0.114
Outsider	3,720	0.06	0.237	0	1	0.083	0.033***	0.087
Insider	3,720	0.019	0.137	0	1	0.019	0.016	0.027
Exited IPO	3,720	0.031	0.173	0	1	0.021	0.025	0.063***
Senior exchange	3,720	0.018	0.134	0	1	0.012	0.012	0.045***
Junior exchange	3,720	0.013	0.112	0	1	0.009	0.013	0.018*
Exit value ($m)[c]	335[d]	74.4	143	0.9	1,240.0	82.7	64.4	74.7
Senior IPO ($m)	68	176	224	4.5	1,240.0	123.2	219.4	170.5
Junior IPO ($m)	47	16.5	20.5	1.8	109.0	17.6	16.0	16.4
M&A ($m)	220	55.4	108	0.9	656.0	84.4	26.7***	40.9*
Survived	3,720	0.407	0.491	0	1	0.411	0.368**	0.493***
US VC investment	3,720	0.125	0.331	0	1	0.100	0.067***	0.31***
Canadian patents	3,720	0.164	0.371	0	1	0.137	0.117	0.324***
Number of CA patents	3,720	0.864	7.205	0	297	0.961	0.524	1.537
US patents	3,720	0.039	0.193	0	1	0.031	0.034	0.063***
Number of US patents	3,720	0.183	2.053	0	71	0.185	0.156	0.246
Log employment at IPO	88[e]	4.453		1.386	9.680	4.491	4.558	4.333
R&D-intensity	88[e]	28,660	52,682	0	327,456	8.2	3.7***	12.2
Left politics	2,884	0.526	0.499	0	1	0.348	0.612***	0.558***

[a]The stars report the significance levels of *t*-tests that compare the GVC subsample against the PVC subsample.
[b]The stars report the significance levels of *t*-tests that compare the MVC subsample against the PVC subsample.
[c]Exit values are reported conditional on an exit of the appropriate type.
[d]Although there are 408 exits, we have a disclosed exit value for only 335 of these 408 firms.
[e]Although there are 115 IPOs, we have disclosed information for only 88 of these 115 firms.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

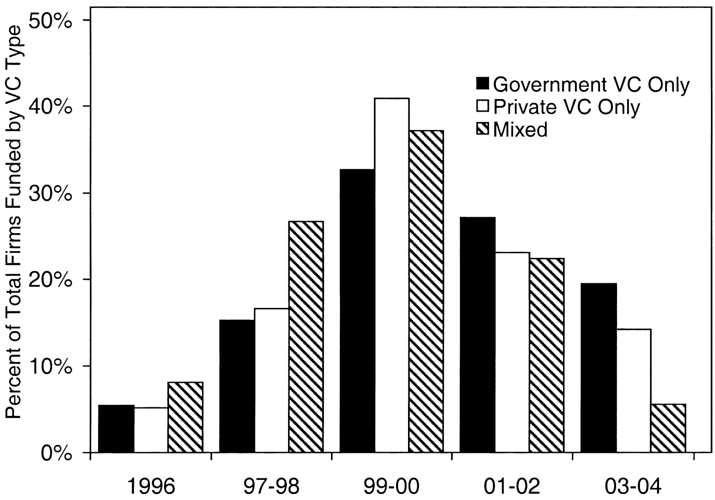

Fig. 9.3 Relative frequency of venture capital investments by period and type

shows the frequency distribution of the ventures' founding year over the sample period. Consistent with previous observations of the venture capital market, the period 1999 to 2000 witnessed the largest number of venture capital-backed firm foundings.

The successful exits consist of 293 acquisitions (129 of which are by publicly-traded US 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 9.1, the median senior IPO is almost ten 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 9.4 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 to 2000 period. Interestingly, M&As show a considerably smoother path over time.

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 through other means. Using this definition, 40.7 percent of the enterprises in the sample survived (i.e., did not go 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

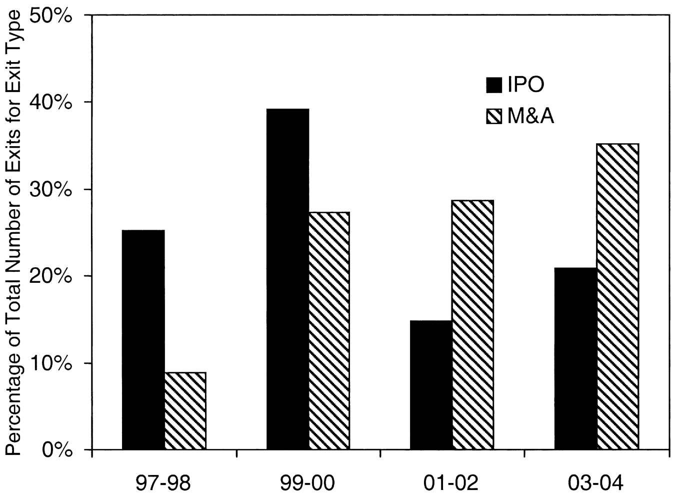

Fig. 9.4 Frequency distribution of exits by IPO and M&A

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 to be acquired by a third party.

An important question is, what kind of enterprises receive venture capital? One of the reasons for supporting venture capital is to address market failures associated with asymmetries of information; another is the promotion of innovative activity. Both of these are widely believed to be associated with high technology firms. We define high technology to consist of both information technology (IT) and biotechnology, both of which are in turn defined using six-digit North American Industry Classification (NAIC) codes. This NAIC based definition of high-technology is broadly consistent with that of Hecker (2005). See Brander and Egan (2007) for a detailed description of these two industry classifications and their NAIC code correspondence. The remaining industries were defined in terms of single-digit NAIC codes. However, given the relatively small number of exits (and investments) in some industries, it is necessary to do some agglomeration. Specifically, we combine all single-digit industries with fewer than 100 enterprises into one of two categories: primary sectors consisting of NAIC codes 1 and 2, and tertiary sectors, or service industries, consisting of NAIC codes 6 through 9. Of the 3,720 enterprises in our sample, we have industry classifications (six-digit NAIC codes) for 2,832 (about 76 percent). Of these 2,832 enterprises, 1,226 (about 33 percent) are in what we describe as the "high-tech" sector.[11]

11. Brander and Egan (2007) provide a definition of IT in terms of six-digit NAIC codes as follows: 333295, 334111, 334112, 334113, 334119, 334210, 334220, 334290, 334413, 334611,

Our regression analysis includes specifications with industry fixed effects, represented by single-digit NAIC code groups, as well as a code for IT and another for biotechnology, as control variables.[12]

Figure 9.5 shows the distribution of venture capital investments by industry, and also indicates the relative proportions of private, government, and mixed investors. To further explore how these types of investors focus on different industry sectors, we estimate a simple multinomial logit model, where the dependent variables are GVC (with the omitted category being PVC) and "PVC and MVC" (with the omitted category being GVC), and where the independent variables are the industry dummies. This simple regression estimates the likelihood that firms in a given sector obtain government or mixed/private investors, and table 9.2 presents the results in descending order of the estimated regression coefficient. Thus, this regression orders the relative importance that different investors have in different industries. The results are striking. Government-sponsored venture capital firms have a preference for lower technology industries, such as resource extraction and manufacturing. The major high-technology areas of information technology and biotechnology, however, are lowest on the list of relative industry preferences. This ranking is essentially reversed for the mixed and private investor category, suggesting that syndication between private and government investors is particularly likely in the high technology sector. We will return to this finding in section 9.5.4.

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 provided by Thomson Financial Canada, but there are two major problems with that data source. First, some industry experts have argued that the data contains some inconsistencies and measurement errors. Second, as noted before, the Thomson Financial Canada data 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 alternative 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.).

335921, 423430, 425110, 443120, 511210, 516110, 517110, 517212, 517410, 517910, 518111, 518210, 519190, 541511, 541512, 541513, 541519, 611420, and 811212. Biotechnology is defined as follows: 325411, 325412, 325413, 325414, 541710, and 621511. Note that biotechnology is particularly difficult to define using the NAIC system.

12. Specifically we use single-digit NAIC codes 1 and 2, 3, 4, 5, 6 through 9, IT, Biotech, and zero as industry controls, where zero indicates that the industry classification is missing.

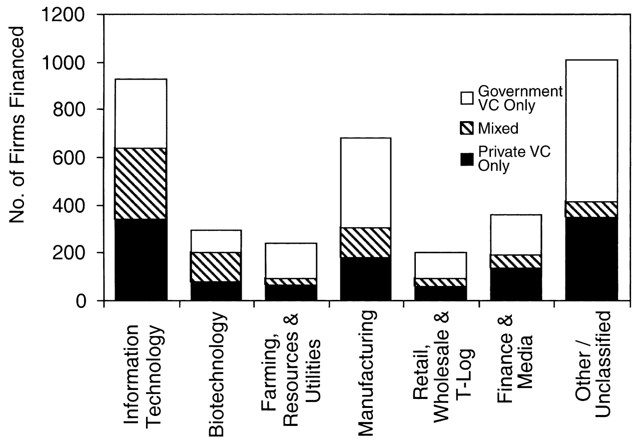

Fig. 9.5 Venture capital investments by industry and type

Table 9.2 Relative ranking of industry preferences from multinomial logit regression

Ranking	Government-sponsored VC (GVC)	Coefficient
1	Farming, resources, and utilities	0.293
2	Manufacturing	0.200
3	Retail, wholesale, transportation, and logistics	0.027
4	Other and unclassified	0.000
5	Finance and media	–0.302
6	Biotechnology	–0.318
7	Information technology	–0.668
	Mixed (MVC) and Private VC (PVC)	Coefficient
1	Biotechnology	2.202
2	Information technology	1.598
3	Manufacturing	1.355
4	Retail, wholesale, transportation, and logistics	0.992
5	Finance and media	0.897
6	Farming, resources, and utilities	0.786
7	Other and unclassified	0.000

We also face other severe data limitations. Our only measure of employment comes from IPO prospectuses, and therefore is available only for a tiny fraction of ventures. A similar problem holds for our R&D intensity measure. Another important limitation is that we were unable to collect reliable measures of the total size of the government subsidy. Moreover, we were unable to systematize any changes in the more detailed rules that affect the attractiveness of the government subsidies. Despite our best efforts, we were also unable to always obtain complete information on industry classification and the first year of financing. We continue to include the associated observations in our analysis by categorizing them into a distinct dummy category. We note that our data is fundamentally cross-sectional (one observation per enterprise), so we cannot perform any panel-based analysis.

9.6 Analysis and Results

9.6.1 Choice of Empirical Specification

Our primary method of analysis is based on regression analysis as implemented by STATA 10. As a first step for the analysis, we focus on characterizing the relationship between investor types and outcome variables. It is important to remember that the investor type is clearly not exogenous, so no causation should be inferred from these regressions. Wherever possible, 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.

There are multiple regression specifications that elucidate different aspects of the underlying data. In table 9.3 we therefore consider one of the most important performance measures—namely, whether a company experienced a successful exit or not—and explore the meaning of a variety of regression specifications. The dependent variable 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 different types of venture capital funds.

We distinguish between two different approaches of representing investor types. The first is a categorical approach, and divides venture-backed firms into three types: firms that only receive private venture capital (PVC)—we will use them as our omitted default category; firms that only receive government-sponsored venture capital (GVC); and firms that receive a mix of the two (MVC). The categorical approach has the advantage of being easy to interpret, although the simple categories do not exploit the full amount of information available. We therefore also consider a continuous variable approach that uses more of the available information. In particular, we calculate the fraction of a company's investors that are government sponsored. Note that in an ideal world, we would want to use the fraction of money received from GVCs, but unfortunately we do not have sufficiently reliable investment data to undertake that approach. Table 9.3 contains two separate row sections, one for the categorical and one for the continuous variable approach.

The columns of table 9.3 contain a variety of alternative specifications for the control variables. The first column reports the model without any control variables. We find that having only government-sponsored VC has a negative and significant effect on the probability of a successful exit. However,

Table 9.3 Exits

	Dependent variable = exit indicator variable coefficient (z score)							
Indicator variable								
GVC	–0.288	–0.300	–0.286	–0.295	–0.228	–0.243	–0.206	–0.217
	(–4.49***)	(–4.67***)	(–4.26***)	(–4.40***)	(–3.29***)	(–3.49***)	(–2.88***)	(–3.03***)
MVC	0.236	–0.030	0.167	–0.046	0.051	–0.111	0.013	–0.103
	(3.30***)	(–0.34)	(2.17**)	(–0.49)	(0.66)	(–1.23)	(0.17)	(–1.11)
Number of VC	—	0.066	—	0.054	—	0.041	—	0.030
		(6.02***)		(4.78***)		(3.63***)		(2.60***)
Constant	–1.162	–1.257	–0.588	–0.718	–2.359	–2.392	–1.873	–1.925
	(–25.01***)	(–25.90***)	(–4.61***)	(–5.40***)	(–16.59***)	(–16.86***)	(–9.95***)	(–10.16***)
R^2	0.0226	0.0368	0.0445	0.0538	0.1194	0.1246	0.1369	0.1396
Fraction variable								
Fraction of GVC	–0.286	–0.318	–0.295	–0.314	–0.229	–0.259	–0.212	–0.232
	(–4.92***)	(–5.15***)	(–4.74***)	(–4.85***)	(–3.48***)	(–3.81***)	(–3.08***)	(–3.29***)
Number of VC	—	0.078	—	0.064	—	0.044	—	0.032
		(8.91***)		(6.98***)		(4.58***)		(3.26***)
Constant	–1.070	–1.244	–0.467	–0.703	–2.339	–2.386	–1.842	–1.918
	(–25.65***)	(–26.41***)	(–3.80***)	(–5.32***)	(–16.40***)	(–16.88***)	(–9.76***)	(–10.14***)
R^2	0.0085	0.037	0.0359	0.0542	0.1173	0.1254	0.1361	0.1403
Common controls								
Year fixed effects	no	no	yes	yes	no	no	yes	yes
Industry fixed effects	no	no	no	no	yes	yes	yes	yes
N	3,720	3,720	3,720	3,720	3,720	3,720	3,720	3,720

***Significant at the 1 percent level.

having both government and private VCs actually increases the probability of a successful exit. This result may seem surprising at first. Before placing any interpretation on this result, we need to realize a fundamental problem: better ventures are likely to raise more rounds of investment involving a greater number of investors and so would have a greater likelihood of receiving investment from a GVC. This means that, for purely mechanical reasons, better ventures that attract more investors are more likely to end up in the MVC category. Column (2) addresses this problem by adding a control for the number of investors. We find that this alone eliminates the significance of the MVC coefficient. We naturally have to be careful not to give a causal interpretation to the number of investors variable: having more investors may improve a company's performance, but better ventures also attract more investors. This specification therefore allows us to focus on how the type of investor is related to outcomes, after controlling for the obvious positive relationship between performance and the number of investors. The continuous variable approach, using the fraction of government investors, provides further evidence that controlling for the number of investors may be important (especially in the categorical specification). We note that the number of investors variable is again highly significant, but that the fraction of GVC variable is hardly affected by its introduction. This suggests that the investor type variables (either GVC and MVC, or fraction of GVC) measure a different effect than the number of investors; that is, these variables separate out the investor type effect from an enterprise quality effect. Note that, obviously, the number of investors is far from being a perfect control for enterprise quality. In unreported robustness checks we replaced this variable with an estimate of the number of rounds obtained by the enterprise. Because of data limitations, we are unable to provide a precise estimate of the number of rounds, but we are able to establish an upper and a lower bound. Using either of these alternative control variables yields very similar results.

It seems natural to also control for calendar time effects. We therefore introduce 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 sometimes used a control variable. As we recall, the period 1996 to 2004 covers a stock market (and IPO) boom in the first few years, a "crash" in 2000 to 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. Columns (3) and (4) of table 9.3 report the results of adding year fixed effects, first without and then with the number of investors control. We find that year fixed effects have relatively little impact on our results.

Columns (5) and (6) report the results of adding industry fixed effects. If one wants to get an idea of the unconditional performance of the different investor types, it can be useful not to control for industry. This is because from an investor perspective, choosing the right industries is part of the investment challenge. In this chapter, however, we focus on the effect that different investor types have on the performance of venture-backed firms. Thus, it is natural to control for the fact that performance metrics, such as the probability of a successful exit, may vary across different industries. We already noted in section 9.4 that the different types of venture capital firms have marked differences in their preference for investing in different industries. Not surprisingly, we find that the addition of industry controls has some effect on the main dependent variables. In particular, we note that the MVC variable loses significance. This is mostly due to the fact that the exit rate is highest in the high technology sectors (IT and biotechnology). Interestingly, we note again that the fraction of GVC variable is robust and remains negative and significant.

Columns (7) and (8) finally consider the model with both year and industry fixed effects. Because column (8) has the most complete set of control variables, it will become the default specification for the remainder of the analysis.

9.6.2 The Relationship between Investor Types and Performance Measures

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. Column (1) of table 9.4 repeats the results from column (8) of table 9.3, showing that the presence of GVCs is associated with a lower probability of successful exit.

A second measure of the performance of venture-backed enterprises is simply survival. Accordingly, column (2) shows how having different types of investors is related to survival. The coefficients for GVC and fraction of GVC are negative but not statistically significant.

The next performance measure we consider is the value of the enterprise at exit. We use an ordinary least squares (OLS) regression where the dependent variable is the natural logarithm of one plus the exit value. For all venture-backed firms that did not experience a successful exit we set the exit value to zero. This is a problematic approximation for two reasons. First,

Table 9.4 **Value creation**

Dependent variable	Exit probit coefficient (*z* score)	Survive probit coefficient (*z* score)	Exit value (log) OLS coefficient (*t* score)	Exit value (log) resolved deals OLS coefficient (*t* score)	Exit value (log) exited deals OLS coefficient (*t* score)	US VC investment probit coefficient (*z* score)
Indicator variable						
GVC	–0.217	–0.048	–0.476	–0.435	–0.355	–0.125
	(–3.03***)	(–0.89)	(–2.65***)	(–1.77*)	(–1.54)	(–1.58)
MVC	–0.103	0.027	0.021	0.252	0.132	0.188
	(–1.11)	(0.36)	(0.06)	(0.54)	(0.55)	(2.04**)
Number of VC	0.030	0.001	0.144	0.155	0.023	0.107
	(2.60***)	(0.11)	(2.37**)	(2.08**)	(1.06)	(8.93***)
Constant	–1.925	–1.366	1.619	1.797	16.923	–2.239
	(–10.16***)	(–10.12***)	(2.61***)	(2.27**)	(21.70***)	(–11.42***)
R^2	0.139647	0.168921	0.077153	0.13208	0.09413	0.258444
Fraction variable						
Fraction of GVC	–0.232	–0.059	–0.576	–0.573	–0.371	–0.182
	(–3.29***)	(–1.11)	(–3.22***)	(–2.34**)	(–1.66*)	(–2.44**)
Number of VC	0.032	0.006	0.170	0.195	0.039	0.129
	(3.26***)	(0.64)	(3.33***)	(3.06***)	(1.88*)	(11.78***)
Constant	–1.918	–1.360	1.680	1.910	17.041	–2.189
	(–10.14***)	(–10.12***)	(2.71***)	(2.43**)	(23.08***)	(–11.24***)
R^2	0.140293	0.168861	0.077534	0.132052	0.089983	0
Common controls						
Year fixed effects	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes
N	3,720	3,720	3,647	2,542	335	3,720

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

an enterprise going out of business may still have a small residual value not observable to us. Second, the sample contains a number of enterprises that have not yet had a chance to realize their true value in an exit event. To at least partially address this, we consider three alternative sample specifications. Column (3) includes all firms, irrespective of whether they survived or had an exit. Column (4) considers the sample of firms for which a resolution has occurred; that is, firms that either had a successful exit, or else have gone out of business. Column (5) only considers firms that have experienced a successful exit. The three specifications use different conditioning criteria, and therefore provide alternative perspectives. Interestingly, the effect of investor types remains quite similar across all three specifications, although the statistical significance becomes weaker the smaller the sample. Overall, however, we note that the presence of GVCs is associated with lower exit values.

Column (6) of table 9.4 contains one more variable that is only indirectly related to value creation. The dependent variable is a categorical variable that takes the value 1 if the enterprise received investment from US investors, and zero otherwise. The idea is that attracting US financing is both an indicator of the firm having good prospects and contributes directly to enhanced value. We find that enterprises with a higher fraction of GVC are less likely to attract US investors—the GVC coefficient in the categorical specification is marginally insignificant at 12 percent.

Overall, we notice that there is no evidence that GVC outperforms PVC and some significant evidence to the contrary: that PVC outperforms GVC. We now turn to examining other outcome variables, especially related to innovation.

Turning to table 9.5, the first two columns examine the relationship between Canadian patents and investor types. Column (1) considers a probit specification where the dependent variable is a categorical variable that takes the value 1 if the enterprise has at least one Canadian patent, and zero otherwise. Column (2) uses a count variable of Canadian patents and estimates a negative binominal regression model. We note that the presence of GVC is associated with a lower propensity to patent. Columns (3) and (4) perform equivalent regressions for US patents. Interestingly, we find that none of the investor type variables are statistically significant.

In addition to counting patents, one may want to look at the "quality" of those patents too. Prior research has established a number of patent quality measures, such as forward citations or patent originality. This data is only available for US patents, and these measures can only be calculated for enterprises that have patents. In unreported regressions we investigated the relationship between investor type and these patent quality measures, but found no statistically significant relationships. However, we refrain from providing a strong interpretation on this finding, given the severe limitations of the data.

One fundamental limitation of patent data is that patents only capture limited types of innovation, and in particular innovation that can be

Table 9.5 **Innovation and employment**

Dependent variable	Canadian patents probit coefficient (*z* score)	Number of Canadian patents negative binomial coefficient (*z* score)	US patents probit coefficient (*z* score)	Number of US patents negative binomial coefficient (*z* score)	R&D intensity OLS coefficient (*t* score)	Log employees at IPO OLS coefficient (*t* score)
Indicator variable						
GVC	–0.096	–0.401	0.119	–0.227	–17027.790	0.203
	(–1.49)	(–2.13**)	(1.16)	(–0.65)	(–0.97)	(0.46)
MVC	0.264	0.122	0.177	–0.060	–13011.710	0.092
	(3.22***)	(0.50)	(1.30)	(–0.15)	(–0.61)	(0.22)
Number of VC	0.049	0.065	0.035	0.001	266.026	0.090
	(4.33***)	(2.50**)	(2.34**)	(0.03)	(0.13)	(1.96*)
Constant	–1.392	–1.433	–2.160	–3.011	–7344.652	2.394
	(–9.50***)	(–3.76***)	(–9.62***)	(–4.76***)	(–0.24)	(1.54)
R^2	0.111133	0.04499	0.123211	0.069326	0.364485	0.487363
Fraction variable						
Fraction of VC	–0.109	–0.368	0.065	–0.269	–11,544.720	0.039
	(–1.77*)	(–1.97**)	(0.67)	(–0.79)	(–0.76)	(0.09)
Number of VC	0.074	0.100	0.042	0.006	62.052	0.089
	(7.23***)	(4.21***)	(3.37***)	(0.17)	(0.04)	(2.13**)
Constant	–1.388	–1.459	–2.118	–2.974	–13,529.260	2.518
	(–9.52***)	(–3.83***)	(–9.54***)	(–4.69***)	(–0.46)	(1.67*)
R^2	0.105401	0.04428	0.12184	0.069441	0.358321	0.485486
Common controls						
Year fixed effects	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes
N	3,720	3,720	3,720	3,720	88	88

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

protected (at least partially) against appropriation. Unfortunately there is no readily available data on innovation externalities. The only other innovation measure available to us concerns R&D spending. Unfortunately, only stock market listed ventures report this data, so we relied on IPO prospectuses. We construct a measure of R&D intensity, defined as the amount of R&D spending per employee. Column (5) of table 9.5 reports the result, showing negative but statistically insignificant coefficients for all the government-sponsored variables. We obtained similar results when using absolute levels of R&D spending, or normalizing R&D spending by total assets.

Probably one of the most frequently stated government objectives for subsidizing venture capital is employment creation. Again we face a serious data collection problem, as only stock market listed ventures publicly report employment figures. Column (6) of table 9.5 reports the results for regressing employment in these firms on their investor types. The GVC coefficients are insignificant. Again, we refrain from providing a strong interpretation of these results, given the extreme limitations of the available data.

Overall, these results cast a doubt on the argument that there is an innovation externality that compensates for the lower performance of enterprises backed by government-sponsored VC firms.

Another interesting but difficult to measure policy objective relates to the promotion of competition and an entrepreneurial economy. The previous analysis of exit performance grouped together different types of exits that represent different ownership structures, which are likely to be correlated with different degrees of competitiveness. Therefore, we now have a more detailed look at the different types of exit mechanisms. As previously mentioned, 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 (M&A) naturally represent the third type of exit. The first three columns of table 9.6 report the results of a multinomial logit specification. The omitted category is ventures that have not experienced an exit. Column (1) reports the coefficients for M&A outcomes, column (2) for junior IPOs, and column (3) for senior IPOs. The most important pattern to recognize is that firms backed by government VCs are much less likely to get acquired. As for junior and senior IPOs, the coefficients for government VC are statistically insignificant. This result lays the groundwork for the main question of interest, whether there is a relationship between types of VC and competition.

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 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

Table 9.6 **Exit types and competition**

Dependent variable	Exit type multinomial logit			Competitive exit multinomial logit	
	M&A coefficient (*z* score)	Junior IPO coefficient (*z* score)	Senior IPO coefficient (*z* score)	Less-competitive coefficient (*z* score)	Pro-competitive coefficient (*z* score)
Indicator variable					
GVC	–0.610	0.273	0.186	–0.584	0.011
	(–3.88***)	(0.70)	(0.51)	(–3.64***)	(0.05)
MVC	–0.439	0.154	0.851	–0.384	0.250
	(–2.21**)	(0.32)	(2.07**)	(–1.84*)	(0.91)
Number of VC	0.038	0.037	0.080	0.029	0.079
	(1.48)	(1.02)	(2.53**)	(1.09)	(2.98***)
Constant	–3.991	–6.276	–27.774	–3.888	–6.404
	(–7.67***)	(–5.79***)	(–30.66***)	(–7.93***)	(–5.88***)
R^2	0.13429932	0.13429932	0.13429932	0.126857	0.126857
Fraction variable					
Fraction of GVC	–0.621	0.348	–0.055	–0.566	–0.120
	(–3.99***)	(0.89)	(–0.19)	(–3.58***)	(–0.55)
Number of VC	0.033	0.036	0.118	0.026	0.094
	(1.50)	(0.96)	(4.73***)	(1.15)	(4.34***)
Constant	–3.989	–6.330	–27.565	–3.904	–6.310
	(–7.69***)	(–5.76***)	(–31.09***)	(–7.98***)	(–5.83***)
R^2	0.13268511	0.13268511	0.13268511	0.126273	0.126273
Common controls					
Year fixed effects	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes
N	3,720	3,720	3,720	3,720	3,720

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

that considers senior IPOs as procompetitive 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; there may by some junior-market listed firms that have a more procompetitive 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 procompetitive. 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 five-digit NAIC definition for an industry.[13] Specifically, we classified an exit by M&A as less competitive when the acquirer had the same five-digit NAIC code, and procompetitive otherwise. Again, we consider this as an indirect and imperfect measure, but a useful proxy for measuring the competitive impact of the IPO or of the acquisition event. The last two columns of table 9.6 report the results of a multinomial logit regression where the omitted category is firms that have not exited, and the two reported categories are firms that have a less competitive (column [4]) or more competitive (column [5]) impact. The regressions suggest that there is no statistically significant relationship between the government VC and more competitive exits, but a significant negative relationship between the government VC and less competitive exits.

Overall, these results suggest that while PVCs achieve more exits, this result mainly comes from achieving more acquisitions. This makes it difficult to assess the full impact on competition. On the one hand, achieving an acquisition is a sign of better enterprise performance. On the other hand, these acquired enterprises seem less likely to directly increase market competition. Whether or not there are indirect effects on competition, either because the threat of new entrants keeps established incumbents more efficient, or because acquiring firms can use the acquired units to better compete in the market place, remains a question for future research.

13. As a robustness check we also run regressions with a definition based on four-digit NAIC or six-digit NAIC but found that this did not affect the main results.

9.6.3 Treatment versus Selection: Using Political Leadership as an Instrumental Variable

The results of tables 9.4 through 9.6 provide a rich description of the statistical relationship between investor types and enterprise outcomes. In general, PVC-supported enterprises perform better than GVC-supported enterprises. However, as already mentioned, one cannot infer a causal interpretation—that PVC support causes better performance. It is possible, and indeed likely, that PVCs simply choose better enterprises than GVCs, given their higher (unsubsidized) return threshold. Furthermore, this is exactly what we expect if the GVC programs were working effectively as they should be funding the "extensive margin"—projects that would not be funded by PVCs.

On the other hand, if weaker GVC performance really is a causal or treatment effect—that GVCs generate weaker performance from otherwise equivalent enterprises—this would lead to a negative assessment of the GVC programs. In short, the mere fact that enterprise performance is positively correlated with PVCs does not tell us much about whether the GVC programs are performing effectively.

To address this question we need to isolate the treatment and selection effects associated with PVCs (or GVCs). From an econometric point of view, this is a classic endogeneity problem. The PVC indicator is not assigned randomly but reflects likely performance, making it an endogenous regressor. The standard solution to this problem is to use an instrumental variable (IV) approach. We need an instrument that is itself exogenous in the sense that it is not affected by performance of venture-supported enterprises (the so-called "exclusion" restriction) but that is correlated with the presence of GVC investment In fact, there is a very interesting instrument with these properties—the political stance of the provincial government in place in a particular period.

In the data, left-leaning governments are associated with additional GVC funding and additional GVC investment. They are also associated with reduced PVC investment. Accordingly, having a left-leaning government provides an exogenous substitution of GVCs for PVCs. This is exactly what we want an instrument to capture. It will capture the effect of exogenous substitution of GVCs for PVCs on performance of enterprises. It will therefore provide a good measure of the "treatment" effect as opposed to the "selection" effect associated with GVCs. While we would not wish to exaggerate the quality of the instrument, the results are at least suggestive and provide a better way of distinguishing between selection and treatment effects than is otherwise possible.

We construct a "left politics" indicator variable that takes the value 1 if a left-leaning political party held power in the province of the financed firm at the time of its first investment, and 0 otherwise. A full list of political parties that have held seats in any one of the provincial legislatures was retrieved from Elections Canada, along with number of seats they held and the total number of seats available in each year from 1996 to 2005. Each party's self-declared political ideology was retrieved from Wikipedia. A party was determined to be left leaning if it identified itself as adhering to the tenets of "social democracy", as opposed to liberalism or conservatism. As a validity check, we surveyed six economics professors at the University of British Columbia, asking them to identify each provincial political party as left, center, or right. They had a 77.8 percent agreement with the self-identified ideology-based classification, as compared with an expected 37.6 percent agreement (for a kappa of 0.6436***).

For firms without a date of first investment, we use the average (mode) of the binary left-leaning winner variable over the period 1996 to 2005. This approximation does not materially alter any coefficients but does allow us to increase the power of the relevant tests. In an unreported robustness check we replace the year-based winner variable with the average winner across all years and found broadly similar, perhaps slightly improved, results. The difference could be attributed to the importance of the effect of politics on financing throughout the firm's life, as compared with at the time of first investment, but also may reflect that a single political party may change its ideology over time, and so be "left leaning" only on average.

Our instrumental variables approach involves two stages. The first stage regresses the presence of GVCs on the "left-leaning" variable. Since we only have a single instrument, we need to combine the GVC and MVC categories into a single category, inelegantly called GMVC. The dependent variable is thus either GMVC or fraction of GVC. Table 9.7 looks at a number of alternative specifications for the first-stage regression. The results indicate a strong statistical relationship between left-leaning politics and the relative importance or presence of GVCs. This result is consistent with casual observations. Most important, it justifies the use of left politics as an instrumental variable. The predicted values from stage 1 then identify exogenous changes in GMVC or fraction of GVC variable. The exogenous component of the relevant government support variable is used as a regressor to explain enterprise performance in the stage 2 regressions.

Table 9.8 reports the results for the (stage 2) IV model. For brevity's sake, we focus on those outcome variables from table 9.4 and 9.5 that we would consider economically most important. The results show that once we exploit exogenous variation in the availability of government-sponsored venture capital, we find an even stronger negative effect. All the regressions that had a negative and significant effect for GVC continue to do so, typically at similar or higher levels of statistical significance. Moreover, two of the variables that had insignificant coefficients in tables 9.4 and 9.5 are now found to also have negative and statistically significant coefficients. In particular, we now find a negative relationship with survival and with US patents. That is, enterprises funded by GVCs are less likely to survive, and also less likely to have US patents.

Table 9.7 **Politics and venture capital**

Dependent variable	GVC probit coefficient (z score)	Fraction of GVC OLS coefficient (t score)	Number of PVC OLS coefficient (t score)	Number of GVC OLS coefficient (t score)	Number of VC full sample OLS coefficient (t score)	Number of VC high tech OLS coefficient (t score)	Number of VC low tech OLS coefficient (t score)
Without controls							
Left politics	0.600	0.197	–0.353	0.450	0.097	0.797	0.131
	(11.79***)	(12.55***)	(–5.84***)	(6.01***)	(0.92)	(3.55***)	(1.41)
Constant	0.301	0.516	1.119	1.296	2.416	3.177	1.729
	(8.72***)	(42.52***)	(24.17***)	(25.23***)	(32.92***)	(24.73***)	(25.25***)
R^2	0.041576	0.052594	0.011861	0.012249	0.000288	0.011907	0.001073
Year fixed effects	no	no	no	no	no	no	no
Industry fixed effects	no	no	no	no	no	no	no
With full controls							
Left politics	0.792	0.223	–0.297	0.593	0.296	0.478	0.163
	(13.21***)	(13.50***)	(–4.70***)	(7.38***)	(2.71***)	(2.23**)	(1.48)
Number of VC	0.211	0.006	—	—	—	—	—
	(6.75***)	(2.31**)					
Constant	0.240	0.616	1.130	1.403	2.533	5.172	2.555
	(1.36)	(13.92***)	(4.95***)	(5.08***)	(6.02***)	(8.04***)	(4.52***)
R^2	0.16803	0.134219	0.124797	0.109129	0.150714	0.068911	0.101006
Common controls							
Year fixed effects	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes
N	2,884	2,884	2,884	2,884	2,884	1,116	1,768

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 9.8 Instrumental variables

Dependent variable	Exit IV probit coefficient (*z* score)	Survive IV probit coefficient (*z* score)	Exit value (log) resolved deals IV reg coefficient (*t* score)	US VC investment IV probit coefficient (*t* score)	Number of Canadian patents IV reg coefficient (*t* score)	Number of US patents IV reg coefficient (*t* score)
Indicator variable						
GMVC	–1.219	–0.639	–7.692	–1.319	–3.252	–0.916
	(–5.65***)	(–2.91***)	(–3.81***)	(–6.75***)	(–2.43**)	(–1.97**)
Number of VC	0.061	0.007	0.328	0.153	0.201	0.026
	(5.31***)	(0.58)	(3.55***)	(13.89***)	(4.43***)	(1.92*)
Constant	–0.686	–0.460	7.848	–1.013	2.331	0.697
	(–2.27**)	(–1.95*)	(4.30***)	(–2.99***)	(2.24**)	(1.79*)
Wald χ^2 or F	χ^2 = 302.00***	χ^2 = 364.20***	F = 14.77***	χ^2 = 644.44***	F = 5.04***	F = 2.23**
Fraction variable						
Fraction of GVC	–1.246	–0.650	–7.901	–1.399	–3.308	–0.932
	(–5.59***)	(–2.90***)	(–3.86***)	(–6.83***)	(–2.44**)	(–1.97**)
Number of VC	0.026	–0.012	0.131	0.118	0.105	–0.001
	(2.85***)	(–1.28)	(1.96*)	(10.33***)	(2.63***)	(–0.13)
Constant	–0.684	–0.453	7.748	–1.016	2.373	0.709
	(–2.26**)	(–1.91*)	(4.37***)	(–2.91***)	(2.26**)	(1.80*)
Wald χ^2 or F	χ^2 = 298.63***	χ^2 = 367.87***	F = 15.05***	χ^2 = 651.31***	F = 5.15***	F = 2.28**
Common controls						
Year fixed effects	yes	yes	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes	yes	yes
N	2,884	2,884	1,763	2,884	2,884	2,884

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

This could be the most important result in the chapter. It suggests that the negative association between GVCs and enterprise performance is essentially entirely due to a treatment effect—to weaker mentoring or value added performance by GVCs as compared with PVCs. Also, while we do not emphasize this finding in view of the various data limitations, it also suggests that there is little if any selection effect, which in turn suggests that the GVC programs are not expanding the extensive margin but instead are competing with PVCs for inframarginal products that would be funded in any case.

We emphasize that we do not have as much data as we would like, that the instrument might not be as good an instrument as we would like, and that there might be alternative explanations of the results. However, to the extent that these results can be taken seriously, they do raise serious concerns about GVC programs.

9.6.4 Market Expansion versus Crowding Out

Probably the most contentious question about government support of venture capital is whether government subsidies increase the size of the market, or whether they merely crowd out private investments. Answering this question, however, remains a challenge; not only because of data limitations but also because a complete answer requires a counterfactual of what would have happened with government support. Even though we will be unable to provide a complete or even satisfactory answer, we nonetheless report some findings that provide some suggestive and indirect evidence.

First of all, the previous subsection notes two empirical results. First, left-leaning governments are associated with additional GVC activity and correspondingly less PVC activity. This in itself suggests that GVC investment substitutes for or crowds out PVC investment. Second, the main finding is that approximately the entire negative association between GVC and performance is due to a treatment effect rather than a selection effect. This is also consistent with crowding out as it suggests that GVCs are not adding much to the extensive margin (i.e., they are not financing many new enterprises below the PVC threshold for investment).

An interesting question is whether there is complete crowding out; that is, whether GVC substitutes for PVC on a one-to-one basis. One way of addressing this is to look at the total number of investors. The coefficient for left politics is positive, but interestingly enough, it is statistically significant only after controlling for industry. Therefore, we perform two additional regressions, one for the subsample of high technology firms and one for the sample of low technology firms. We note that the coefficient is positive and statistically significant in the high technology subsample but statistically insignificant in the low technology subsample. This evidence is thus consistent with the notion that there is partial crowding out for high technology enterprises. Moreover, for low technology enterprises we cannot reject the hypothesis that there is full crowding out.

As noted before, the analysis of financing patterns among inframarginal firms is useful but certainly incomplete. To get a second perspective on the question of whether GVC augments the market versus crowding out PVC, we consider the pattern of deal origination. In particular, we ask which venture capitalists are relatively more active in first-round financing; i.e., in bringing new enterprises into the venture capital market. Table 9.9 provides some simple descriptive statistics about origination patterns.

From the perspective of the GVCs, we may ask what fraction of their deals were also originated GVCs. This includes all pure GVC deals, as well as those MVC deals that were originated by GVCs. One detail is how to treat MVC deals that were originated by a mix of PVCs and GVCs (called mixed originations or "MixOri" in table 9.9), hence the distinction between inclusive and exclusive numbers. Table 9.9 shows that GVCs mostly "self-originate," i.e., they originate almost all of their own deals. Indeed, if we include deals with mixed origination, 95 percent of all enterprises by GVCs were also originated by GVCs. This pattern is less pronounced for PVCs, where that number is 82 percent. Moreover, the pattern of self-origination is more pronounced for low technology rather than high technology deals. Another way of looking at the origination patterns is to ask how many deals

Table 9.9 **Patterns of origination**

	Full sample	High tech subsample	Low tech subsample
Number			
In total	3,720	1,226	2,494
Financed only by PVCs	1,208	414	794
Financed only by GVCs	1,784	388	1,396
Financed by a mix of PVCs and GVCs (= mixed)	728	424	304
Of mixed, originated by PVCs	121	84	37
Of mixed, originated by GVCs	328	150	178
Of mixed, originated by a mix of GVCs and PVCs (= MixOri)	194	132	62
Of mixed, origination unknown	85	58	27
Percent			
Financed by PVCs that were originated by PVCs (incl. MixOri)	82.28%	80.77%	83.38%
Financed by GVCs that were originated by GVCs (incl. MixOri)	95.01%	88.86%	97.79%
Financed by PVCs that were originated by PVCs (excl. MixOri)	71.80%	63.85%	77.59%
Financed by GVCs that were originated by GVCs (excl. MixOri)	87.02%	71.35%	94.08%
Originated by PVCs then became mixed	9.10%	16.87%	4.45%
Originated by GVCs then became mixed	15.53%	27.88%	11.31%

Notes: "Number" stands for number of enterprises; "Percent" stands for fraction of enterprises; "Mix-Ori" stands for mixed originations.

become MVC. That is, among all the deals originated by GVCs, how many of them later add a PVC as a coinvestor? Table 9.9 shows that only 9 percent of all deals originated by PVCs ever receive any funding from GVCs. The percentage of deals originated by GVCs that ever receive any funding from PVCs is slightly higher at 15 percent. Moreover, we find that these percentages are higher for high technology firms.

Table 9.9 suggests that there is a significant bifurcation in the market that relatively few deals are originated by one type of venture capitalist and subsequently financed by the other. The GVCs seem to be slightly more active originators than PVCs, although the differences do not appear dramatic. Another interesting finding is that the segmentation of the market appears more dramatic in the low technology segment than in the high technology segment. Overall, these results are consistent with the notion that GVCs may be contributing to a moderate market expansion, especially for high technology firms. In the low technology segment, however, the market appears to be particularly segmented.

The evidence so far suggests that while there is considerable evidence for segmentation and crowding out, there is also some evidence for market expansion. We may also want to ask to what extent the additional firms brought into the market by GVCs perform on the various outcome measures. We already saw that enterprises funded by GVCs perform worse on average for many outcome variables. The question remains whether among the enterprises that received funding from both GVCs and PVCs there are systematic differences according to whether the enterprise was originated by GVCs or PVCs. In an unreported regression we explored origination patterns focusing on the MVC subsample. No strong patterns emerged; that is, the coefficients for the different types of originators were almost all insignificant.[14]

One additional step of our analysis was to examine whether there are systematic differences between the two main types of subsidies provided by the federal government. Most of the government-sponsored venture capital funds fall under the so-called "Labor-sponsored" programs, which benefit from a mix of provincial and federal subsidies. The purely federal government-sponsored venture capital comes from the largest Canadian government-owned development bank, called the BDC. In additional unreported regressions we examined whether enterprises funded by the BDC performed systematically differently from the other GVCs. The coefficients were generally statistically insignificant (though positive), suggesting that there are no systematic differences between Labor-sponsored and BDC-sponsored enterprises. The only exceptions were for the presence of US investors and for the number of Canadian patents, where the BDC coefficient was positive

14. The only exceptions worth mentioning are that the presence of a government originator is associated with fewer US investors but more US patents. We remain slightly at loss for an interpretation for the second of these results.

Table 9.10 Exit values for PVCs and mixed VCs

Sample	PVCs only	Mixed only	Both
GVC deal fraction	0.187	–7.86	–1.89
	(0.16)	(–4.03)***	(–2.06)**
Number of invested funds	0.36	0.08	0.15
	(2.12)**	(0.98)	(2.53)**
Indicator variable			
Year fixed effects	yes	yes	yes
Industry fixed effects	yes	yes	yes
Constant	1.99	7.23	3.11
	(1.15)	(3.99)***	(2.77)***
R^2	0.10	0.10	0.08
Number of observations	1,177	716	1,893

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

and statistically significant. This may be an indication of the investment policies of the BDC: to foster relationships with US investors and to file patents in Canada (although not in the United States).

A concern that is closely related to crowding out is that the presence of GVCs might reduce the return to PVCs. If GVCs are simply competing with PVCs for the same projects, this might have the effect of reducing the return to PVCs. We therefore regressed the exit value of enterprises supported by PVCs on the share of enterprises supported by GVCs in a specific province in a particular year. We refer to this variable as the GVC deal fraction. We consider the exit value for enterprises funded purely by PVCs, as well as the exit values for the combination of private and mixed venture capital. The results presented in table 9.10 control for the quality of a venture using the total number of funds that participated in its financing.

The results are interesting but not compelling. It appears that the presence of a larger share of GVC activity lowers the exits values associated with enterprises with mixed PVC and GVC support, but has no statistically significant or economically meaningful effect on exit values of enterprises with pure PVC support. Thus, if there is crowding out, it does not seem to have an effect on the exit values of purely privately supported enterprises.

9.7 Concluding Remarks

In this chapter 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 objectives are closely associated with economic welfare. Overall, it appears that there is a consistent pattern of superior performance for PVCs. 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. 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 US investment.

The effects on competition are less conclusive. On the one hand there is clear evidence that PVCs are associated with a greater likelihood of an IPO on a senior exchange (the TSE, NYSE, or NASDAQ), and GVCs with IPOs on junior exchanges (mainly the TSX-VN). This suggests that PVCs may generate more competitiveness. However, PVCs 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 GVCs, enterprises funded by PVC finance operate more often in high-technology industries. They also show a greater propensity to patent.

Putting these three areas together—value creation, competition, and innovation—it appears that enterprises supported by private venture capital have 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 principle, it would be desirable to have data about the actual investment provided to each venture by the different types of venture capitalists, 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.

In section 9.3 we outlined a set of observable performance measures that would shed light on whether the GVC programs were providing valuable policy contributions. Abbreviated versions of these "observables" and the actual findings are described in the following.

1. It should not be surprising if GVC-supported enterprises exhibit lower private performance than PVC-supported enterprises. This would be expected under a well-designed program.

In fact, GVC-supported enterprises do exhibit weaker "private" performance as measured by the frequency of successful exits, exit values, and survivorship than PVC-supported enterprises but, as noted, this is not itself inconsistent with a good program.

2. If the external (i.e., nonprivate) effects of GVC-supported enterprises fall short of PVC-supported enterprises, this raises questions about the effectiveness of these programs.

While we cannot measure external benefits directly, we believe that the innovation process is characterized by positive externalities and we therefore take patents as an indicator of innovation externalities. The patent itself of course acts a property right to convert potential external benefits to private benefits, but we still expect that some additional externalities are also generated. A second external benefit relates to increased competition. On both these measures, PVCs perform somewhat better than GVCs.

3. The extent of crowding out is very important. If GVCs appear to be crowding out private venture capital, this would undermine any positive impact of those programs.

We find suggestive evidence of at least some crowding out.

4. If GVCs have weaker private performance than PVCs this could be due to either selection or treatment (or both). A poor program would be characterized by a large negative treatment effect and a small selection effect.

We use an instrumental variables approach to separate the treatment effect from the selection effect. While the results are far from definitive, we find suggestive evidence that the poorer performance of the GVC-supported enterprises is due to treatment rather than selection. In other words, enterprises supported by GVCs appear to perform more poorly than otherwise equivalent enterprises supported by PVCs.

On the whole, our conclusions cast doubt on the effectiveness of government-sponsored venture capital programs in supporting strongly-performing enterprises. There are, however, some additional considerations that should be kept in mind. One consideration is a potential "training effect" of GVC programs. Individual fund managers are typically less experienced and less well paid in the GVC sector than in the PVC sector. Furthermore, individuals sometimes move from the GVC sector to the PVC sector, but rarely move the other way. Thus, one additional benefit of GVC programs might lie in providing training for venture capitalists. However, it is also possible that the weaker performance of GVCs might be related to other personnel issues. In particular, success in the GVC sector might lie partially in good lobbying skills and good "government relations skills" rather than in good mentoring of enterprises. It is also likely that the "survivor" principle—good fund managers are retained and poor managers are fired or reassigned—operates more vigorously in the private sector.

Notwithstanding our findings casting doubt on GVC programs, it must be acknowledged that there have been some tremendous successes. Possibly the biggest domestic venture success story in Canada relates to "Research in Motion" (RIM), the developer of the BlackBerry Internet communications device. The external benefits of this one success would cover the costs of at least a portion of the GVC support in Canada. More broadly, it does not follow from our analysis that government support for venture capital has been unsuccessful. Even if some of the government-sponsored venture capital increases the number of firms funded, it remains 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 a first step in the direction of a full policy analysis. Still, our unique data-collection methods allow us to examine data that is considerably more complete than previous studies of Canadian venture capital and the overall analysis provides some cautionary notes about the alleged benefits of government-sponsored venture capital.

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