*Risk Financing for Knowledge-Based Enterprises: Mechanisms and Policy Options**

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Abstract

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1 Introduction

Enterprises that require outside capital beyond the amount invested by the founders, family and friends (commonly known as “the three Fs”) will turn to a variety of financing mechanisms. Two important mechanisms are debt and equity. Debt involves borrowing money from an institutional lender that is repaid with interest. Equity involves capital investments made by outside parties who become partial owners of the firm. Young enterprises in particular soon reach a point where their owners will consider financing options in one or both of these categories. This is a key decision for entrepreneurs, since each one of the financing tools has its advantages and disadvantages for different types of endeavors.

Sound corporate finance usually requires an appropriate balance between debt and equity based on the nature of the income that a firm is likely to generate. A relatively low-risk business with highly predictable cash flows can take on more debt than a firm with variable and volatile cash flows. The advantage of debt is that it does not require an entrepreneur to give up ownership rights. Its disadvantage is that it normally requires a fixed schedule of repayment, regardless of the performance of the business; if a firm cannot make its monthly payments, it can find itself in default. Furthermore, lenders are generally less willing to lend to new firms that deal with product, service or organizational innovation, because these firms’ cash flows are much more difficult to predict. Not having a track record of revenue growth and operating margins, particularly at the early stages in their lives, means there is little that can act as security for providers of debt. If the firm fully depends on an innovation that is still under development, lenders

may not see it as possessing the means to pay interest until that product or service is available for sale.

In the atypical occasion where loans are provided to a new knowledge-based enterprise (NKBE)[1], such as when real assets are available or sales contracts exist, there are other reasons why this form of capital may not be suitable. Debt on the balance sheet can be destabilizing, forcing the company into payments during a period when revenue should be reinvested into the company. In addition, NKBE entrepreneurs often require swift access to capital due to high volatility characterizing the markets they operate in. For NKBEs, then, a critical part of the financing during their early stages of development is likely to be in the form of equity financing. This is a more "patient" form of capital for early stage operations with returns linked directly to the earnings of the firm.

This paper examines the various mechanisms for risk financing: debt, including direct loans and loan guarantees, equity, including business angels and venture capital, and government grants.[2] The two main tools for debt financing – direct loans and loan guarantees – and for equity financing – business angels and venture capital – are discussed in the first two sections. Government policies affecting risk financing mechanisms come next. The final section concludes.

[1] The term "new knowledge-based enterprise" (NKBE) is used in this paper more or less equivalently to the term "new-technology-based firm" (NTBF) that tended to dominate earlier literature.
[2] The paper does not discuss two other sources of risk capital – personal investments made by entrepreneurs in their businesses and retained earnings – as these do not involve external financing.

2 The Importance of Risk Financing for Knowledge-Based Enterprises

Knowledge-intensive, innovative firms offer a return on investment that is skewed and highly uncertain, with risk characteristics and default probabilities that are hard to estimate. The likely existence of substantial informational asymmetries between such companies and investors make it difficult to come up with a mutually agreeable financing contract, since entrepreneurs may possess more information about the nature and characteristics of their products and processes than potential financiers. In addition, the intangible nature of innovative activities makes the assessment of their monetary values difficult before they become commercially successful and offers little salvage value in the event of event of failure. Regarding the firms, smaller companies tend to have limited market power, a lack of management skills, a higher share of intangible assets, an absence of adequate accounting track records and few assets, if any. The assessment can therefore be made that the more knowledge-intensive the firm, and the smaller its size, the harder it will be for it to gain access to capital. A European Commission study published in 2002 identified access to financing as the most crucial challenge facing small and medium-sized enterprises (SMEs) (European Commission, 2002: 13).

This challenge of successfully moving an innovation into the marketplace is often referred to as “Crossing the Chasm” (Moore, 1991) or the “Valley of Death” (Branscomb and Auerswald, 2001). On the one side of this valley stand the innovators and their innovations. On the other side stand investors and potential customers who possess capital to fund more work and knowledge of what the market requires. Crossing

the distance between them involves bridging three fundamental and interrelated gaps (Branscomb and Auerswald, 2001:10-12):

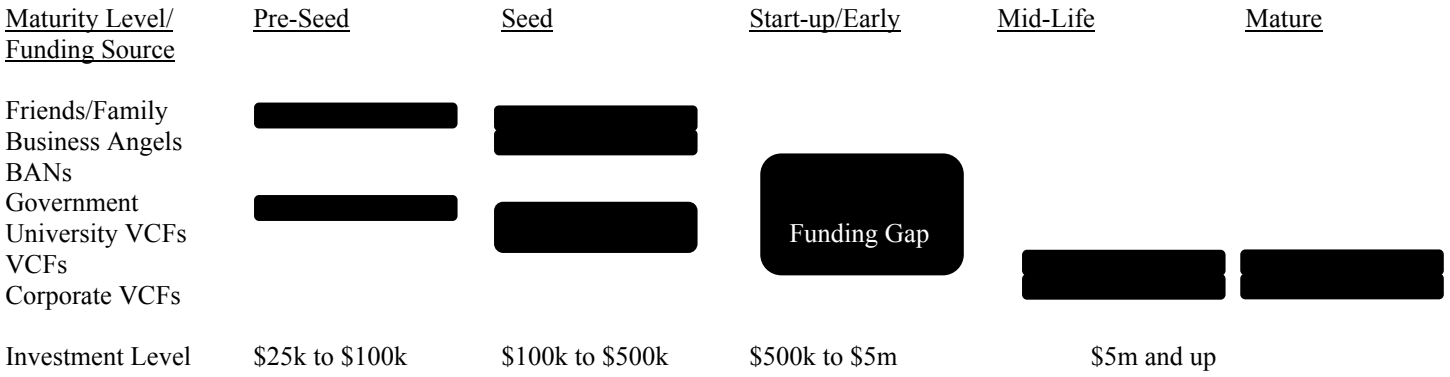
- A financing gap between initial funds – typically received from personal assets, government agencies or corporate research – that support more basic research and the investment funds to turn the idea into a market-ready prototype. This gap is usually bridged by risk financing through equity or by government programs specifically constructed for this purpose.
- A research gap between the scientific or technical breakthrough and the basis for a commercial product. Sometimes, additional work is needed on functionality, affordability, and quality before an innovation can develop into a product that can compete in the marketplace.
- An information and trust gap between the innovator and the investor and customer, each with a different understanding of the innovation and with dissimilar expectations of what it is to accomplish. The technologist knows what is technically feasible and what is novel in the proposed approach; the investor knows the process of bringing new products to market, and the customer has some preconception of what the innovation can do. Communication between these parties must be effective if all of their expectations are to be met.

Occasionally, these gaps will be narrow. A firm may be a spin-off and receive sufficient funding from its parent company, or have a paying customer from its inception. However, only rarely will all of these three gaps be absent.

The financing gap for NKBEs can be further explained by examining the different types of risk financing available to firms depending on their maturity. The

maturity level that the firm has reached (pre-seed, seed, start-up, mid-life, or mature) will dictate the funding sources it will have access to and the level of investment they will typically be willing to make. As Figure 1 shows, the financing gap (for NKBEs as well as for many other young ventures) exists primarily between seed and early stage investments at (approximately) the $500,000 to $5 million range, where private and informal funds cannot reach alone and where formal investors – business angels and venture capital funds – are wary of committing. As will be explained in this paper, this funding gap has been gradually widening, largely because VCFs are increasingly shifting investments to focus on more mature firms with larger capital needs (see section 4.2).

Figure 1. The financing gap for NKBEs



Source: Adapted from Council on Competitiveness, 2004:36; Branscomb and Auerswald 2002a:33

The research gap is no less crucial for NKBEs in their journey across the "Valley of Death". Bridging it involves turning research results into an emerging technology and finally into a marketable product. To the extent that the outcome of such work is proprietary and the entity undertaking it the primary or sole beneficiary, it will be undertaken by the private sector. However, the company must also bear the risk that the

research will not yield any profitable results. The intense competition and shorter product life cycles generated by a global marketplace, tighter budgets for government programs, and shareholder emphasis on short-term returns have affected the ability of companies to engage in this type of work, particularly that which leans more toward basic than applied research (U.S. House Committee on Science, 1998: 39-40).

Lastly, the information and trust gap must be addressed in order to navigate the "Valley of Death" successfully. This requires effective communication between inventors and investors regarding the bringing of a new product into the marketplace. One part of the information gap is connecting entrepreneurs with investors: information in the risk capital market flows inefficiently, often based on personal and professional ties. Another part involves the simple act of defining a successful venture: for scientists and engineers, this often means creating a company and a product of which they are proud and which can be their long-term, lucrative occupation; for investors, success generally means the realization of equity value through a liquidity event such as an acquisition or an initial public offering (IPO) within 5 years or so. Each side may suspect the other of wanting to take advantage of information it possesses to maximize returns (Callahan and Muegge, 2003: 641). Closing the information and trust gap involves the two sides accepting the fact that they are partners and that success depends to a large extent on their ability to interact openly.

3 Types of Risk Financing – Debt

In its most common form, capital financed through debt requires a periodic payment of interest and debt reduction, or a lump sum payment upon expiration of the loan. The advantages of debt financing are that interest payments are tax-deductible and equity – read control management – is not surrendered. However, its disadvantages, especially to NKBEs, are substantial.

In debt financing, the investor's return is limited to interest paid while being fully exposed to downside risk if the borrower defaults on the loan. Therefore, NKBEs which often lack collateral that can be used to secure bank loans are perceived to be riskier than other types of enterprises. Lack of accounting records, inadequate financial statements and often weak business plans make it difficult for the banks to properly assess the creditworthiness of NKBEs. The high administrative costs of lending or investing small amounts do not make loan portfolios for such companies a profitable business. Thus, a debt financing gap develops for NKBEs, turning debt financing into an inappropriate mechanism for risk financing of this type of companies.

3.1 Direct Loans

Direct loans are loans made directly to the borrower, although in some cases they can be made through an intermediary organization. Commercial and industrial banks as well as savings and loan associations offer a plethora of direct loans, including personal loans, secured credit lines, unsecured credit, and term loans covering short- and long-term financing for businesses. Institutional lenders, including commercial-finance firms (for example, GE Capital and Chrysler Capital Corporation) and insurance

companies have historically been a major source of long-term direct loans for industry. However, their investment standards are very high, and new or speculative ventures are rarely considered. Public utilities, major corporations, and industrial bonds are their preferred vehicles of investment. Some government programs also offer direct loans, especially to SMEs (see section 5.2.1).

3.2 Loan Guarantees

Under the loan guarantee concept, commercial lenders make and administer loans while certain third parties provide guarantees for the borrower. If the lending institution finds the borrower to have some weaknesses that may lead to an inability to repay the loan, the loan guarantee assures it that if this should happen and a payment default occur, the lender will be reimbursed for his loss (either in full or in part, depending on the type of loan guarantee). The borrower, however, remains obligated for the full amount due. As with direct loans, NKBEs developing new technologies will typically be deemed too risky to qualify for this type of financing. However, some loan guarantee programs – usually undertaken by a public entity – do offer risk financing opportunities (see section 5.2.2).

4 Types of Risk Financing – Equity

Equity financing involves the selling of ownership interest in a business in exchange for capital. The most basic hurdle to equity financing is finding investors who are willing to buy into the business. The degree to which a business is willing to share management control may be just as crucial to equity financing as its appeal to investors. This is because by selling equity interests in an enterprise some of the owner's autonomy and management rights are sacrificed.

4.1 Business Angels

Some private investors will make small investments, usually between several tens of thousands of dollars to several millions of dollars, in high-risk ventures at their inception stage. These private investors, referred to as business angels, are typically wealthy individuals who allocate a small part of their net worth to investments in high-risk/high-reward early stage businesses or in more mature businesses that have smaller capital needs than those in search of venture capital. For the entrepreneur, angel financing often provides the critical first funds needed to attract key employees and to develop a technology or a product to the stage where more significant venture capital funding becomes available. In addition to providing financing, business angels often contribute, both formally and informally, their expertise, knowledge and contacts to the business they invest in.

In return for their investments, business angels receive common stock in the enterprise, although some may demand preferred stock giving them certain rights and liquidation preferences over the common stock. Some angel financing may also involve

convertible debt (i.e. debt that is repaid in cash or – as is more often the case – converted into shares when the first institutional capital is raised) or redeemable preferred stock, both providing a clearer exit strategy for the investor. Moreover, if the business angel requests preferred stock or convertible debt, the entrepreneur must consider both his ability to repay the investment but also the possible impact of the initial investment on future financing rounds; future investors such as venture capital funds will likely not want to use their investment to bail out prior debt to previous investors.

An additional aspect of angel financing may involve the right of first refusal (ROFR) to participate in the next round of financing for the enterprise. While many entrepreneurs see this as an additional reward for the initial investors, providing a business angel with ROFR may be to their disadvantage if the next round of investors demands to limit the number of participants in that round or the size of their individual investment.

Given their previous experience and/or as part of the financing agreement, business angels are often appointed to the firms' board of directors following an investment. Some will agree to have the seat on the board taken from them once the company raises a certain amount of equity financing or if their ownership percentage falls below a certain level. Others will demand to remain on the board throughout the company's existence.

Lastly, in order to protect their investment, business angels often ask the firm to agree not to take certain actions without their approval in what are known as negative or restrictive covenants. Such actions may include selling all or a substantial share of the firm's assets, issuing additional stock to existing management, selling stock below prices

paid by the investors or creating classes of stock with liquidation preferences or other rights senior to the business angel's class of security. Some business angels may also ask for price protection for their stock in the form of anti-dilution provisions that will result in their receiving more stock should the firm issue stock at a price lower than they paid for theirs. As with the ROFR and board representation, firms will usually insist on there being stages in the firms' evolution at which these restrictive covenants disappear so as not to unduly limit their right to raise more capital or to restrict their ability to manage.

In many regions and countries, business angels have organized themselves into networks. These networks create channels for communication between investors and entrepreneurs, and enable a more effective mobilization of informal capital. By collecting investment-seeking individuals into groups, business angel networks (BANs) can increase the supply of risk capital and the efficiency in which it is used (as a consequence of more investors being introduced to more investment proposals). Furthermore, business angels often meet other and previously unknown investors in the business angel networks. Such meetings often result in business angels co-investments by two or more business angels, so as to reduce risk and enlarge the amount of invested capital. Furthermore, collaboration amongst business angels may result in syndication. This may take the form of business angels agreeing not to negotiate individual terms with potential entrepreneurs but only to invest within the framework of the network. Angels may also pool their investments in a common fund that is managed by the network. Business angel networks therefore have an agglomeration effect that is important for entrepreneurs and investors alike.

The importance of individual business angels and BANs to risk financing at the regional, national and global levels is hard to quantify due to the informal nature of this type of financing. Their success is also difficult to measure, since they are under no obligation to report on their activities. In the U.S. it is estimated that their impact is substantial; over 250,000 business angels invested some $15.7 billion in 2002 (compared to $21.3 billion invested by VCFs that year – see section 4.2). That same year, the forming of the Angel Capital Association (ACA) was initiated to act as a networking hub for American and Canadian BANs, enabling them to share information and collect data and statistics they require; it currently has over 60 members (ACA website). In the U.K., which along with the U.S. has the most developed angel linkages, BANs – especially publicly operated ones – are important actors at the local level, where much of their activity is operated by the local Learning and Skills Councils (which are responsible for funding and planning of local training and consultation initiatives) and the Business Links offices responsible for supporting local firms (Kluth and Andersen, 1999: 131). Private BANs with a regional focus, such as Xénon in Wales and the Oxfordshire Investment Opportunity Network covering Oxford and the southeast, occupy an increasingly smaller share of total investments, whereas BANs

operating at the national level, such as the National Business Angel Network (NBAN), are seeing their share of total investments rise. In 2003, over 18,000 business angels were active in the U.K., investing more than £500 million in around 3,500 enterprises (Sormani, 2004). Overall, the European Union saw the number of BANs in the Member States rise from 64 in 1999 to 176 in 2003 (European Commission, 2003a: 24).

4.2 Venture Capital

Venture capital is the second type of equity risk financing and the one more typically used by firms that have successfully raised pre-seed and seed funding. It is provided by venture capital funds (VCFs) that make investments of several millions of dollars (typically between five and fifty million) in return for stock. As in the case of business angels, venture capital is often the course taken by NKBEs with little or no collateral cash flows and looking to expand their capital in return for a share in future profits.

There are three major types of VCFs: private partnerships, subsidiaries of industrial corporations and financial institutions, and public entities. In most countries, private partnerships control the largest share of venture capital resources. Subsidiary VCFs of financial institutions are affiliated with banks, pension funds and other entities of this type, while those of industrial corporations are often spun-off from the mother

company (see below). Public VCFs are set up – but not always managed – by national or regional governments (see section 5.3.2) (Smith and Florida, 2000: 201-207)

VCFs assess business plans that are submitted to them for their potential commercial success. They evaluate the promise of the firm's technology and consider the experience and flexibility of management and potential market size. Like business angels, they rely heavily on personal contacts in their search for – and initial screening of – venture opportunities; in the U.S., nearly two-thirds of proposals considered by VCFs were referred by personal or business acquaintances (Smith and Florida, 2000: 213). A second characteristic shared with business angels is that VCFs will also often demand preferred stock, representation on the board of directors, and numerous restrictive covenants as conditions for their investments. These investments are usually made in stages so as to closely monitor potential profitability of funded projects over time. In addition, venture capitalists maintain close contacts with managers to continuously scrutinize every aspect of the firm over the investment period; in most cases, the VCF will demand an active role in management and decision-making. Often, venture capitalists will insist that, as a condition of investment, the company move its offices closer to those of the VCF. As a result of the personal contacts that drive many venture capital investments and of the desire of venture capitalists to be in close contact with their portfolio companies, sources of venture capital and the firms it funds tend to be highly geographically concentrated.

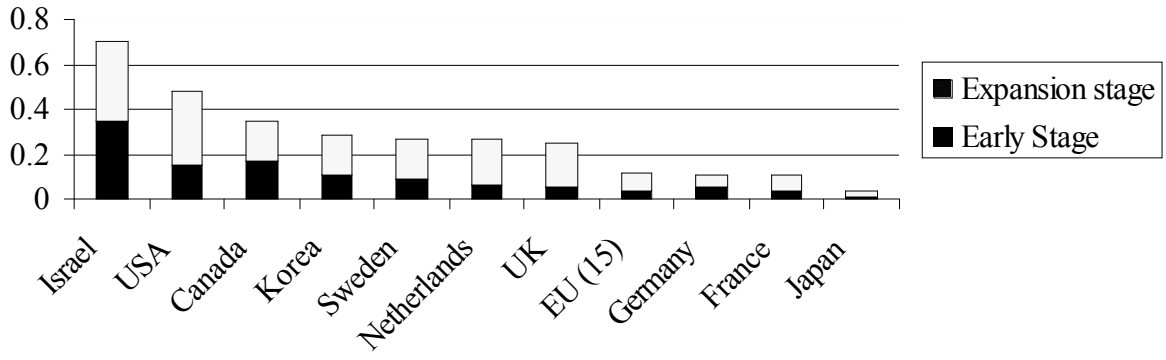
Despite the number of cautionary steps taken by venture capitalists, however, most VCF-backed firms do not succeed. Approximately one in ten will be sold for a large profit, reflecting the high-risk/high return character of investment in NKBEs. Yet few

companies will fail completely. Some can be sold off by the VCF for a low price to an established business, and most will have assets – including intellectual property – of some value.

The proportion of venture capital investments targeting enterprises in their inception stage versus those targeted at more mature enterprises vary considerably across time – reflecting the often faddish nature of investments – and between countries. An OECD study of venture capital trends in several countries shows that firms in Israel, the U.S., and Canada, for example, have seen more investments during the early and expansion stages (0.35 percent, 0.15 percent and 0.18 percent of GDP respectively in 1999-2002), whereas those in the Netherlands, Sweden and the U.K. experienced venture capital investments predominantly during later stages of their existence (0.15 percent of GDP) and much less (0.05-0.1 percent of GDP) during earlier stages (OECD 2004b: 7). These differences in financing profile partly reflect differences in industrial structure as well as in capital markets. Thus, countries where strong public equity markets exist that encourage IPOs, such as the U.S., will attract venture capital to enterprises in their earlier stages, while countries where buyouts offer easier and faster opportunities to achieve higher returns would attract venture capital in the later stages of funding. Similarly, in countries where the stock market plays a central role in financing investment, monitoring companies and reallocating corporate control, such as the U.S., venture capital tends to be invested in early-stage ventures and high-tech industries, while in countries where banks play a much more significant role in capital markets, such as Germany and Japan, venture capital provides primarily later stage financing to low-tech industries.

Figure 2 illustrates venture capital investments by stages (early versus expansion) in several countries:

Figure 2. Venture capital investment by stages as share of GDP, 1999-2002



Note: EU(15) refers to the 15 countries in the European Union before the expansion on 1 May 2004

Source: OECD 2004b:7.

In addition, it should be remembered that VCFs are interested first and foremost in earning maximum returns for their investors, not in commercializing new technologies. Even when they do support NKBEs, venture capitalists prefer to support those that have at least completed the inception stages of technology development and even proceeded beyond the product development stage. Therefore, trends in venture capital disbursements should not be confused with trends in the funding of early stage technology development. As Figures 3 and 4 below show, there is a strong correlation between the total amount of invested venture capital and the average venture capital deal size: the more capital is available, the larger

the average deal becomes. This is also confirmed by ample anecdotal evidence. In addition, it can be argued that as the average size of venture capital deals increase and the pressure to provide attractive returns to investors in large funds intensifies, venture capital tends to flow to projects in mature stages of development and to already-proven technologies (Branscomb and Auerswald, 2002b: 48).

Table 1. Total venture capital investment 1998-2006 (in US$ billion)

	'98	**'99**	**'00**	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**
USA	20.7	53.5	104.4	40.5	21.7	19.6	21.8	22.3	26.4
EU	6.7	11.2	19.6	12.7	10.1	4.2	4.7	4.9	5.8
Israel	0.5	1	3.2	1.6	1	0.8	1.2	1.1	1.2

Source: NVCA, PriceWaterhouseCoopers, European Commission

Table 2. Trends in average venture capital deal size 1998-2006 (in US$ million)

	'98	**'99**	**'00**	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**
USA	5.8	9.9	13.4	9.1	7.1	6.8	7.3	7.3	7.4
EU			5.1	2.9	2.9	3.4	4.4	4.8	7.4
Israel	2.1	2.8	5.6	3.3	3.2	2.8	4	3.4	

Source: NVCA, PriceWaterhouseCoopers, Dow Jones VentureOne and Ernst & Young

One specific type of VCF worth discussing in greater detail is the corporate VCF that is a subsidiary of an industrial corporation. It is common for established firms to make equity investments in high-tech start-ups so as to gain a better understanding of emergent technologies, to prepare potential candidates for strategic alliance or acquisition, or as a means to supplement their own R&D efforts. Examples abound all over the world, and include Mitsubishi's Captech Corporation, General Electric Equity, ChevronTexaco Technology Ventures, and Intel Capital. However, financing of NKBEs by established corporations is almost always restricted to research undertaken in areas relevant to the funders' core competencies. While corporations will spend lavishly on technological innovations that support their core businesses, they are fundamentally disinclined to support technological innovations that challenge existing lines of business, require a fundamental shift of business model, or depend on the creation of new complementary infrastructure (Branscomb and Auerswald 2002b: 48).

Finally, another type of VCF that has recently gained in popularity is the university VCF, created and used by higher education organizations to finance their spin-offs. Since they encounter the same challenges in raising risk capital as other entrepreneurs, universities are increasingly willing to create in-house entities that invest in start-ups founded by their researchers; some may also share costs with industry partners in exchange for equity. These university VCFs may be particularly important in countries that have had little experience with local private VCFs but that possess high-

quality academic institutions, such as many Central and Eastern European countries. Academic entrepreneurs can use them to gain both funding and skills that will remain relevant for future, non-academic innovative endeavors (Iliev, 2005: 17). However, a recent study has shown that university VCFs have little effect on the quantity and quality of start-ups founded by researchers affiliated with the universities in question. This is because most university entrepreneurs often possess adequate ties to external venture capitalists. Therefore, it has been argued that university venture capital usually substitutes for, rather than adds to, external venture capital in its effect on start-up activity (Di Gregorio and Shane, 2003: 225-226).

5 Government Policy Options for Risk Financing

As shown earlier in this paper, new knowledge-based enterprises tend to face difficulties in their access to various sources of funding. However, there exist specific financing mechanisms which can address the special needs of such firms. An important remaining question is whether the market, if left to its own devices, will provide these mechanisms – and in sufficient quantities – or whether government intervention for risk financing is required. The following section deals with this question and presents policy options for risk financing that governments can make use of.

5.1 Should Governments Intervene?

The importance of NKBEs in the knowledge-based economy and the information society is large and growing larger. Knowledge-based economies are driven by the creation and expansion of new economic activities in the high-tech and knowledge intensive sectors and by the diffusion of new technologies within the economy. As such, the knowledge-based economy depends extensively on commercializing innovations and knowledge assets through the creation and expansion of knowledge-based start-ups. An efficient risk financing system that can assist in this objective is therefore of the utmost importance (European Commission, 2003b: 149).

Risk financing therefore not only helps NKBEs enter the market and grow, but also assists in the growth of the economy as a whole and in the transitioning of a society into a more knowledge-based one. For example, in a study covering twenty industries in the U.S. manufacturing sector over the span of thirty years, it was found that an increase in venture capital availability to an industry results in an increase in patents from it and

that a dollar of venture capital could be up to ten times more effective in stimulating patenting than a dollar of traditional corporate R&D. It is estimated that while venture capital has been less than three percent of corporate R&D spending in the U.S., it is responsible for some fifteen percent of industry innovation (Kortum and Lerner, 1998: 2-4).

However, there are two main reasons to believe that the private sector alone will usually not supply all deserving NKBEs with sufficient quantities capital and that there continues to be a role for public risk financing programs. The first is that, as has been discussed in this paper, risk financing from the private sector flows largely to specific geographic areas and to more mature technology fields and enterprises. Very young, technology-intensive firms, especially those located in regions not targeted by private investors and/or working on technology areas that still require significant development time (e.g. nanotechnology) find it hard to attract funding sources. By awarding capital to such NKBEs, public risk financing programs help companies cross the "Valley of Death" and may encourage geographic diversity of innovation. Such programs also act as certification agents that endorse funding recipients as being of high quality; this is especially true if the assessments of potential recipients are undertaken by outside evaluators. Other investors may then be more wiling to risk their own capital in these enterprises.

The second rationale for public involvement in risk financing is that of the overall underinvestment in R&D due to the inherent positive spillovers (externalities). Competitors may gain access to a firm's innovations and imitate them, developers of complementary products could profit without they themselves investing in the R&D, and

consumers could reap benefits beyond those calculated into the product price. Small, knowledge-intensive companies are the main victims of this underinvestment, since they are particularly unlikely to successfully defend their intellectual property positions or to extract most of the rents in the product market (Lerner and Kegler, 2000: 312-315).

The growing recognition of the importance of NKBEs and of the challenges they face in raising risk financing has led to a proliferation of government programs to close perceived financing gaps, especially those faced by smaller and highly innovative firms during the initial period of their existence. For example, one study estimated that in the U.S., the federal government provides between twenty and twenty-five percent of all funds for early-stage technology development (Branscomb and Auerswald, 2002a: 20-24). The following sections examine policy options for governments – including examples from specific countries – in the form of debt financing, equity financing, and grants programs.

5.2 Policy Options for Debt Financing

5.2.1 Direct Loans

Some governments offer direct loan programs, including micro-lending, particularly targeting SMEs at the inception stage. These programs generally require a personal guarantee from an investor with a stake in the business. For example, the U.S. Small Business Administration offers direct long-term loans for fixed assets of up to $500,000 and MicroLoan programs of up to $25,000.

However, most direct loan programs do not appear to be suitable for financing NKBEs since they do not share potential upside return but assume a significant portion of

downside risks. For example, the Business Development Fund (*Erhvervsudviklingsfonden*) was established in Denmark to provide high-risk loans to high-technology projects in start-ups and established enterprises. The Fund was set up to share the downside risk, but receive only a fixed interest for commercially successful projects. More than sixty percent of total funding was lost on more than 900 funded projects. The fund was recreated as the Danish Investment Fund (*VækstFonden*) in 2000.

5.2.2 Loan Guarantee Programs

Many governments have implemented loan guarantee programs to close the debt financing gap for NKBEs. The aim of these programs is to transfer part or some of the lending risk to the public sector while leaving the administration of the loans in the hands of the banks (in order to maintain efficiency and contain program costs). In most cases, the subsidy component is not reflected in the interest rate that is charged to borrowers, which is usually the market rate plus a small premium, but rather in the government's incurring of some or all of the costs when clients default on their loans. The lending banks can be induced to assume part of the risk by insisting that they properly appraise all loan applicants and do not lend to overly risky borrowers. They may also be required to reward good clients by substituting part of collateralized loans with the loan guarantee.

There are essentially two public policy parameters in loan guarantee schemes: the premium on the interest rate and the amount guaranteed. The premium can act as a deterrent to the take-up of such schemes, whereas the proportion of loan guarantee by the government can encourage their use. Thus, the government needs to carefully balance these parameters to ensure that deserving firms are financed while maintaining the

financial sustainability of these programs. Examples of such programs include Canada's Small Business Loans Act (SBLA) program, the Danish Investment Fund, and the British Small Firms Loan Guarantee Scheme (SFLG) (OECD, 2004a: 31-33).

In addition, several countries have created national or regional institutions that provide financial entities with credit guarantees on the repayment of loans given to NKBEs. In return, the enterprises receiving the loans pay guarantee fees to the public institutions that secure the credit guarantees. Another option is for enterprises to grant loan guarantees to one another through institutions they create on a voluntary basis to help satisfy their credit needs. Examples of such risk-pooling schemes for guaranteeing loans include Japan's Credit Guarantee Corporations (CGCs), France's Mutual Guarantee Funds (MGFs) and Italy's Confidi (SME associations operating at a local level) (OECD, 2004a:33-34).

5.3 Policy Options for Equity Financing

5.3.1 Regulatory Framework for Investment

Relaxed investment regulations, specifically those affecting pension funds and capital gains tax rates, may lead to an increase in capital made available for financing risk. Furthermore, increasing the expected rate of return on investments in NKBEs is likely to shift venture capital investments towards NKBEs with less collateral, namely those at the earlier stages and working on more advanced technologies (Da Rin, Nicodano and Sembenelli, 2005: 25). For example, when the U.S. changed its existing policy in 1978 and began allowing pension funds to invest in venture capital funds, these soon became the American venture capital industry's primary source of capital (Gompers

and Lerner, 1999: 2-3). Comparable trends, although not as dramatic perhaps, have been observed in countries such as Denmark, Ireland, Japan and the U.K. when they amended the rules allowing pension funds to be invested in high-risk enterprises. Similarly, countries that followed the U.S. lead in decreasing capital gains tax rates (undertaken in 1993) often managed to induce more people to become entrepreneurs, and thereby increase the demand for, and consequently the supply of, venture capital commitments. And the EC's Risk Capital Action Plan (RCAP), implemented between 1998 and 2002, led to important reforms in investment regulations and tax frameworks at the European level (European Commission, 2003a).

Nonetheless, all countries maintain some form of investment regulation on equity financing for NKBEs. In many countries, regulations designed to limit risks for pension funds result in a low share of institutional investment in private equity. National initiatives in equity financing, such as Canada's Labor-Sponsored Venture Capital Corporations (LSVCCs), may crowd out private investment and hinder the development of private equity funds (Canada's public initiative was restructured in 1986 and 2001 to amend this). Government equity guarantees, such as those provided by the Israeli government, could tilt investment flows toward excessively risky enterprises, and may not be the most appropriate vehicle to stimulate institutions to invest in private equity funds. Instead, liberalizing investment restrictions in local pension and insurance funds from investing in private equity funds may have a more positive outcome.

5.3.2 Government Business Angel and Venture Capital Initiatives

Many examples of public VCFs are those created using government funds but operated by private entities as either for- or non-profit entities. In the U.S., for example, the Small Business Investment Act passed in 1958 authorized the founding Small Business Investment Companies (SBICs). These are privately organized and managed investment firms, licensed by the Small Business Administration (SBA), which fund SMEs by channeling long-term federal loans into VCFs, loans and combined debt and equity mechanisms (Smith and Florida, 2000: 210). Currently, there are over 270 SBICs nationwide with $3.5 billion in private funds and $1 billion in government money to lend. However, they are often too restrictive for NKBEs.

Two examples also exist in the U.S. of the defense and intelligence community's willingness to adopt VCFs as tools for technology harvesting. In 1999, the Central Intelligence Agency (CIA) created In-Q-Tel Corporation, a non-profit VCF charged with funding NKBEs in the information technology domain, and in 2003, the U.S. Army created OnPoint Technologies Inc., a non-profit VCF funding innovative mobile power and energy technology with potential application to military needs. In both cases, NKBEs were deemed able to develop products that are unique to a specific user community but for which a wider market does not exist. Venture capital was considered the best financing option because it provided the fastest and most flexible mechanism for NKBEs in the targeted technology areas.

In the U.S. public VCF scene, however, it is the state and local governments that are most active largely due to their closer relationship with businesses and regional / local innovation compared to the federal government. Specifically for SMEs, state and

local governments have traditionally taken the lead for policy formulation and implementation (Vonortas, 2000: 18). The fact that sources for venture capital as well as firms it is invested in both tend to be geographically focused also helps to explain this phenomenon.

Based on the belief that risk capital stimulates innovation and that public funding can support regions outside of traditional venture capital centers, many states have experimented with a variety of mechanisms for stimulating or providing equity financing. Some states have used public funds to underwrite privately managed VCFs, acting as passive limited partners and placing few stipulations on the type of investments made. Examples include New York State's Venture Capital Investment, the Maryland Venture Capital Trust, Massachusetts' Technology Development Corporation and the Michigan Investment Fund. Another mechanism has been to allow public pension funds to commit assets to venture capital or to directly invest in new enterprises. Examples of the latter include the California Emerging Ventures and the New York State Venture Capital Investment created by the largest and second largest public pension funds in the U.S. A third mechanism has been the creation of business consulting, partner brokering and information disseminating entities for NKBEs, such as the Regional Technology Alliances in California.

However, it must be remembered that risk capital is only one of many inputs necessary to create knowledge-based and technology-intensive economic growth, and if other conditions are not met, increasing it will have little effect on a region's capability to generate innovation. An important lesson to be learned from the U.S. case is that public provision of risk capital is most appropriate in areas where infrastructures for innovation,

including equipment and talent, already exist. If no more than a handful of good deals are there to attract investors, closing what is the "funding gap" will have little effect (Smith and Florida, 2000: 226-227).

Another example of a national government creating public VCFs to boost national innovation is Israel. In 1990, only one venture capital firm existed in Israel, managing approximately $30 million. That year, the Ministry of Finance together with the Ministry for Industry and Trade initiated two new programs to bolster the local VC industry. The first, Inbal, was an equity guarantee scheme that provided seventy percent guarantees to investors in three local publicly-traded VCFs. The government agreed to buy the shares from investors in any of the three funds, should they want to sell them, at a price equal to a given percentage of the purchase price. The program led to the formation of six publicly traded Israeli VCFs, each with between $15 million and $20 million in capital, and was phased out by 1994.

The second program, Yozma, established ten new privately-owned VCFs with an average government investment of $8 million. The government provided 40 percent of initial funding (the rest was raised overseas) and was a limited partner in the funds, but had no say in investment decisions made by their foreign managers. Foreign investors were given an option to buy the government's portion of the fund after five years and the purchase price was set as the amount the government had invested plus interest on that amount for five years plus a royalty to the government of seven percent of future profits. Eventually, eight out of the ten funds were bought out with very high returns, and Yozma was discontinued after six years.

In 2002, with the bursting of the high-tech bubble and the decrease in venture capital funding in Israel, the Ministry of Industry and Trade created the $11 million Heznek program, which is similar to Yozma in that it is based on the government matching investment in a start-up company proportional to the capital put forward by the investing entity. The government does not appoint directors or engage in management, and the private investors are able to choose to buy out the government by repaying their share – with interest – anytime within the first five years (Ben-Ari, 2006).

In the European Union, the European Investment Fund (EIF) enhances risk financing by channeling appropriated E.C. and European Investment Bank funds to VCFs. In 2002, it invested 471.5 million euros in 36 VCFs, down from 800 million euros in 57 VCFs the year before. Its emphasis is on NKBEs, which comprise close to 75 percent of its total portfolio of commitments (European Commission, 2003b: 17).

New, improved risk-finance mechanisms are currently being set up as part of the Competitiveness and Innovation Program (CIP), the companion to the Seventh Research Framework Program (FP7) of the European Union (European Commission, 2005). More specifically, the CIP Financial Instruments purport to address squarely the first of the three funding gaps identified in Section 2 of this paper by facilitating access to finance for SMEs: seed, start-up, expansion and business transfer. Investments in technological development, innovation, and technology transfer are very much within the scope of the instruments:

- The *High Growth and Innovative SME Facility*: GIF1 for early stage (seed, start up) and GIF2 for expansion stage investments.

- The *SME Guarantee Facility*: debt financing via loans or leasing, microcredit financing, guarantees for equity fund investments in SMEs, and securitization of SME debt finance portfolios.

The CIP Financial Instruments also address, to some extent, the third gap:

- The *Capacity Building Scheme* (a) to stimulate the supply of private venture capital to innovative SMEs and (b) to provide technical assistance to improve the credit appraisal procedures in financial intermediaries for SME debt financing.

5.4 Grants

National, regional and local governments as well as private foundations can all provide risk financing in the form of grants. These are usually merit-based and highly competitive and may be awarded on a "cost-sharing" basis in which the recipient is required to invest a certain amount in addition to the grant given.

Foundations are usually relatively small players in the risk financing game; their mandates usually do not cover this type of activity, but their non-profit character may enable them to make investments where profit is not the objective. In the U.S., for example, private foundations are required to pay out 5 percent of their assets every year through grants to charitable organizations, scholarship donations to individuals, or program related investments in entities serving a public purpose and that do not return a profit to the foundation. Similar regulations govern foundations elsewhere. Furthermore, foundations are usually able to invest in VCFs and as part of their asset portfolio strategy, and can also make equity investments in NKBEs as part of their payout obligation, as

long as financial profits are not the primary goal of such investments and the public good is extended.

Governments, both national and regional, are more active grant providers on the risk financing scene and this is particularly true for grants to NKBEs. In the U.S., the example of the Small Business Innovation Research (SBIR) program is important, since it is one of the largest government grant programs in terms of budget. Operating since 1983, its aim is to channel federal R&D funds to small businesses that contribute to agency missions. The program is administered by eleven Federal agencies: the Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Homeland Security and Transportation, and the Environmental Protection Agency, the National Aeronautics and Space Administration and the National Science Foundation.[3] SBIR initially required agencies with annual extramural R&D budgets of more than $100 million to set aside 0.2 percent of their funds for SMEs, but this share was gradually increased over the years and currently stands at two and a half percent. In 2002, some $1.5 billion in federal R&D funds were allocated under the SBIR program for awards to firms with 500 and fewer employees undertaking R&D and commercialization activities.

The SBIR program has three phases. Phase I funds feasibility studies to assess an innovation's technological and commercial promise; up to $100,000 can be allocated for such activities. Phase II funds up to $750,000 worth of more extensive R&D to further evaluate scientific and technological merit of an idea and the chances for successfully bringing it to the market. Phase III involves very limited SBIR funding, if

[3] The Homeland Security Advanced Research Projects Agency (HSARPA) of the Department of Homeland Security (DHS) joined the SBIR program, in December 2003; until recently, the Nuclear Regulatory Commission also participated in the SBIR program.

any, and is where the enterprise is expected to raise additional funding for commercializing the technology, usually from government agencies, private investors or the capital market.

Since 1995, the SBIR program also features a Fast Track process for projects that can attract outside investors who will match Phase II funding, in cash, contingent on the project's selection for Phase II award. The aim of the Fast Track process is to prevent any significant gaps in funding between phases I and II. Projects that obtain such outside investments and thereby qualify for the Fast Track receive interim funding of $30,000 to $50,000 between Phases I and II and are evaluated for their Phase II award under a separate, expedited process. In addition to providing a financing boost to companies, it also encourages them to seek private investors and potential customers, thereby focusing them more on the commercialization of their product.

As a result of the Fast Track process, a significantly higher percentage of Fast Track projects have obtained Phase II award than non-Fast Track projects. In the Department of Defense, the largest government actor in the SBIR program, over 90 percent of projects qualifying for the Fast Track have received interim funding and been selected for Phase II award. In a survey conducted of firms participating in the Department of Defense's SBIR Fast Track, over half of the Fast Track firms experienced no funding gap between Phase I and II, and the average funding gap was 2.4 months. By contrast, over 80 percent of companies not participating in the Fast Track Program confronted a funding gap averaging 4.7 months between the end of Phase I funding and the beginning of Phase II funding. Furthermore, the Fast Track process was found to attract new firms to the SBIR program that are younger and smaller than non-Fast Track

firms. 88 percent of Fast Track firms had no prior Phase II awards, compared with 30 percent with no prior Phase II awards for non-Fast Track firms (Wessner, 2000).

An analysis of the social returns of the SBIR program illustrates the advantages of public investments in NKBEs. It rested on the assumption that if the social benefits of the program are greater than the social costs and if, without public support, the private costs to duplicate the programs results would be greater than public benefits, then the program is socially valuable and public funds are well spent. In the case of the SBIR program, it was found that the funded companies would not have undertaken the work without public support because the rate of return they expected would not have been acceptable, and that the social returns were greater than the estimated private returns had SBIR funding not been available. The SBIR program was therefore found to be investing in very socially desirable projects (Link and Scott, 2000). At the time of this writing, the U.S. Academies of Science was running an extensive evaluation study of the SBIR program which was expected to release a positive appraisal of the program.

6 Exit Mechanisms

The final stage in the risk financing process is exiting. In order to make money on their investments, investors need to turn illiquid stakes in private enterprises into realized return. Traditionally, this involved either a public sale (initial public offering, IPO) or a merger or acquisition (M&A) of the company by either the original founders or another company. In an IPO, the more glamorous and visible of the two mechanisms, the company issues shares to the public for the first time. When this happens, investors are usually required by the investment bank making the IPO to hold their shares in the

company (in order not to send a negative signal to the market by an insider "cashing out") for a certain period of time (usually several months) and may retain seats on the board of directors. When the "lock-up" period is over, investors can sell their shares or distribute the shares themselves. A much more common, though less visible, exit mechanism is M&A. When this occurs, the venture firm will receive stock or cash from the acquiring company and the investor will distribute the proceeds from the sale to its limited partners.

More recently, it is increasingly common to see other more innovative forms of exits besides IPOs and M&A. These include reserve mergers with a listed "shell" company and the setting up of over-the-counter (OTC) trading with listing on a major exchange. The former, also known as a reverse takeover (RTO) or a back door listing, allows a privately held company to become publicly owned when the shareholders of the private company sell all of their shares to a publicly-listed shell company in exchange for shares of the public company. The publicly traded corporation is called a "shell" since all that exists of the original company is its organizational structure. The private company shareholders receive a substantial majority of the shares of the public company and control of its board of directors. OTC trading, on the other hand, merely involves a bi-lateral contract between two parties on the direct sale of a private company.

Having exit mechanisms in place is a critical condition for successful risk financing, and governments can assist in this either directly, for example through the creation of second-tier stock markets for IPOs, or indirectly, for example, through the enabling of tax-free mergers of SMEs with larger companies and reducing capital gains taxation. Both types of government involvement have been implemented extensively in the U.S. and more recently in other OECD countries, and both raise the share of high-tech

investments, including investments in early-stage companies (Da Rin, Nicodano and Sembenelli, 2005: 6). In the U.S., for example, the second-tier market, NASDAQ, was the first of its kind when it began operating in 1971, and is still the most successful in terms of number of quoted companies and their market capitalization as share of GDP. The U.S. also has regulations in place that enable the merging of small companies with larger ones – or subsidiaries of large companies – without paying a capital gains tax.

7 Conclusions

Knowledge-based enterprises are important for countries transitioning into knowledge economies and hoping to rely on advanced technologies for their economic growth. The innovations these enterprises generate stimulate trade, generate outside investment, create knowledge and improve the potential of human capital. However, most traditional funding mechanisms are unsuitable for NKBEs, especially those working on advanced technologies that are in early stages of development. They often turn to equity financing from specific sources dealing with risk capital and to government for funding.

Beyond the founders' own financial resources – and contributions by friends and family – business angels are an important funding source for NKBEs, and will also be a source of expert advice and guidance to inexperienced entrepreneurs. However, individual angels will not provide more than small amounts of capital and their strategy will mainly be to avoid bad investments rather than pick winners since they have a limited ability to reduce their risk through diversification. Several angels working together as a network (BAN) enable risk-sharing and resource pooling and may lead to more investments being made and to adopting a "picking winners" strategy. These networks are currently emerging to fill the new gap created between individual angels and venture capital funds. A better understanding of the more formal modes of cooperation between business angels, including their mechanisms for pooling resources and investing jointly, would be useful for governments. They could then consider new policy mechanisms, such as matching funds for angel investors, to incorporate into national innovation strategies.

Venture capital is another important source of equity financing for NKBEs, traditionally in the form of private funds, and now also in the form of corporate and university funds. VCFs will usually commit larger amounts over several rounds of financing and demand active involvement in the management of the recipient company. The amount of capital raised by VCFs will depend heavily on the existence of effective exit mechanisms, such as IPOs and M&As, and on the availability of enterprises to invest in locally. Since these conditions now exist in many developed countries, the amount of capital that VCFs raise worldwide is growing and, with it, their disinterest in small, risky investments and their appetite for larger, safer deals. Therefore, most VCFs are becoming less relevant as sources of equity financing for NKBEs at the inception stage, especially those that are less centrally located and working on technologies that are at early stages of development.

Government policies for venture capital should, therefore, not necessarily focus on increasing available funds but rather on increasing the funds actually invested especially in companies less targeted by the private sector either due to their location or technological focus.

This leads to the third source of risk financing catered by national and regional governments. Creating a regulatory framework that encourages risk financing, becoming directly involved in debt and equity financing, providing advice and information to NKBEs and managing grants are the ways in which policymakers can help entrepreneurs bridge the "Valley of Death" for NKBEs. Since they are less concerned with making profits, governments possess the capability to allocate risk capital to less privileged areas and entities: young firms, firms in geographical areas lacking in risk financing sources

and expertise, and firms developing technologies that the private sector still hesitates to support. Governments, however, historically have had a mixed track record of "picking winners", especially in terms of companies that will successfully commercialize their innovations. Ideally, public sector programs would address risk financing indirectly, via regulation and consultation. Governments may get directly involved in risk financing activities only when objectives such as regional development become the core policy goal and market failure in providing the appropriate funding is rather evident..

In closing it must be stressed that the roles that business angels, VCFs, and government programs traditionally play in the risk financing world are constantly evolving, and new types of actors, such as university VCFs, are appearing. As public and private entities continue to address the challenges surrounding the raising and allocation of risk capital, reliable data and evaluation criteria for measuring success are becoming increasingly important (Sohl, 2003: 15). Entrepreneurs, investors and public policy makers will continue to rely on such information for making decisions, and there are still many areas of the risk financing domain, such as that of business angel financing, where the data is incomplete or nonexistent. In order for risk capital to continue playing the crucial role it currently does in modern knowledge-based economies, more research into the elements comprising it will be required.

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