Public Policy, Venture Capital and Entrepreneurial Finance*

CHRISTIAN KEUSCHNIGG

University of St. Gallen (IFF-HSG)

February 25, 2009

Abstract

Venture capital has become an important source of financing young entrepreneurial firms. Venture capital backed firms are often perceived as more innovative and as creating more value than others. Perhaps for this reason, policy makers are keen to create a good institutional framework to facilitate the development of an active venture capital industry. We explore the role of tax policy in determining the incentives of individuals to start up new firms and of venture capitalists to finance and advise them. In particular, we examine how business taxation together with start-up capital subsidies affect the volume and quality of venture capital backed entrepreneurship.

JEL-Classification: D82, G24, H24, H25

Keywords: Entrepreneurship, venture capital, taxes, subsidies.

Address: IFF-HSG, Varnbuelstrasse 19, CH - 9000 St. Gallen, Switzerland.

*Financial support by the Swiss National Science Foundation under project no. 100012-113418 is gratefully acknowledged. I am indebted to Soren Bo Nielsen for the many insights and discussions during our previous joint work.

1 Introduction

Venture capital (VC) has become an important source of finance but also a source of professional support for new firms in high-technology industries. A firm's transition from birth of the idea to a marketable product not only involves technological experiments and development of prototypes. Developing marketing strategies, attracting key clients and reliable suppliers, hiring new personnel, and raising further financing requires managerial skills. Start-up entrepreneurs typically lack the necessary capital and often would benefit from professional assistance. Venture capitalists (VCs) can fill these gaps. They have access to capital and are endowed with managerial and industry know-how. They dispose of a well connected network of suppliers, customers and key personnel. Indeed, the defining characteristic of VC is the combination of financing and commercial assistance. The main functions of VC financing consist of screening, contracting and advising (see Kaplan and Stromberg, 2001, for a concise statement of the stylized facts. Gompers and Lerner 1999 and Kaplan and Stromberg, 2003, 2004 provide detailed empirical evidence). In contrast to more passive bank financing, VCs arrange for entrepreneurs to receive support by creating links to suppliers and possible customers, attracting key personnel, providing strategic and marketing advice and helping the professionalization of the firm.

Venture capital started out in the U.S. half a century ago and has grown impressively since then. Almost half of new firms in the U.S. which are sold off at IPOs (Initial Public Offerings) have been backed by VC (see Gompers and Lerner, 2001). In Europe, VC emerged significantly later. Only in the most recent years have VC firms become prominent financiers of young technology firms. Statistics published by EVCA (European Private Equity and Venture Capital Association) report a total investment of 71 billion Euros in 2006, up from 10 billion in 1997 and 24 billion in 2001.¹ As in previous years, seed and start-up investment constituted only a minor part (8.3 pct in 2006) while expansion and replacement investments absorbed 21 pct. The major part was in financing buyouts (70.7 pct). In 2005, 5.2 pct of total investments was allocated to seed and start-up, 26.6

¹See EVCA Barometer June 2005 on <http://www.evca.com>.

pct to expansion and replacement investments, and 68.2 pct to financing buyouts. The EVCA statistics further reveal marked differences across countries. Sweden, U.K. and Netherlands had the largest Private Equity/VC markets in Europe (1.44, 1.26 and 1.05 pct of GDP in 2006, respectively), while France's share was slightly above the European average of 0.57 pct. Germany and Switzerland recorded only around 0.2 pct of GDP.

Innovation generates large social returns. Jones and Williams (1998) suggest that the social rate of return on R&D is about 30% while private returns are much lower, between 7 to 14%. These authors argue that, from a social perspective, R&D investments should be two to four times higher than what is actually observed! While VC accounts for a rather small part of total investment, it is concentrated in the most innovative sectors. Kortum and Lerner (2000) found that VC is responsible for a disproportionately large share of overall industrial innovation in the U.S. A dollar of VC appears to be about three times more potent in stimulating patents than a dollar of traditional corporate R&D. According to their estimates, VC accounted only for about 3 pct of corporate R&D from 1983 to 1992 but was responsible for about 8 pct of industrial innovation in this decade. Given an unchanged potency of venture funding, VC investments should have accounted for about 14% of U.S. innovative activity in 1998. Policy makers and the business community have thus taken a strong interest in improving the conditions for financing new firms, and in the development of an active VC industry in particular. Young VC backed firms are considered an important source of innovation and growth. Several questions arise when developing a policy perspective. Is there enough risk capital available? Do administrative procedures and requirements hinder entrepreneurship in the first place? Are government grants and subsidies to new firms appropriate? Do taxes block the creation and development of start-ups? Do taxes deter the support and advisory effort of VCs to their portfolio companies?

The VC industry regularly evaluates public policy with respect to whether it is suitable to promote the development of private equity and VC markets and to encourage entrepreneurship. For instance, EVCA in 2003 and again in 2004 published a benchmark-

ing report on the tax and legal environment in its member countries (see EVCA, 2004). The assessment evaluates 13 indicators relating to both the supply-side (i.e. investors in private equity and VC funds and fund managers investing directly in companies) and the demand-side of private equity and VC (i.e. creation of entrepreneurial firms). Among the tax indicators covered are (i) company tax rates, with special attention to those applicable to small and medium-sized companies; (ii) capital gains tax rates for individuals; (iii) income tax rates for private individuals; (iv) tax incentives for individual investors investing in private equity; (v) the entrepreneurial environment; and (vi) fiscal incentives to enhance research and development.

The benchmarking report reflects a firm belief that taxes matter for entrepreneurship. Empirical research in public finance indeed testifies to the importance of taxes for entrepreneurship. For example, Rosen (2005) in summarizing his research with a series of co-authors produces ample evidence that once started, the decisions in new firms regarding employment, capital investment and production are markedly influenced by taxes. Gentry and Hubbard's (2000) empirical analysis demonstrates that the progressivity of the tax schedule is important for entrepreneurship. They argue that the progressivity of the income tax acts like a success tax that taxes successful ventures generating high incomes at particularly high rates and thereby significantly reduces the probability of entrepreneurial entry. Gordon (1998) and Cullen and Gordon (2007), on the other hand, argue that high personal tax rates could actually encourage entrepreneurial activity when individuals are able to exploit the option to incorporate. The argument is that entrepreneurs would choose to be noncorporate in the early stage when the business makes losses. They would then save taxes by offsetting these losses against other personal income. Once the business starts to record profits, an entrepreneur prefers to incorporate in order to exploit low corporate taxes. According to this view, high personal income tax rates can encourage entrepreneurship because they imply high tax savings from offsetting losses in the early phase. Boadway and Tremblay (2005) offer a broad overview of the theoretical public finance literature on entrepreneurship and examine various rationales for policy intervention with respect to start-up entrepreneurship.

Apart from this public finance literature on entrepreneurship, there is little theoretical or empirical work on the effects of public policies on VC financed entrepreneurship. Exceptions are a couple of contributions by Poterba (1989a,b) and Gompers and Lerner (1998). These authors find some evidence of a moderately negative effect of the capital gains tax on VC investments and fund raising. Capital gains taxation tends to depress demand for VC by discouraging entrepreneurial entry. Since the entrepreneur's income from starting a firm mainly consists of capital gains earned in the start-up period, the capital gains tax makes VC backed entrepreneurship less attractive relative to dependent employment. The capital gains tax can also importantly affect contracts. Cumming (2005) found for Canada that a lower capital gains tax can significantly increase the use of convertible preferred equity. The capital gains tax can also hamper fundraising since investors' returns mainly consist of capital gains as well. In addition, Gompers and Lerner (1998) found that liberalization of pension fund investment regulations is an important source of new capital and can thereby stimulate the expansion of the industry. More recently, Da Rin, Nicodano and Sembenelli (2006) have found that the corporate capital gains tax hurts VC investments in Europe, in particular for early stage investments.

None of this empirical literature has actually been able to identify how taxes might change the relative performance of VC-backed compared to other firms by affecting the incentives of VCs to provide support and add value to their portfolio companies. Our own previous theoretical work has aimed to shed light on how exactly taxes as well as subsidies can affect the number of VC-backed firms and the incentives of entrepreneurs and VCs to exploit the full potential of these firms (see Keuschnigg, 2003, 2004a-b, and Keuschnigg and Nielsen, 2003a-b, 2004a-b).

The effectiveness of subsidies to capital and research investments of young firms has been investigated empirically by Lerner (1999) and Wallsten (2000), among others. These authors conclude that programs such as the Small Business Innovation Research (SBIR) program in the U.S. can significantly raise the growth of awardee firms compared to other matched firms. This superior performance was confined to awardees in areas with

substantial new firm creation. Wallsten found significant crowding out effects although he too argued that the program could help firms to attract additional private funding. The program might thus have a certification role in the sense that participation in the program makes firms more likely to attract additional venture financing.

This paper discusses the effects of taxes and subsidies levied at different stages of a firm's life-cycle. We explore how they impact on VC and bank financed investment and entrepreneurship. In particular, we examine subsidies representing the various investment grants, interest subsidies, and subsidies to capital expenditure in research and development which are prevalent in many countries. We explore the taxation of capital gains in new firms when sold off to new investors, the taxation of wages in an alternative occupation, and corporate income taxation. Our analysis indeed shows that a limited focus on the taxation of early stage firms cuts too short. The taxation of mature companies is as important for start-ups as the direct taxation of infant companies. Corporate and dividend taxes reduce entrepreneurship even though these taxes are typically paid only by mature companies rather than young ones. Indeed, Djankov et al. (2008) estimate that the impact of the corporate tax on aggregate investment occurs to a large extent on the entry (entrepreneurship) margin. The basic insight is that taxes which reduce the value of mature firms thereby diminish the gains from setting up new companies as well.

To organize the review of the literature, this chapter develops a small model of heterogeneous firms. The most profitable firms receive active VC financing on top of passive bank loans while the less profitable ones exclusively rely on bank financing. Investment levels are determined by the firms' financing capacity, i.e. their ability to raise external funds. The main results concern the effects of tax and subsidy policies. We show how they influence investment levels of different types of firms, how firms self-select into bank and VC financing, and how they affect start-up incentives and entry. For example, investment subsidies boost investment, firm values and entry. They also benefit to a larger extent the more profitable firms and, therefore, induce a larger share of start-ups to go for VC financing. Success taxes such as corporate tax or dividend and capital gains taxes

reduce the cash-flow and, thus, financing capacity and investment levels per firm. They also reduce firm value and entry, and they harm the more profitable VC backed firms relatively more so that a smaller fraction of start-ups ends up with VC support. The analysis also reveals that the type of investment incentives and the timing of tax liabilities over a firm's life-cycle are important. For example, subsidies given in a fixed amount are more attractive to companies with low investment returns while subsidies proportional to the investment scale favor the more profitable companies which invest at a larger scale.

Finally, alternative capital income tax systems have different implications for more and less profitable firms and, in turn, on the choice between VC and bank financing. The tax reform literature postulates two types of so-called 'investment neutral' corporate tax systems: a cash-flow tax allows for immediate expensing of investment but denies deduction of costs of finance such as interest expenses or imputed cost of equity. Such a system implies a high tax liability at the cash-flow stage when the return to investment accrues, and a low tax burden at the investment stage. In contrast, an ACE (allowance for corporate equity) allows for full deduction of the costs of finance but denies immediate investment expensing. Compared to a cash-flow tax, the tax burden is shifted from the late cash-flow to the early investment stage. First of all, we show that these 'investment neutral' tax systems are not neutral when the firms' ability to invest is restricted by their limited financing capacity. We then show that an ACE system favors highly profitable relative to less profitable firms. In consequence, this system induces a larger fraction of firms to go for VC financing, raises expected firm value at the start-up stage and encourages entrepreneurship relative to a cash-flow tax.

Section 2 a small model of VC and bank financing of heterogeneous firms. Section 3 reviews the empirical evidence on VC value added and illustrates the consequences for investment and entrepreneurship when the VC sector becomes more efficient. Section 4 turns to tax policy and compares the results of the present model to the insights of the existing literature. Section 5 discusses adverse selection and Section 6 shortly turns to other important areas of public policy. Section 7 summarizes.

2 A Model of Venture Capital and Bank Financing

What are the effects of taxation when the market for start-up financing is shared among banks and VC firms? There is some research to explain what determines entrepreneurs' choice between bank and VC financing, e.g. Ueda (2004) or Winton and Yerramilli (2006). Landier (2003) and Inderst and Mueller (2006) similarly discuss the special role of VC firms as compared to banks. None of these papers investigates how taxes might differentially affect bank and VC financed firms, market splitting among banks and VC funds, entrepreneurship and aggregate income. A first attempt is Keuschnigg and Nielsen (2005) who suggest a search model where VC backed firms earn excess returns over bank financed firms due to active VC support. Among all entrants, a segment of firms is matched (rationed) with a limited number of VC firms and earns excess returns. The remaining part is left with passive bank financing. Ex post, VC and bank financed firms are different, but all firms within each class are identical. In this chapter, we introduce a novel model of heterogeneous firms with variable investment where the more profitable firms go for more expensive VC financing while the less promising but still viable ones remain with bank financing. The model is a generalization of Tirole (2001, 2006) and Holmstrom and Tirole (1997) and merges this with a model of heterogeneous firms as pioneered in Melitz (2003). It offers a formal framework to discuss potential policy effects and to compare with the existing literature.

External Financing: Risk-neutral entrepreneurs are endowed with a single project which they can run at a variable scale. The sequence of events is: (i) entrepreneurs' entry decision; (ii) investment return v becomes known and firm chooses VC or bank financing; (iii) firm obtains external funds and invests; (iv) entrepreneur and VC choose effort; (v) firm succeeds or fails. Given limited own assets A , entrepreneurs raise external funds from VCs or banks to leverage investment I . After start-up, the return to investment $v \in [v_0, v_1]$ differs across firms, leading them to choose different financing modes. If successful, the venture yields an end of period return (cash-flow) vI that increases linearly

with investment. In case of failure, there is no return at all and investment must be completely written off. If the expected surplus per unit of investment is positive, firms wish to invest as much as possible until they exhaust their financing capacity. The firm's success probability depends on the entrepreneur's effort, yielding $p > p_L$ if effort is high. The VC's active role in the company can raise the success chances by q , reflecting the value added of VC financing and giving a total success probability of $p + q$. With bank financing, success depends only on the entrepreneur's effort.

The government subsidizes investment costs and claims part of the company's profit in case of success. The net present value of taxes paid over subsidies received is

$$\tau = [(p + q)t - s]I - z, \quad (1)$$

where z is a fixed and s a proportional investment subsidy and tI refers to profit taxes paid when the company reports a positive cash-flow. This tax is meant to include all success taxes such as corporate, dividend and capital gains taxes. When the company fails, the return is zero and no tax is paid.

When the company is able to obtain VC financing, it also takes additional bank loans to further leverage own capital. Returns per unit of investment are shared among stakeholders where a part v^m or v^b is reserved to repay VCs (index m for monitoring investor) and banks and a part t is claimed by government as a success tax. The entrepreneur collects the residual share v^e . The private surplus net of τ is divided according to $\pi = \pi^e + \pi^m + \pi^b$, or

$$\begin{aligned} \pi^e &= (p + q)v^e I - A, \quad v^e = v - v^m - v^b - t, \\ \pi^m &= (p + q)v^m I - cI - \kappa - I^m, \\ \pi^b &= (p + q)v^b I - [(1 - s)I - z - I^m - A], \\ \pi &= \rho I - \kappa + z, \quad \rho \equiv (p + q)(v - t) - c - 1 + s. \end{aligned} \quad (2)$$

Except for I , I^m and v , all parameters are constants. VCs not only contribute money in the amount of I^m , but also business advice and monitoring services which raise the

success probability by q . The monitoring and advising cost, $cI + \kappa$, consists of a fixed cost plus a term linearly rising with the investment scale. The fixed cost is incurred before investment and reflects the VC's initial cost of learning the details of the project.²

We assume perfect competition among financial intermediaries and a perfectly elastic supply of funds where the deposit rate is normalized to zero. There is no shortage of financial funds. The entrepreneur extracts the entire joint surplus π when intermediary profits are zero, $\pi^m = \pi^b = 0$. However, the financing constraints below limit the amount of external funds. When the VC gives a loan I^m , the firm requires an additional bank loan equal to the square bracket in (2), or $I - I^m - A$ in the absence of tax. If the investment return is large enough to yield a positive margin ρ , the entrepreneur obtains a surplus $\pi = \rho I - \kappa + z$ which increases linearly with investment. Hence, the firm raises external funds and expands investment until financing capacity is exhausted.

The firm's financing capacity reflects the pledgeable income available for repayment which depends on effort towards a high success probability. Once investment is sunk, the entrepreneur might prefer to consume 'private benefits' bI and accept a low success probability p_L , instead of focussing on the core business. Similarly, the VC firm might prefer to avoid the variable monitoring cost cI (after the initial cost κ is sunk) and get not sufficiently involved in the firm so that the success probability declines by q . In this situation of double moral hazard, both the entrepreneur and VC must have sufficient incentives to provide the required effort for a high success probability $p + q$. At this stage, investments I and κ are already sunk and profit shares are fixed. The incentive constraints for full effort are $pv^e \geq p_L v^e + b$ and $q \cdot v^m \geq c$ or

$$IC^e : v^e \geq \beta \equiv b / (p - p_L), \quad IC^m : v^m \geq \gamma \equiv c / q. \quad (3)$$

²Since advising and coaching is time intensive, the portfolio of VC firms compared to banks tends to be much smaller and more focussed. Kannianen and Keuschnigg (2004) have developed a theory of VC portfolio size where the quality of advice and VC support is traded off against the number of portfolio firms. Cumming (2006b) provides empirical evidence in support, and Keuschnigg (2004a) explores the tax consequences. These issues are beyond the scope of the present analysis.

The minimum shares necessary to guarantee the entrepreneur's and VC's contribution for a high success probability are, thus, $v^e = \beta$ and $v^m = \gamma$, respectively.³

Since monitoring services make VC more expensive than bank loans, bank credit is preferred. Hence, the firm cedes a minimum share $v^m = \gamma \equiv c/q$ to assure managerial advice and monitoring services. Given competition in investment financing, the VC is also asked for a loan and breaks even if

$$I^m = (p + q) v^m I - cI - \kappa = p\gamma \cdot I - \kappa. \quad (4)$$

To maximize own surplus, the firm attracts additional bank loans to expand investment. Given the VC's contribution, the entrepreneur accepts the minimum incentive compatible share β to maximize pledgeable income and, thereby, the firm's debt capacity. The bank lends as long as $(p + q)(v - t - \gamma - \beta)I \geq (1 - s - p\gamma)I + \kappa - z - A$, i.e. as long as pledgeable income is large enough to guarantee repayment. The right hand side is the required bank loan when the VC finances a part I^m . Assuming that pledgeable income grows slower than the need for bank loans, investment expansion will ultimately be bounded by the financing constraint, leading to an investment level of (use $q\gamma = c$)

$$I = \frac{1}{\theta} \cdot (A - \kappa + z), \quad 0 < \theta \equiv (p + q)\beta - [(p + q)(v - t) - c - 1 + s] < 1. \quad (5)$$

Suitable parameter restrictions are discussed in a separate technical Appendix. They imply $0 < \theta < 1$ so that own equity is leveraged with external financing to expand investment, $I > A - \kappa + z$.

Banks Versus Venture Capital: Not all firms might benefit from VC since the extra advising and monitoring services must be separately compensated, making VC more expensive. The alternative is to rely exclusively on a standard bank loan. In this case, the firm does not benefit from managerial support ($q = 0$) but also avoids the compensation

³We assume that the project is not viable and is not financed if incentive constraints were violated. This would always be the case if $p_L = 0$. Hence, we assume p_L to be low enough.

of consulting costs ($c = \kappa = 0$). The firm claims a minimum share β to maximize pledgeable income and boost its financing capacity. A lower index is introduced to refer to the source of finance. Without benefits and costs of managerial advice, the leverage factor and profit margin under pure bank financing are

$$\begin{aligned} \text{surplus} \quad \pi_b^e &= \frac{\rho_b}{\theta_b} (A + z) + z, & \pi_m^e &= \frac{\rho_m}{\theta_m} (A - \kappa + z) - \kappa + z, \\ \text{profit margin} \quad \rho_b &= p(v - t) - 1 + s, & \rho_m &= (p + q)(v - t) - c - 1 + s, \\ \text{leverage factor} \quad \theta_b &= p\beta - \rho_b, & \theta_m &= (p + q)\beta - \rho_m. \end{aligned} \quad (6)$$

Firms are heterogeneous with respect to investment returns. After start-up, returns are drawn from an interval $v \in [v_0, v_1]$. Knowing v , the firm chooses the financing mode. We generally assume taxes and subsidies to be small, i.e. close to zero. The following parameter restrictions, discussed in a separate Appendix, imply that (i) profit margins ρ_j are strictly positive; (ii) leverage factors $1/\theta_j$ are finite and larger than unity in the entire interval; and (iii) low return projects prefer pure bank financing while firms with very profitable investment opportunities opt for VC financing:

$$v > \beta, \quad q > pc, \quad \frac{p + q}{q} > \frac{A}{\kappa}. \quad (7)$$

After learning its investment productivity v , a firm opts for the financing mode which yields the larger surplus, $\pi_m^e \geq \pi_b^e$. At low realizations, bank financing is preferred, high return projects go for VC financing with additional bank credit. Over the entire range, the net present value always increases with project returns. There must thus be a single crossing of the profit lines and, at the point of indifference v_* when the two curves cross, the value under VC financing rises faster than under bank financing. Figure 1 illustrates.

The indifference condition $\pi_b^e(v_*) = \pi_m^e(v_*)$ yields $[(1 - s)q - cp](A + z) = (p + q)\theta_b\kappa$ which is further manipulated to obtain a closed form solution for the cut-off value

$$v_* = \beta + t + \frac{1 - s}{p} - \frac{(1 - s)q - cp}{(p + q)p} \frac{A + z}{\kappa}, \quad (8)$$

where v_* is, of course, in the admissible interval $[v_0, v_1]$. We limit attention only to small taxes and subsidies close to zero.

Entry: A priori, project returns are distributed with density $g(v)$ and an associated cumulative distribution function $G(v)$. To start a firm, an entrepreneur must irrevocably give up alternative income w . She is willing to do so if the expected net present value is large enough. Upon start-up, the company must anticipate the financing choice once it learns the project return. Expected net present value is, thus,

$$\bar{\pi}^e = \int_{v_0}^{v_*} \pi_b^e(v) \cdot dG(v) + \int_{v_*}^{v_1} \pi_m^e(v) \cdot dG(v) \geq w. \quad (9)$$

Obviously, everything that strengthens expected profit by allowing for a higher incentive compatible investment leverage encourages entry.

Fig. 1: Venture Capital vs. Bank Financing

3 The Value Added of Venture Capital

A firm's success rests on the entrepreneur's effort and due diligence (see the empirical results reviewed in Rosen, 2005). In addition, VCs add value by establishing contacts, giving strategic business advice, and generally helping in the professionalization of young

firms. There is substantial empirical evidence on the value added role of VCs. Hellmann and Puri (2002) show that VC backed start-ups in Silicon Valley are much faster in introducing stock option plans for high skilled personnel and in hiring a professional sales manager. Also, the presence of a VC makes it more likely that the entrepreneur is replaced by a professional CEO from outside if her lack of managerial abilities turns out to be an impediment to the firm's rapid growth. The VC's influence is particularly strong in the early phase of business development when the informational problems are the largest, but becomes insignificant later on when the firm has successfully matured. Hellmann and Puri (2000) show that VC-backed firms introduce more radical innovations and pursue more aggressive market strategies compared with other start-ups. For example, once a VC joins the firm and provides finance, the probability of introducing the new product on the market jumps up by a factor of more than three!

Part of this superior performance of VC backed firms might result from VCs being able to locate the more profitable firms than banks. In line with the theory of the preceding section, the empirical work of Sorensen (2007) implies that selection and value added effects are simultaneously important. He finds important sorting effects in the sense that the most experienced investors get the best deals. The probability of success of a firm financed by the most experienced investor in his sample is 39 pct which compares with only 15 pct of firms financed by the least experienced investors. These findings are in line with Bottazzi, Da Rin and Hellmann (2007) or Gompers, Kovner, Lerner and Scharfstein (2006) who emphasize human capital of VCs, showing that more experienced VCs are significantly more involved with their portfolio companies and are able to generate larger returns on exit. The results hold when controlling for sorting effects. Sorensen (2007) calculates that sorting (the best investors getting the best deals) explains 58 pct of this increase in success probability while the investor's influence explains 42 pct.

Apart from investor experience, the productive contribution of VCs to business growth also rests on the existence of appropriate incentives on the part of the financier. Indeed, the empirical evidence on the impact and value added of VC is less clearcut in Europe

than in the U.S. (see Bottazzi and Da Rin, 2002, for a skeptical view while Audretsch and Lehmann, 2004, arrive at a more positive picture). Finance theory has addressed VC incentives in terms of a double-sided moral hazard problem, where both the entrepreneur and VC must exert effort in the company (see Holmstrom, 1982; Aghion and Tirole, 1994; Casamatta, 2003; Inderst and Mueller, 2004; Repullo and Suarez, 2004; Schmidt, 2003; and our own previous work mentioned above).

To illustrate the importance of the value added function, we investigate in the model of Section 2 the consequences of VCs getting more experienced and efficient. With the same monitoring cost, advice increases the success probability to a larger extent, by $dq > 0$. The Appendix of this chapter linearizes the model and derives comparative static results.⁴ A more active style of VC financing raises the firm's success probability and, in turn, pledgeable income and debt capacity. Firms are thus able to expand investment by leveraging own equity to a larger extent (see A.5). VC backed firms become larger than those relying on exclusive bank financing. The value added of VC financing boosts performance of VC backed relative to bank financed firms. These firms would be larger anyway because they are the more profitable ones, but they grow even larger on account of VC support. Much of the extra investment financing comes from additional bank lending rather than borrowing from VCs. To see this, we compute the change in $I^m = (pc/q)I - \kappa$ in (4) and get $dI^m = -\frac{pc}{q}I \cdot \hat{q} + \frac{pc}{q} \cdot dI$ which is, in fact, ambiguous. Given an unchanged monitoring cost, it becomes cheaper to incentivize VCs when they are more productive. They get a smaller share $\gamma = c/q$ per unit of investment which also restricts their financial contribution. On the other hand, when the firm's total investment is larger, VCs also lend a larger amount. However, this does not cover the total need for increased external funding, so that bank lending $dI - dI_m = \frac{pc}{q}I \cdot \hat{q} + \frac{q-pc}{q} \cdot dI$ clearly increases since $q > pc$. This relates to the certification role of VCs, i.e. the presence of a VC raises the firms' pledgeable income and allows them to borrow more from banks. When VCs become more

⁴The hat notation, e.g. $\hat{q} \equiv dq/q$, indicates percentage changes relative to values in the initial equilibrium. As an exception, we use absolute changes, e.g. $\hat{t} \equiv dt$, $\hat{s} \equiv ds$ and $\hat{z} \equiv dz$, for small policy variables which are initially zero.

productive, this certification role is emphasized.

When VC value added as reflected in q gets larger, the expected surplus of a VC backed firm rises since both the profit margin as well as the leverage factor increase in q . As a result, the cut-off return v_* declines, see (A.8). Since a more active style in VC financing (higher q) benefits only VC backed firms, it shifts up the π_m^e -line in Figure 1, leading to a lower cut-off return. A larger share of start-ups prefers VC financing. At start-up stage, when the subsequent financing choice is anticipated, the expected value of a new firm in (9) also rises which strengthens incentives for entry. Note that a small variation of the cut-off value has no impact on expected value since the discrete financing choice implies $d\bar{\pi}^e/dv_* = [\pi_b^e(v_*) - \pi_m^e(v_*)]g(v_*) = 0$. Only the direct effect of more valuable VC support is important which is relevant only for VC backed firms. Expected profit ex ante, before the investment return is realized, changes by

$$d\bar{\pi}^e = \int_{v_*}^{v_1} \frac{\partial \pi_m^e(v)}{\partial q} dG(v) \cdot dq.$$

Prior to learning its project return, a firm always has some chance that it's innovation turns out to be very profitable and suitable for VC financing. Using the elasticity in (A.7) and dividing by w ($= \bar{\pi}^e$ if free entry with zero profits, thus $\hat{\pi}^e \equiv d\bar{\pi}^e/w$) yields

$$\hat{\pi}^e = \int_{v_*}^{v_1} \left[\frac{1}{\rho_m} + \frac{v - \beta}{v\theta_m} \right] vq \frac{\rho_m I_m}{w} dG(v) \cdot \hat{q}. \quad (10)$$

Via ρ_m , I_m and θ_m , the integrand depends on the return v . A more productive VC industry not only leads to a larger share of start-up firms to opt for VC financing (selection effect, v_* falls), but also encourages entry in general (level effect, $\bar{\pi}^e$ rises which attracts new entrants). The performance of VC backed relative to bank financed firms rises.

4 Tax Policy and the Venture Capital Sector

The life-cycle of a young firm involves a typical sequence of events. The government defines a policy environment. From the perspective of the entrepreneur, starting a firm

is an occupational choice problem. Entrepreneurship is worthwhile only if it promises a higher expected present value of income than an employed career. Starting a company typically requires some early ‘seed investment’ to turn the idea into a project and develop a business plan which can be presented to a financier. Often, this limited seed investment is financed from own resources, family, business angels etc.⁵ When the project is innovative and the firm’s investment promises high returns, own equity is typically far from sufficient to finance expansion investment and fully exploit the growth potential. The firm must thus approach an external investor. However, the entrepreneur typically needs more than just money. Experience at this stage is often mainly with technical product development rather than the management of a growing company. The firm thus needs both money and managerial advice and will ideally be able to enlist VC financing. Experienced VCs can help with industry experience, managerial know-how, a network of contacts and can give strategic business advice. On the other hand, VC is more expensive than standard bank financing since the monitoring and advising services must be compensated, and is thus suitable only for the most profitable projects. When expansion investment is successful, and the firm’s product is successfully launched, the returns to investment materialize and give rise to profits. As the firm enters this more mature stage with access to standard market finance. At this point, it can be sold to new investors, possibly in an IPO on a stock market for young technology companies. The VC firm typically divests and entrepreneurs often realize part of their stake.

Public policy influences private decisions at different stages of the firm’s life-cycle. The relative tax burden on labor compared to cumulative capital income tax, consisting of the present value of corporation, dividend and capital gains taxes, affects incentives for entrepreneurship and determines the rate of business creation. The amount of external finance needed is reduced by investment subsidies. Such subsidies are offered by numerous government programs, such as direct investment tax credits paying for part of the

⁵In the model of section 2, the VC’s fixed cost κ of investigating the project could equivalently be interpreted as an early seed investment of the entrepreneur. After self-financing of seed investment, the firm is left with own assets $A - \kappa$ to finance expansion investment.

investment cost, subsidized interest for small businesses, credit guarantees etc. Public credit guarantees, at a cost to the government in case of failure, allow banks and investors to charge lower interest than would otherwise be possible.

When firms successfully mature to production stage, they start to earn positive profits that are subject to corporation tax and, when distributed to private investors, dividend and capital gains tax. The corporate tax together with depreciation rules and other provisions in the tax base such as interest deductibility, immediate write-offs, tax treatment of research expenditures etc. influence the further growth of mature firms. The capital gains tax kicks in and cuts into the privately earned gains during the start-up period when the entrepreneur sells of part of her stake. These taxes subtract from cash-flow and pledgeable income and thereby reduce firms' investment scale by reducing their ability to raise external funds. Success taxes all reduce the private value of companies, independent of their implications for the scale of investment. Although not paid during the start-up period but only much later, they have an important negative impact on start-up activity and incentives in the early stage of business development. All these taxes reduce the company value which can be expected when starting a business and putting in effort to enhance survival chances. It's not only the capital gains tax which is relevant for venture capital backed entrepreneurship. We now discuss the principal policy impact in the context of the theoretical model of Section 2 and relate the results to the existing literature.

4.1 Wage Tax

The rate of business creation depends on the expected capital income by starting one's own firm relative to the entrepreneurs' alternative career prospects. For this reason, wage taxation is quite relevant for start-up activity as the empirical literature mentioned in the Introduction emphasizes. The wage tax exclusively influences the occupational choice decision. In reducing the opportunity cost of entrepreneurship w in (9), it stimulates entry and business creation. If a high tax load on labor relative to capital income, as in countries with a dual income tax such as the Nordic countries, strongly boosts entrepreneurship, new

firms might possibly start to compete down prices in their specialized market segments so that the return to investment v declines. The tax might thus discourage investment and the net present value of young firms. If firms are finance constrained, this reduction in investment scale is welfare reducing because, being constrained, investment is too low in private equilibrium. Simply pushing agents into entrepreneurship might not be a good policy because it would only lead to more start-up firms but a smaller scale of them. If this happened, more entrepreneurship would reduce efficiency and welfare because investment tends to be too low already in the untaxed market equilibrium.⁶

The mirror image of this result is that low capital income taxes increase entrepreneurship. However, part of it may only be motivated to convert highly taxed labor income into lightly taxed capital income (Gordon, 1998, Crawford and Freedman, 2007, and Egger, Keuschnigg and Winner, 2008). This income shifting has led to substantial losses in tax revenue in some Nordic countries with a dual income tax regime (Soerensen, 2005). However, tax shifting may be less of a problem with innovative, VC backed firms in search of large growth opportunities.

4.2 Success Taxes

Profit or success taxes include corporate taxes, dividend and capital gains taxes. They all have in common that they reduce the cash-flow or income that are created by successful investment. In a purely neoclassical model of the firm, taxes impair investment because they reduce the return to investment. In the model of Section 2, this channel is, in fact, excluded because the return to investment v results upon drawing from a return distribution and is exogenously given thereafter. In line with substantial empirical evidence, tax effects operate entirely by their impact on financing constraints. The level of investment per firm depends on two measures, the amount of equity or own assets A , and the amount of pledgeable income available for incentive compatible repayment of external funds. The novel channel for tax effects in the present model is that success taxes reduce pledgeable

⁶The welfare implications are discussed more extensively in the next subsection.

income. They thereby reduce the financing capacity and the firm's ability to expand investment by raising more external funds. We thus find in (A.2) and (A.5) that the tax reduces the investment scale of VC and bank financed firms by $\hat{I}_m = -((p+q)/\theta_m) \cdot \hat{t}$ and $\hat{I}_b = -(p/\theta_b) \cdot \hat{t}$, respectively. An increase in the tax t per unit of capital, where tI_j is the total tax paid by a firm of type j , depresses VC backed investment more severely than bank financed investment since the success probability $p+q$ and the leverage factor $1/\theta_m$ are higher with VC financing. Similarly, within each group, the tax is relatively more harmful to more profitable firms which are those with a larger leverage.

Clearly, success taxes reduce firm values under either financing mode, see (A.4) and (A.7) or $\hat{\pi}_b^e = -(1/\rho_b + 1/\theta_b) (\rho_b I_b / \pi_b^e) p \hat{t}$ and $\hat{\pi}_m^e = -(1/\rho_m + 1/\theta_m) (\rho_m I_m / \pi_m^e) (p+q) \hat{t}$, respectively. The explicit solution in (A.8) implies that the value line for VC financing is shifted down in Figure 1 to a larger extent compared to pure bank financing. Consequently, the pivotal investment return rises. Success taxes thus discriminate against VC financing so that, in the end, fewer firms demand VC. Finally, since the tax reduces the value of all types of firms, it clearly diminishes expected value $\bar{\pi}^e$ of a start-up company upon entry before the profitability of investment is revealed. Extracting a larger net present value of taxes from firms relative to the tax load on alternative activities clearly reduces incentives to start new firms. Success taxes discourage business creation and entrepreneurial entry.

Success taxes are particularly damaging and have first order negative welfare effects even with small tax rates. To see this, note that the social surplus of bank and VC financed firms is equal to $\pi_b = (pv - 1) I_b$ and $\pi_m = ((p+q)v - c - 1) I_m - \kappa$, respectively. Given positive profit margins (see the discussion of 7), a larger investment scale would yield a strictly positive social surplus at the margin but is not possible in private equilibrium due to finance constraints. Hence, if policy tightens finance constraints and thereby reduces the investment scale, welfare must fall since investment is already too low in private equilibrium. In making finance constraints more tight and thereby reducing investment, success taxes impose first order welfare losses.

This welfare result is in parallel to the results in our previous own research (see the review in Keuschnigg and Nielsen, 2006, and the specific results in Keuschnigg and Nielsen, 2003a-b and 2004a-b). In line with a large part of the theoretical VC literature, we have included variable effort by the entrepreneur and VC but a fixed investment size. In this work, underinvestment is reflected in too little entrepreneurial effort and VC advice and, therefore, overly high rates of business failure. By way of contrast, the present model treats effort as a discrete all or nothing decision so that it is not variable at the margin. Underinvestment is thus not reflected in effort but rather in the scale of investment as determined by the financing constraint. While there is not much empirical evidence on differences in effort and success rates across VC backed and comparable other firms, the empirical literature clearly suggests that VC backed firms are able to raise more capital which points to the certification role of VC as in this paper. The policy conclusions are, however, broadly consistent and qualitatively the same in both frameworks.

Corporate Tax: A particularly important among success taxes is the corporate tax. All in all, the tax might reduce economic efficiency on three fronts. First, by discouraging mature firm investment after the exit of a VC,⁷ the tax reduces private firm value by more than it adds to the present value of tax revenue. The corporate tax thus involves an excess burden or deadweight loss like any other tax which discourages private activity. The impact of the tax on size and value of mature firms depends importantly on depreciation allowances and other deductions as well. Second, the tax burden gets capitalized in the firm value. In reducing mature firm value, the corporate tax is likely to magnify financing frictions during the start-up and expansion phase considered here. By reducing the financing capacity and early expansion investment, the corporate tax leads to a first order welfare loss since investment scale is already too low in the market equilibrium. This first order welfare loss is much more severe than the tax distortion of mature firm investment which results only in a second order welfare loss and would thus disappear

⁷The investment return vI might itself depend on what happens after successful completion of the start-up phase and exit of a VC.

for small taxes. Third, given the above average innovation potential of young VC backed firms, the loss in aggregate innovation will not be made up by increased innovation of established firms. By its negative effect on firm creation, the corporate tax is likely to reduce the rate of innovation and economic growth. In view of the knowledge spillovers created by new firms, entry of young innovative firms might be too low even in the absence of taxes. If there are important external effects from private innovation activity, the tax again reinforces a preexisting market distortion and is therefore particularly harmful. There are thus two additional reasons which raise the cost of the corporate tax beyond the usual deadweight loss that is associated with other taxes as well. In consequence, the effects of the corporate tax on VC backed innovative entrepreneurship are particularly harmful.

Dividend and Capital Gains Taxes: At the investor level, corporate income can accrue either as dividends or capital gains and is subject to personal taxes. A young growth company, be it VC financed or not, will typically not pay dividends during the start-up phase since cash-flow, if there is one at all, will be needed to finance further investment before acquiring additional external financing. Once firms have survived to a mature production stage and have accumulated a large enough capital stock, they will start paying dividends. Dividend payments are typically observed only at a more mature stage when the VC firm has already exited by means of an IPO, management buy back or sale to another firm. The fact that start-up firms are usually not paying dividends does not mean, however, that dividend taxation wouldn't be relevant for their performance. Quite to the contrary. Capitalization of dividend taxes paid during the mature stage reduces firm values, irrespective of whether there is any impact of dividend taxes on mature firm investment or not.⁸ Lower firm value reflects a reduced cash-flow which can

⁸There is an unresolved debate about whether mature firms, in response to dividend taxes, reduce investment or not (new versus old view of dividend taxation). A general consensus seems to be that dividend taxes do not distort investment of large, mature firms which can finance their investments fully with retained earnings, but they reduce investment by young and growing firms. This is precisely what

be distributed to the stakeholders of the company, thereby reducing pledgeable income, debt capacity and investment at earlier stages, and eventually reduces entrepreneurship. Except for the potentially different impact on value and size of mature firms, the effects on business creation and investment in the start-up phase are qualitatively similar to the corporate tax.

The capital gains tax is generally believed to be the most relevant tax impediment to VC financed investments, the reason being that the return to investment both to entrepreneurs and VC firms mostly accrues in form of capital gains during the start-up period. It would be seriously incomplete, though, to limit attention only to the capital gains tax. The size of the capital gains is determined by the value that is realized when the VC firm divests, by IPO, acquisition, buy back or write-off. The value of the firm at this stage depends on future profits net of taxes if the company didn't fail already before the transition to the mature state. Since corporate and dividend taxes are capitalized into firm value, they reduce the capital gains that can possibly be created during the start-up phase. The focus in the VC literature on the capital gains tax is too narrow.

So far, we have assumed full loss offset in capital income taxation. The consequences of incomplete loss-offset are analyzed by Keuschnigg and Nielsen (2003b) in a model of fixed investment and variable effort. In the present context, one can anticipate two consequences. First, a restriction in loss offset raises the effective tax burden and should thus reduce entry. And second, loss offset limitations make failure more costly and could strengthen incentives, making it cheaper to incentivize the entrepreneur and thereby strengthening pledgeable income and financing capacity.

A lower capital gains tax might stimulate fund inflows by individual investors but less by tax exempt institutions such as pension funds. The empirical literature (Poterba, 1989a,b, and Gompers and Lerner, 1998) finds that the capital gains tax mainly affects entrepreneurial entry rather than fund inflows. Our theoretical framework thus starts from the presumption that fund raising is not a limiting factor. In fact, there might be

our framework implies for VC financed growth companies.

too much money chasing too few attractive investments (Gompers and Lerner, 2000). If at all, VC financing is probably constrained by the possible shortage of management skills and entrepreneurial know-how required in VC investing (Bottazzi et al., 2007, or Gompers et al. 2006), rather than a shortage of financial funds.

4.3 Subsidies to the Cost of Capital

Many policies to encourage business creation include direct subsidies to investment spending. In the U.S., empirical research on the Small Business Innovation Research (SBIR) has shown that grants significantly raise the growth of awardee firms compared to others (see Lerner, 1999, and his review in 2002). Wallsten (2000) found significant crowding out effects although he too argued that the program could help firms to attract additional private funding. Our theoretical model shows indeed that investment subsidies raise investment by helping firms to raise more external funds from outside investors and also points to the fact that the impact might systematically differ across different types of firms. Investment subsidies are either given in a fixed absolute amount z or as a fraction s of the chosen investment level. Both types of subsidies boost investment of all firms, although with different impact. A flat subsidy z acts like an increase in own equity but has no impact on investment multipliers $1/\theta_j$. By (A.2) and (A.5), it triggers a proportional increase in investment, $\hat{I}_m = \hat{z}/(A - \kappa) > \hat{I}_b = \hat{z}/A$. The fixed cost associated with VC financing uses up part of own assets and thereby reduces the amount of external borrowing by VC backed firms. Hence, the percent increase in investment is larger for VC backed compared to bank financed firms. Further, the absolute increase in investment, $dI_b/dz = I_b(v)/A = 1/\theta_b(v)$, is larger for more profitable firms which are leveraged to a larger extent. The same holds for VC backed firms which are similarly heterogeneous in their investment returns.

A proportional investment subsidy magnifies the leverage factor by $\hat{\theta}_j = -\hat{s}/\theta_j(v)$, and thereby investment by $\hat{I}_j = -\hat{\theta}_j$, where $j \in \{b, m\}$. A higher return reduces the factor θ at rate $p + q$ for VC backed companies, compared to p for bank financed firms. Hence,

a proportional investment subsidy not only has a relatively larger impact on VC backed relative to bank financed firms. Different from a flat subsidy, it boosts investment of more profitable firms to a larger extent also within each class. Hence, in general, a proportional subsidy favors investment of more profitable companies relatively more. Intuitively, since the best companies invest at a much larger scale, a proportional subsidy also subsidizes them to a larger extent compared to smaller, less profitable firms.

VC backed firms benefit more. The subsidies thus reduce the cut-off value v_* and induce more firms to demand VC support. Independent of this selection effect, the subsidies raise the net present value of both types of firms. From (A.4) and A.7),

$$\hat{\pi}_j^e = \left(\frac{1}{\rho_j} + \frac{1}{\theta_j} \right) \frac{\rho_j I_j}{\pi_j^e} \left[\hat{s} + \frac{1}{I_j} \cdot \hat{z} \right], \quad (11)$$

where $\pi_b^e = \rho_b I_b$ and $\pi_m^e = \rho_m I_m - \kappa$ in an initial untaxed equilibrium. Within each class, the investment scale I_j increases with a firm's profitability. The square bracket thus shows that the value of a flat subsidy becomes relatively less important for more profitable firms while an ad valorem subsidy is given in proportion to the investment level and, thereby, favors the highly profitable firms to a larger extent. Since a subsidy boosts profits of all types of firms, it also raises the expected value $\bar{\pi}^e$ prior to the productivity draw as given in (9) and thereby clearly encourages firm entry and business formation.

4.4 Revenue Neutral Policies

All of the isolated policies considered up to now either increase or decrease the present value of net tax revenue per firm. We have also emphasized the fact that one and the same policy change can have rather different effects on different types of firms as distinguished by their investment productivity. In the following, we discuss two policy strategies that keep the net present value of tax revenue constant and yet favor the most productive VC backed companies at the expense of less profitable bank financed firms.

Flat versus Proportional Subsidies: In reality, investment subsidies differ in non-trivial form. Some subsidies are limited to a maximum amount per firm and are independent of investment scale, others are strictly proportional. Suppose now that the government replaces flat by proportional investment subsidies in a way that keeps tax revenue constant. The net present value of a specific firm's tax liability is given in (1) and yields an aggregate value of net tax payments equal to $T = \int_{v_0}^{v_*} \tau_b(v) dG(v) + \int_{v_*}^{v_1} \tau_m(v) dG(v)$. The policy raises s and reduces z , starting from values of zero, in a way that keeps tax revenue unchanged, $\hat{T} = dT = 0$, or

$$\hat{T} = -\bar{I} \cdot \hat{s} - \hat{z} = 0, \quad \bar{I} \equiv \int_{v_0}^{v_*} I_b(v) dG(v) + \int_{v_*}^{v_1} I_m(v) dG(v). \quad (12)$$

Denote the average investment level per firm by $\bar{I}$. Shifting investment incentives from flat to propotional subsidies thus requires $\hat{z} = -\bar{I} \cdot \hat{s}$. Using this in (A.2) and (A.5) and noting $I_b = A/\theta_b$ and $I_m = (A - \kappa)/\theta_m$ yields

$$\hat{I}_b = (I_b - \bar{I}) \frac{1}{A} \cdot \hat{s}, \quad \hat{I}_m = (I_m - \bar{I}) \frac{1}{A - \kappa} \cdot \hat{s}. \quad (13)$$

Clearly, the suggested policy affects firms rather differently. In particular, note that the leverage factor for VC backed firms rises rapidly for the best projects with a return near the upper bound. These firms clearly invest more than average, $I_m > \bar{I}$, and will correspondingly benefit from the policy. One can show that at the cut-off value v_* , investment levels are $I_b(v_*) > I_m(v_*)$ since the fixed cost of VC investing reduces the investment scale. We can thus not prove whether marginal firms near the cut-off return are above or below average. Since the least profitable firms clearly choose bank financing, one can safely assume that firms with a return near the lower bound invest below average, $I_b(v) < \bar{I}$, and therefore loose from the policy. To sum up, shifting investment incentives from flat to proportional subsidies favors the largest, most profitable, VC financed firms and discriminates against the smallest bank financed companies.

Similar conclusions are obtained when inspecting the impact on firm values. Substituting the policy into (A.4) and (A.7) yields

$$\hat{\pi}_b^e = (I_b - \bar{I}) \left(\frac{1}{\rho_b} + \frac{1}{\theta_b} \right) \frac{1}{\bar{I}_b} \hat{s}, \quad \hat{\pi}_m^e = (I_m - \bar{I}) \left(\frac{1}{\rho_m} + \frac{1}{\theta_m} \right) \frac{\rho_m I_m}{\pi_m^e} \frac{1}{I_m} \hat{s}. \quad (14)$$

As before, the policy favors the most profitable, VC backed firms with the highest investment scale and harms firms with very low returns which are most likely bank financed. For the same reason as before, we cannot show how profits of pivotal firms in either financing mode are affected. It is thus not possible to determine whether the policy induces more firms to opt for VC financing or not. Given that firm values increase for both types of firms, expected value $\bar{\pi}^e$ ex ante also rises which makes start-up entrepreneurship more attractive.

Fundamental Tax Reform: The general tax reform literature recommends two rivaling concepts of “investment neutral” tax systems: cash-flow taxes as proposed in the Meade Report (1978), Hall and Rabushka (1985), or the U.S. President’s Panel (2005), among others. The rivaling concept is the allowance for corporate equity (ACE), pioneered by Boadway and Bruce (1984) and introduced into the tax reform debate by the IFS Capital Taxes Group (1991). The choice between cash-flow versus allowance for equity is again on the agenda of the current Mirrlees review for tax reform.⁹ These alternative proposals for investment neutrality are generally thought to be equivalent and to give rise to the same present value of tax burden and tax revenues, see e.g. Bond and Devereux (2003). It is also acknowledged that the two concepts, while equal in present value terms, differ in terms of the timing of tax payments. The cash-flow tax gives immediate tax relief to current investment but denies any deduction of the costs of financing (no deductions of interest on debt or of imputed cost of equity). Hence, tax liability is low at the early investment stage and high when the firm earns the cash-flow from successful investment. The cash-flow tax is back loaded and shifts the tax burden into the future. In contrast, the ACE tax with an allowance for the cost of financing at the cash-flow stage (deduction of interest on debt and of imputed cost of equity) but no deductions at the investment stage shifts the tax burden to the present and is front loaded. In a purely neoclassical investment model with perfect information, the timing of tax burden is irrelevant. We now

⁹Ongoing research under the Mirrlees Review commissioned by the editorial team can be accessed under www.ifs.org.uk/mirrleesreview/index.php.

show that the timing of tax liability becomes very important in a world with financing constraints. In particular, moving from a cash-flow to an ACE system strengthens the financing capacity of the most profitable firms and favors VC financing.

Consider now a marginal, revenue neutral move from an ACE to a cash-flow tax system which shifts a firm's tax liability from the early investment stage (reduce s) to the late cash-flow stage (raise t). To implement this policy package, we first define the average success probability over all bank and VC financed firms,

$$\bar{p} \equiv \left[p \int_{v_0}^{v_*} I_b(v) dG(v) + (p+q) \int_{v_*}^{v_1} I_m(v) dG(v) \right] / \bar{I}, \quad p < \bar{p} < p+q, \quad (15)$$

where $\bar{I}$ is defined in (12). Clearly, this average success probability is an endogenous concept, depending on firms' selection into bank and VC financing and on investment scales of different types of firms. In computing the change in aggregate tax revenue as before, we again start from an untaxed position (reducing tax base effects) and find, after substituting from (A.1),

$$\hat{T} = \bar{I} \cdot (\bar{p} \cdot \hat{t} - \hat{s}) = 0 \quad \Leftrightarrow \quad \hat{s} = \bar{p} \cdot \hat{t}. \quad (16)$$

To mimick the move from an ACE to a cash-flow tax in a revenue neutral way, we raise the success tax by $\hat{t}$ (denying a deduction for costs of finance raises the tax liability in the cash-flow stage), and allow for a proportional investment subsidy in the amount of $\hat{s} = \bar{p} \cdot \hat{t}$ (moving to a cash-flow tax with immediate expensing reduces the tax liability at the investment stage). Although the government abstains from taxing more or less in the aggregate, this self-financed policy change has non-trivial consequences. Consider the investment responses in (A.2) and (A.5), leading to $\hat{I}_b = [\hat{s} - p \cdot \hat{t}] / \theta_b$ or

$$\hat{I}_b = \frac{\bar{p} - p}{\theta_b} \cdot \hat{t} > 0, \quad \hat{I}_m = -\frac{p + q - \bar{p}}{\theta_m} \cdot \hat{t} < 0. \quad (17)$$

Clearly, replacing an ACE tax with a cash-flow tax shifts the tax burden from the investment to the cash-flow stage and thereby discriminates against investment of the most profitable firms which tend to be VC financed, in favor of the least profitable firms which

are bank financed. The discrimination against the more profitable VC backed firms is also reflected in the relative changes in firm values in (A.4) and (A.7), giving $\hat{\pi}_b^e > 0 > \hat{\pi}_m^e$,

$$\hat{\pi}_b^e = (\bar{p} - p) \left(\frac{1}{\rho_b} + \frac{1}{\theta_b} \right) \cdot \hat{t}, \quad \hat{\pi}_m^e = -(p + q - \bar{p}) \left(\frac{1}{\rho_m} + \frac{1}{\theta_m} \right) \frac{\rho_m I_m}{\pi_m^e} \cdot \hat{t}. \quad (18)$$

Obviously, this also holds for the pivotal firm with return v_* . By shifting up in Figure 1 the value line for bank financed projects and shifting down the line for VC backed firms, the policy raises the pivotal investment return and, thereby, discourages firms to demand VC. Evaluating (A.8) yields

$$\hat{v}_* = \left[p - \bar{p} + \frac{A}{\kappa} \frac{q}{p+q} \bar{p} \right] \frac{1}{pv_*} \cdot \hat{t} > 0. \quad (19)$$

Since $p < \bar{p} < p+q$, the sign is guaranteed to be positive. The square bracket is $(A - \kappa) q / \kappa$ and, thus, positive when $\bar{p} = p+q$, and it is $\frac{A}{\kappa} \frac{q}{p+q} p$ when $\bar{p} = p$. Hence, moving from a cash-flow to an ACE system (reduce t and raise s) makes the tax system more front loaded by shifting the tax burden from the late cash-flow to the early investment stage. This policy favors investment and firm values of the more profitable VC backed companies at the expense of less profitable ones and, thereby, leads more firms to demand VC financing. An ACE system should thus be more conducive to the expansion of the VC industry. Since the expected values of bank and VC financed firms are affected in opposing ways, it remains unclear whether the policy boosts entry.

A revenue neutral policy that cuts success taxes and finances the revenue losses with a reduction in upfront investment subsidies then favors VC backed companies but harms bank financed firms. In earlier work (see Keuschnigg and Nielsen, 2004a-b, for example), we have assumed a fixed investment scale of firms but allowed entrepreneurial and VC efforts to vary continuously, leading to an endogenous success probability p . The impact of VC support was not on external funding and investment leverage but rather on the success probability of firms. In that framework, both efforts were found to be too low, and failure rates too high, since both the VC and entrepreneur had to bear the full cost of managerial and advising effort but were entitled to only part of the returns. In the present model, investment is too low due to finance constraints. Both formulations have in common

that a reduction in success taxes financed by a reduction in upfront subsidies favors VC backed companies even if the net present value of tax revenues remains unchanged.¹⁰ A low tax burden late in the firm's life-cycle either increases the reward to effort and, thus, raises firms' survival chances, or it raises the financing capacity and boosts investment scale. The reform could thus contribute to a more active or a larger VC industry without throwing more money at it. The key rationale for this policy is not to stimulate entry, but to sharpen incentives and raise pledgeable income. Keuschnigg (2004) showed how the policy could give rise to knowledge spillovers and boost innovation based growth.

5 Selection Versus Value Added

The suggested front-loading should favor VC backed over bank financed firms. Note that $p < \bar{p} < p + q$ in our model. Comparing (16 and A.1) shows that the present value of tax payments falls for VC backed and rises for bank financed firms. Since it remains unchanged on average, the policy has not a clear-cut effect on entry. However, more start-up activity is probably not desired. For entirely different reasons, the literature based on De Meza and Webb (1987), or De Meza (2002) for a more recent statement and the evidence discussed and presented in Cressy (1996, 2002) and Parker (2003), argues that entry should actually be actively discouraged since entrepreneurship might be too high when there is cross-subsidization from good to bad firms in bank financing. Firms are probably very heterogeneous with respect to their success probability and/or value created (De Meza and Webb, 1999).

Cross-subsidization occurs when banks cannot easily distinguish between high and low quality firms. While entrepreneurs might be fully aware of the quality and success chances, a bank might have difficulties to judge from outside what the potential of a new firm without past track record really is. Banks thus tend to offer uniform financing

¹⁰In earlier work, we have exclusively concentrated on VC financing and have not discussed any selection effects between bank and VC financed firms.

conditions to heterogeneous firms and might be unable to prevent cross subsidization in their credit portfolio. Lending conditions are then too unattractive to the very best firms, but too favorable for low quality firms. As a result, credit conditions allow entry of less able entrepreneurs who would not get financed if banks had a chance to correctly assess individual risk. If a correct risk assessment of young firms without track record is not possible from outside, the bank makes a loss while the marginal entrepreneur just breaks even. In consequence, the net present value of the venture is negative from a social perspective. Policy should be concerned to reduce entry rather than encourage it. From a normative perspective, the literature has argued for interest taxes and other measures to increase the cost of capital, rather than start-up subsidies. Interpreted in the light of the framework of the preceding section, the net present value of taxes on the company and investor level should be positive and exceed the wage tax burden to discourage entry.

The recent synthesis and generalization of the literature based on Stiglitz and Weiss (1981) and De Meza and Webb (1987) by Boadway and Keen (2005), see also the discussion of Boadway and Tremblay (2005), makes the point that firms differ not only in one but possibly in several dimensions with no clear correlation pattern of success probabilities and returns of different types. In not being able to distinguish different firm types, banks will again offer uniform credit conditions. However, with heterogeneity in several dimensions such as survival probabilities or market potential, uniform bank lending does not give rise to a clear cut pattern of cross-subsidization, or only in rather special cases (one being the DeMeza-Webb framework). To cut a long discussion short, the implication is that bank financing leads to excess lending and overinvestment of some types of firms while lending would be too restrictive and entrepreneurial investment too low in other types of new ventures. Clear cut policy recommendations are no longer possible. If banks are unable to distinguish heterogeneous firms, government is expected to be even less able to differentiate. As a default rule, tax policy should arguably remain neutral towards the entry margin. Other reasons such as knowledge spillovers might still call for a policy to encourage entry of more innovative firms.

Keuschnigg and Nielsen (2008) have analyzed issues of adverse selection in a model of VC financing. Apart from the potential cross-subsidization in VC portfolios, the paper also shows how convertible securities are useful to induce desired self-selection of entrepreneurs, see Cumming (2006a) for empirical results in this direction. Compared to banks, VC firms use more flexible contractual forms such as convertible securities and stage financing to tailor financing needs to the specific character of firms (Kaplan and Strömberg, 2003, 2004, document the rich nature of actual VC contracts).

6 Other Areas of Public Policy

Taxes and subsidies are by far not the only important area of public policy towards innovative entrepreneurship and VC financing. There might be policy complementarities leading to mutually reinforcing effects (e.g. Cumming, 2007). One omission of the present review is the tax treatment of stock options for employees (Gilson and Schizer, 2003). Substantial tax savings might be possible due to tax deferral when stock options are taxed only at the date when the option is exercised and income actually is realized, rather than at the date of issue.¹¹ A favorable tax treatment of employee stock options could help young technology firms to attract key personnel at a lower wage cost at a time when cash-flow is low or non-existent.

One important precondition for an active VC industry is access of young technology companies to liquid stock markets. Liquid stock markets allow VCs to exit from their portfolio companies faster and more profitably. This exit possibility also helps the entrepreneur to regain control over the company when the concentrated stake of the VC firm is broadly dispersed over smaller market investors at an IPO. Since entrepreneurial independence is a main motivation for entrepreneurship in the first place, the presence of specialized stock markets makes potential entrepreneurs more willing to start a firm

¹¹The problem is similar to the tax advantage of applying the realization principle in capital gains taxation, rather than taxation upon accrual.

(Black and Gilson, 1998). It also makes the value added of VC financing more attractive to entrepreneurs since the intense control of VCs is expected to last only for a limited time period. According to Micchelacci and Suarez (2004), the presence of liquid stock markets allows VCs to exit faster and to reshuffle their activities to new early stage companies where VC support is needed the most. In equilibrium, liquid stock markets boost innovation and growth because the faster turnover of VC allows for a larger rate of VC backed entrepreneurship. The empirical analysis of Da Rin, Nicodano and Sembenelli (2006) indeed finds that the presence of stock markets significantly stimulates VC activity.

There are other important areas of public policy, unrelated to taxes and subsidies. Among them are: entry regulations and administrative barriers to start firms (Fonseca, Lopez-Garcia and Pissarides, 2001); patent protection to allow young firms to safely appropriate their innovation rents, and investor protection and reporting rules (e.g. Armour and Cumming, 2006); bankruptcy laws that do not permanently stigmatize failed entrepreneurs (diminished job prospects in case of failure make innovators less willing to start a firm in the first place, see Gromb and Scharfstein, 2003, Landier, 2006); or liberal pension fund regulations to allow pension funds to diversify by allocating funds to VC firms which facilitates fund raising (Gompers and Lerner, 1998).

7 Conclusions

The creation of young firms is a significant factor in promoting employment and innovation. VC has become an increasingly important source of funding for start-up firms. In combining financing with active advice and monitoring, VC can help the professionalization of portfolio companies and add value. Therefore, VC backed firms appear to outperform similar firms without access to VC, making them a particularly important source of job growth and innovation. Policy makers are thus much concerned about creating the right policy environment for a dynamic VC industry.

Our policy analysis implies that success taxes such as the capital gains tax may be quite

harmful to VC financed entrepreneurship. The corporate tax is harmful to investment and valuation of mature firms and is most likely to be even more harmful to finance constrained start-up firms. In reducing the returns to effort, the corporate tax impairs the incentives for effort and advice at the firm's start-up stage and may, thus, contribute to an overly high failure rate and harm the quality of VC investments. Alternatively, as in the framework of this chapter, the tax reduces pledgeable income and the financing capacity of young firms and thereby restricts investment. The analysis lends some support to the advocates of cutting the capital gains tax or giving corporate tax relief to small innovative firms. However, such tax relief should be confined to VC backed firms only. In terms of practical tax policy, two issues should be noted. First, the burden of the capital gains tax may already be quite low compared to other capital income taxes. The deferral of capital gains until realization implies interest gains that significantly reduce the actual tax burden. Second, there might be some practical difficulties in selectively applying a tax break to VC backed firms only.

Many programs to stimulate business creation involve investment subsidies. In reducing the present value of net tax liability, they favor entry. The analysis has also shown that the specific form of the subsidies is important. Compared to flat subsidies given in a fixed absolute amount, proportional subsidies are more favorable to the more profitable firms which are more likely to receive VC support. The analysis has also shown that subsidies are relatively less effective in boosting investment by VC backed firms, compared to a cut in success taxes. For the same reason, a profit tax with an allowance for financing costs also favors the more innovative and, thus, more profitable VC backed firms, compared to a cash-flow tax which gives tax relief upfront. Shifting the tax burden from the late cash-flow stage when the returns to effort and investment accrue, to the early investment stage sharpens incentives for effort and strengthens the financing capacity of the most profitable firms even if the net present value of tax liabilities remains unchanged. Hence, the structure of investment subsidies and the details of capital income taxes regarding to definition of the tax base, have non-trivial consequences for investment and growth of bank versus VC financed firms.

Appendix: Comparative Statics

The hat notation denotes logarithmic derivatives such as $\hat{q} \equiv dq/q$. For small policy changes starting from an untaxed position of $t = s = z = 0$, define $\hat{\tau} = d\tau$, $\hat{s} = ds$ and $\hat{z} = dz$. The net present value of tax payments in (1) depends on the firm's profitability v . Compared to a VC backed company, a bank financed firm owes $\tau(v) = (pt - s)I(v) - z$. Starting from an untaxed position, one can ignore tax base effects via changes in I . The tax liability of a type j firm with investment $I_j(v)$ thus changes by

$$\hat{\tau}_b = I_b \cdot (p \cdot \hat{t} - \hat{s}) - \hat{z}, \quad \hat{\tau}_m = I_m \cdot [(p + q) \cdot \hat{t} - \hat{s}] - \hat{z}. \quad (\text{A.1})$$

Bank Financed Firms: Investment in (5-6) changes by

$$\hat{\theta}_b = -\frac{1}{\theta_b} [pv \cdot \hat{v} - p \cdot \hat{t} + \hat{s}], \quad \hat{I}_b = -\hat{\theta}_b + \frac{1}{A} \cdot \hat{z}. \quad (\text{A.2})$$

Profits are $\pi_b^e = \rho_b I_b + z$ and change by $\hat{\pi}_b^e = \hat{\rho}_b + \hat{I}_b + (1/\pi_b^e) \hat{z}$, where the effect on the profit margin is

$$\hat{\rho}_b = \frac{1}{\rho_b} [pv \cdot \hat{v} - p \cdot \hat{t} + \hat{s}]. \quad (\text{A.3})$$

Combining with the preceding results and collecting terms gives

$$\hat{\pi}_b^e = \left(\frac{1}{\rho_b} + \frac{1}{\theta_b} \right) [pv \cdot \hat{v} - p \cdot \hat{t} + \hat{s} + \frac{1}{I_b} \cdot \hat{z}], \quad \frac{1}{\rho_b} + \frac{1}{\theta_b} = \frac{p\beta}{\theta_b \rho_b}. \quad (\text{A.4})$$

VC Backed Firms: Investment in (5-6) changes by

$$\hat{\theta}_m = -\frac{1}{\theta_m} [(v - \beta)q \cdot \hat{q} + (p + q)(v \cdot \hat{v} - \hat{t}) + \hat{s}], \quad \hat{I}_m = -\hat{\theta}_m + \frac{1}{A - \kappa} \cdot \hat{z}, \quad (\text{A.5})$$

where $v > \beta$ since profit margins are assumed to be positive over the entire range as was discussed in the context of (7). Values $\pi_m^e = \rho_m I_m - \kappa + z$ under VC financing change by $\hat{\pi}_m^e = \frac{\rho_m I_m}{\pi_m^e} (\hat{\rho}_m + \hat{I}_m) + \frac{1}{\pi_m^e} \hat{z}$, where the effects on the profit margin are

$$\hat{\rho}_m = \frac{1}{\rho_m} [(p + q)(v \cdot \hat{v} - \hat{t}) + \hat{s} + qv \cdot \hat{q}]. \quad (\text{A.6})$$

Combining and collecting terms gives

$$\begin{aligned}\hat{\pi}_m^e &= \left(\frac{1}{\rho_m} + \frac{1}{\theta_m} \right) \left[\frac{\rho_m I_m}{\pi_m^e} [(p+q)(v \cdot \hat{v} - \hat{t}) + \hat{s}] + \frac{\rho_m}{\pi_m^e} \cdot \hat{z} \right] \\ &: + \left(\frac{1}{\rho_m} + \frac{v-\beta}{v\theta_m} \right) \frac{\rho_m I_m}{\pi_m^e} qv \cdot \hat{q}.\end{aligned}\quad (\text{A.7})$$

Equilibrium: The pivotal return v_* equates firm values in the two financing modes.

The direct derivative of (8), evaluated at the untaxed position, yields

$$\hat{v}_* = \frac{1}{v_*} \hat{t} - \frac{q - cp}{(p+q)pv_*\kappa} \hat{z} - \left[\frac{p+q}{q} - \frac{A}{\kappa} \right] \frac{q}{(p+q)pv_*} \hat{s} - \frac{(1+c)q}{(p+q)^2} \frac{A}{v_*\kappa} \hat{q}. \quad (\text{A.8})$$

Clearly, the cut-off increases with success taxes, implying that they discriminate against choosing VC, while both types of investment subsidies favor VC financing by reducing the cut-off value.

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