Public Policy, Start-up Entrepreneurship, and the Market for Venture Capital*

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Abstract

Venture capital has become an important source of financing young firms. Venture capital backed firms are often perceived as more innovative and as creating more value than others. Perhaps for this reason, policy makers have taken interest in an active venture capital industry. We explore the role of public policy in determining the incentives of individuals to start up new firms and of venture capitalists to finance and advise them. We consider how policy thereby influences the size and nature of the industry and how it affects aggregate welfare. We examine the impact of wage and corporate income taxes as well as capital gains taxes and start-up capital subsidies on the volume and quality of venture capital backed entrepreneurship.

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1 Introduction

Among new entrepreneurial firms in high-technology industries, venture capital (VC) has increasingly become an important player, not only as a source of finance but also as a source of professional support. The firm's transition from birth of the idea to a marketable and profitable product not only involves technological experiments and development of prototypes. Acquiring new facilities, developing marketing strategies, attracting key clients and reliable suppliers, hiring new personnel, team building, and raising further financing to expand the business requires formidable managerial expertise and entrepreneurial experience. While proficient at the technological side, start-up entrepreneurs not only lack the necessary capital, but are typically also in dire need of professional assistance. Seasoned venture capitalists (VCs) are well suited to fill these gaps. They have good access to capital, are endowed with own managerial experience and detailed knowledge of the industry. They can count on a well developed network of suppliers, customers and key personnel. Indeed, the defining characteristic of VC is the combination of finance and commercial assistance. In contrast to passive bank financing, VCs arrange for entrepreneurs to receive support in various ways by creating links to suppliers and possible customers, getting hold of key personnel, providing strategic and marketing advice and helping the professionalization of the firm in other ways.

Venture capital started out in the U.S. half a century ago and has vigorously grown in the last twenty years. Almost half of new firms in the US which are sold off at IPOs (Initial Public Offerings) have been backed by VC (see Gompers and Lerner, 2001). In Europe, the introduction of VC started significantly later, and only in the most recent years have VC firms become prominent financiers of young technology-firms. Recent statistics published by EVCA (the European Private Equity and Venture Capital Association) report a total investment by members of the Association of 37 billion Euros in 2004, up from 5.5 billion in 1995.[1] As in previous years, strict seed and start-up investment constituted a minor part of the total amount (some 2.7 billion Euros or 7.3 pct.). The rest was absorbed

[1] See EVCA Barometer June 2005 on http://www.evca.com.

by financing buyouts and by expansion-stage investments (26.6 and 7.9 billion Euros, respectively). The EVCA statistics further reveal marked differences across countries. Sweden and The Netherlands had the relatively largest Private Equity/VC markets in Europe (between 0.7 and 0.8 pct. of GDP), followed by UK and France (between 0.4 and 0.6 pct.) while Germany, Denmark and Finland recorded only around 0.2 pct. of GDP.

While VC accounts for only a rather small part of total investment, it tends to be concentrated in the most innovative sectors of the economy. Empirical research for the U.S. by Kortum and Lerner (2000) among others has documented that VC is responsible for a disproportionately large share of overall industrial innovation. According to their results, a dollar of venture capital 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 healthy 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 important 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 itself surely considers public policy to be relevant and keeps an eye on whether the general policy environment is suitable to promote the development of private equity and venture capital and to encourage entrepreneurship. For instance, EVCA in 2003 and again in 2004 published a benchmarking report on the tax and legal environment in its member countries (cfr. EVCA, 2004).[2] The assessment evaluates 13 indicators

[2]See also the related Press Release from EVCA of May 24, 2004.

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 EVCA benchmarking report defines a favorable tax environment by the following criteria: (i) Company tax rates, especially for small and medium sized enterprises should help to support entrepreneurship. (ii) A favorable tax treatment of the sale of unquoted investments in growth companies should strengthen the incentive to entrepreneurial investment. (iii) Income tax rates for private individuals should support, attract and retain human capital, in particular entrepreneurs, researchers and highly qualified company managers. (iv) Tax incentives should be adopted for individual investors investing in private equity funds. (v) Fiscal R & D incentives should be adopted.

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 (2002), 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 thus 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 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 can be an important source of new capital and can thereby stimulate the expansion of the industry. More recently, Da Rin, Nicodano and Sembenelli (2005) 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. Our theoretical analysis yields an ambiguous conclusion on the desirability of such subsidies. Although successful in boosting the rate of business creation, start-up subsidies may in fact reduce the quality of VC backed entrepreneurship.

Ever since Black and Gilson (1998), the presence of specialized stock markets for young technology firms is considered as an important precondition for an active venture capital industry. Liquid stock markets allows 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 indepence 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. 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 (2005) indeed finds that the presence stock markets significantly stimulates VC activity.

The present chapter synthesizes our previous theoretical work and discusses the consequences of selected taxes and subsidies such as those emphasized by the EVCA benchmarking report mentioned above. They are relevant at different stages of the firm's life-cycle. The chapter explores how they impact on the quantity and quality of VC financed entrepreneurship. In particular, we examine a subsidy to start-up investment representing the various investment grants, interest subsidies, 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 occupations alternative to the pursuit of an entrepreneurial career, and corporate income taxation. Our analysis indeed shows that a limited focus on the taxation of small early stage firms cuts too short. The taxation of mature firms might be as important for start-ups as the direct taxation of infant companies. The corporate income tax may well reduce entrepreneurship even though the tax is only paid by mature companies rather than young ones. The basic insight is that by reducing the value of mature firms, the corporate tax diminishes the gains from setting up new companies as well.

Our primary focus is on the consequences of taxes and subsidies on the rate of business creation and the quality of VC financing in industry equilibrium. We set up a two-period model of industry equilibrium that is rich enough to reveal the effects of taxes and subsidies on the survival probability of start-ups, IPO prices, capital investment of mature firms, and overall welfare. The core of the model is the relationship between a finance-constrained entrepreneur and a VC firm that must pay for the new firm's physical investment expenses. The firm's success rests on the entrepreneur's effort and due diligence, as is well established in the empirical literature (such as that reviewed in Rosen, 2005). It also reflects the VC's engagement and contribution to the firm as argued above and empirically documented by Gompers and Lerner (1999) and Hellmann and Puri (2000, 2002), among many others. 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 and Kaplan and Stromberg, 2003, 2004 for detailed empirical evidence). VCs carefully screen and select business plans. They have developed sophisticated financial

instruments and contractual arrangements to alleviate the problems resulting from informational asymmetries. They add value by establishing contacts, giving strategic business advice, and generally helping in the professionalization of young firms.

The chapter abstracts from screening and selection problems by assuming uniform quality among entrepreneurs. Instead, we focus on the value added role of VCs which is an important one. Hellmann and Puri (2002) show empirically 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. In short, the VCs add value and raise the likelihood of success by promoting the professionalization of young firms. 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! Rapid market introduction is strategically important because the first firm on the market enjoys a first mover advantage.

Part if this superior performance of VC backed firms might result from VCs being able to locate more profitable firms than other investors, rather than adding value themselves. The issue of selection versus value added has been empirically investigated by Sorensen (2005). He indeed finds important sorting effects in the sense that the most experienced investors get the best deals. He finds that the probability of success of a firm financed by the most experienced investor in his sample is 39 pct. which compares with a success probability of only 15 pct. of firms financed by the least experienced investors. He then reports 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. Although

ignorance of sorting and selection effects leads to considerable overestimation of the degree of investor influence, the value increasing role of VC financing remains a very important one.

It seems that the productive contribution of VCs to business growth is not a guaranteed matter. Apart from investor experience, it may also rest 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, 2003, 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). Since neither party's effort is verifyable and contractible, the VC contract must be carefully crafted to provide appropriate incentives to both the entrepreneur and VC. In focussing on the real effects of VC in industry equilibrium, we postulate a particularly simple model of the entrepreneur's and VC's interaction. In this framework, a Pareto-optimal contract allocates profit shares depending on each partner's importance for the firm's success. The contract can be implemented as straight equity.

Within our simple model, the contract specifies that the VC acquires an equity stake for a price that covers at least the physical start-up costs plus possibly an upfront payment to the entrepreneur. The agreed profit sharing is chosen to optimally allocate incentives to the entrepreneur and VC in order to maximize the joint surplus to be divided among them. Although profit sharing is Pareto-optimal among the members of the team, it nevertheless implies that each party is able to appropriate only a share of the marginal gains from putting forth extra effort while she will have to bear the entire private cost of doing so. For this reason, entrepreneurial effort and VC advice tend to be too low compared to a socially efficient allocation, resulting in an overly high failure rate among

start-ups.[3] In our set-up, no such distortion is present with respect to the rate of business creation. The literature has indeed been very skeptical towards policies that simply aim to promote the rate of business creation. In fact, it often argues for a tax rather than a subsidy to entry (cfr. De Meza, 2002; see also the discussion in Cressy, 2002, and Parker, 2003). From a normative point of view, our model does not support policies to accelerate business creation either but rather argues for a better quality of start-ups. A better quality reflects improved incentives for entrepreneurial effort and VC support and is felt in a lower failure rate among start-up firms. Our analysis supports policies that do not aim at more but rather more successful VC backed firms. There is a quality-quantity trade-off.

Most real world policies towards young firms subsidize the cost of capital from start-up investment. Policy analysis within our model shows that these subsidies are indeed effective in stimulating entrepreneurship but are questionable from a broader welfare perspective. Since start-up subsidies are given independent of the ultimate success, they are not useful in strengthening individual incentives for more entrepreneurial effort and managerial advice. In raising the present value of a project, they make entry more attractive. Precisely because they are effective in generating entry, they tend to depress market prices and firm values which ultimately erodes the reward to private effort. Since effort is too low in private equilibrium, subsidizing start-up cost tends to reduce welfare. Capital gains taxes have an ambiguous effect on entrepreneurship while they may be quite harmful in welfare terms. Wage taxes lead individuals into entrepreneurial careers, but likewise may be unwarranted from a welfare angle. Instead, taxes on entrepreneurs would be more sensible, leading to fewer but more successful and more valuable firms. Finally, corporate income taxes tend to be particularly harmful to the quantity and quality of VC backed entrepreneurship. Since they reduce the value of mature companies, they not only retard entry but also impair the reward to effort in start-up firms. Quite generally, any policy reducing the value of mature companies will feed back negatively on incentives

[3] We will discuss the robustness of this conclusion in section 2.6.

within start-up firms.

To state our arguments more precisely, we now set up a stylized equilibrium model in section 2. It will be shown how alternative policy instruments affect different behavioral margins during a firm's life-cycle and thereby determine the quantity and quality of VC investments in industry equilibrium. Section 3 derives the impact of public policy and section 4 concludes.

2 A Model of Start-ups and Venture Capital

2.1 Overview

Figure 1 illustrates a stylized two-period model of young and mature firms. The sequence of events unfolds from left to right. At the beginning of the first period, the government defines a policy environment, consisting of the policy instruments listed at the bottom of the figure. The entrepreneurial and traditional sectors produce a perfectly substitutable output with a price normalized to unity. Production in the traditional sector is Ricardian, converting one unit of labor into W units of output, and thus paying a fixed wage W. The traditional sector absorbs all labor resources not demanded by the entrepreneurial sector. There is a population of mass one of agents. Weighing the prospects of an entrepreneurial career against employment in the traditional sector, a mass E of agents opts for entrepreneurship to pursue their business ideas. The remaining population $L = 1 - E$ chooses employment. The occupational choice decision of individuals thus shifts production to one or the other sector. In the second period, output is supplied by entrepreneurial firms only, traditional firms being inactive.

An entrepreneur must first undertake a 'seed investment' to turn her idea into a project and develop a business plan which can be presented to a financier. For this purpose, individual i needs to incur a (non-pecuniary) cost h^i, capturing the time and effort required in the process. Individuals are assumed to differ in their basic inventiveness.

Some create their project at low cost, while others have to put in more effort. Lacking own resources to start the firm, an entrepreneur proposes a deal to a VC firm to finance and advise the venture. When accepting the contract, the VC acquires a profit share $1-s$, leaving a share s to the entrepreneur, against a total price $B+(1-z)\,I$ that covers at least the private start-up investment I net of a possible government subsidy z plus an extra upfront payment B to the entrepreneur. The parameters s and B of the contract are optimally chosen to reflect the relative importance of the entrepreneur's and the VC's contribution to the firm's success during the start-up phase. The contract must also be sufficiently attractive to induce the entrepreneur to give up the alternative career.

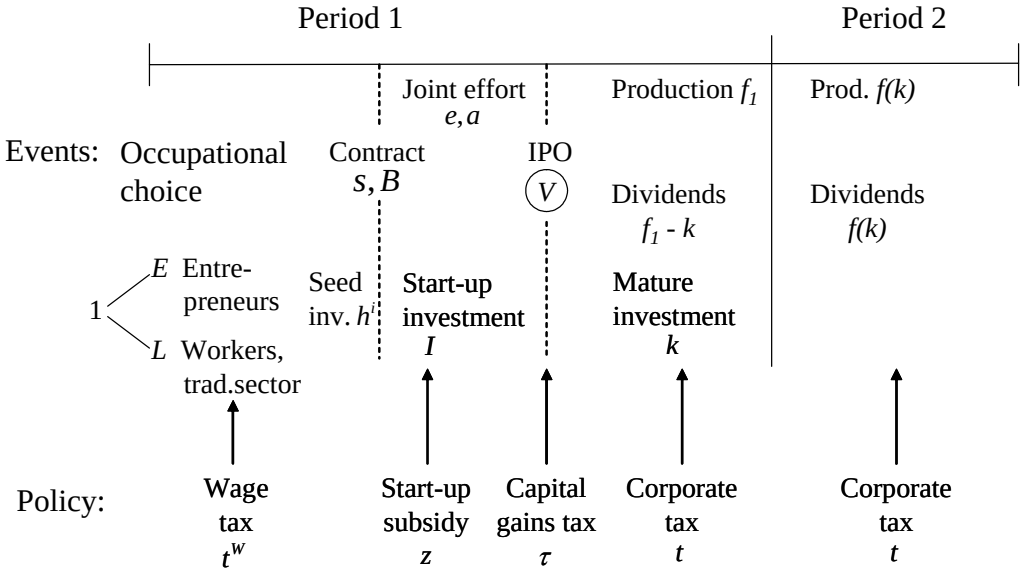


Figure 1: Events and Notation

Having specified the terms of the contract, the firm is started up with a fixed capital investment I. The venture is risky. Both the entrepreneur and the VC must put in effort to enhance the firm's chances. The likelihood of success is specified as $p=p\,(e,a)$ and depends on entrepreneurial effort e and VC advice a. If a venture succeeds, production starts, and the firm can be sold to new investors, possibly at an IPO, for a price V. At that point in time, the capital gains tax at rate τ due and cuts into the privately earned gains during the start-up period.[4] If it fails (with probability $1-p$), the firm will be shut

[4]For simplicity, we assume complete loss-offset in capital gains taxation. The consequences of incom-

down without any production and revenues whatsoever. When firms successfully mature to production stage, they produce f_1 for the remainder of the first period. A part k of this production is retained and invested internally to accumulate capital, while the residual is distributed as dividends to owners. In the second period, production $f(k)$ is continued at a level depending on mature firm investment k. Revenues net of the corporate tax at rate t are paid out to owners. The capital stock k is assumed to depreciate in full over the second period. Depending on the level of wages or entrepreneurial income received, and on the market rate of interest, individuals choose optimal life-cycle consumption.

The policy instruments to be investigated are: t^W a tax on wage income; t a corporate income tax on mature firms; τ a capital gains tax on new firms, levied symmetrically on entrepreneurs and VCs; and z a subsidy to start-up investment. A fraction θ, $0 \leq \theta \leq 1$, of mature firm investment k can be expensed in the first period from the corporate income tax, even though capital only depreciates in the second period. The remaining part $1-\theta$ is deducted from the tax base in the second period. Government budget imbalances are offset with lump-sum taxes or transfers in the same period.

The model is solved by backward induction, in the reverse order of Figure 1. Most of the elements of the model are as in Keuschnigg and Nielsen (2004b); however, we do amend the framework in that article to enable an analysis of corporate income taxation. The full details of our model and its solution are available in the working paper version, Keuschnigg and Nielsen (2004c). Below, we shall limit our remarks to those model elements which are most crucial to understanding the effects of taxes/subsidies on entrepreneurship and welfare.

2.2 Mature Firm Value and Investment

Consider first the investment decision and the valuation of of mature firms. A mature firm is assumed to pay net of tax dividends $\chi_1 = (1-t) f_1 - (1-\theta t) k$ and $\chi_2 =$

plete loss-offset is analyzed by Keuschnigg and Nielsen (2003b).

$(1-t)\,f(k)+(1-\theta)\,tk$, where f_1 is a fixed amount of first period output and $f(k)$ is second period output, $f(.)$ being a standard concave production function. A part θ of mature firm investment is immediately expensed against the corporation tax; the remaining part reduces the tax bill next period. This definition of dividends assumes internal investment finance. At IPO, the value V of a mature firm reflects the present value of the net dividend flow, $V=\chi_1+\chi_2/R$. The gross interest factor is $R=1+r$, u is the user cost of capital and V_1 denotes that part of firm value which is optimized with respect to mature firm investment,

$$V=(1-t)\,f_1+V_1,\quad V_1=\frac{(1-t)\,[f(k)-uk]}{R},\quad u\equiv\frac{(1-\theta t)\,R-(1-\theta)\,t}{1-t}. \tag{1}$$

Maximizing firm value with respect to investment k yields

$$f'(k)=u\quad\Rightarrow\quad\frac{dk}{dR}<0,\quad\frac{dk}{dt}\leq 0,\quad\frac{dk}{d\theta}>0. \tag{2}$$

Since the corporate income tax raises the cost of capital, it reduces mature firm investment. If $\theta=1$, however, so that capital investment can be immediately expensed, the corporate income tax becomes a cash flow tax, neutral to investment (presuming a positive corporate income tax). An increase in the rate of immediate investment expensing promotes investment if the tax rate is positive. Finally, a rise in the interest rate tends to lower investment in mature firms.

Using the envelope theorem, the effects of taxes on mature firm values are

$$\frac{dV}{dR}=-\frac{V_1+(1-\theta t)\,k}{R},\quad\frac{dV}{d\theta}=t\frac{rk}{R},\quad\frac{dV}{dt}=-\frac{V}{1-t}\left[1+\frac{(1-\theta)\,rk}{RV}\right]. \tag{3}$$

The IPO value will be negatively affected by increases in both the corporate income tax and the interest rate, while a rise in the expensing parameter stimulates firm value provided that the corporate tax is positive. It is important to note that the corporate income tax always reduces mature firm value irrespective of how it affects distorts their investment decisions. The value of a mature firm is the ultimate reward for starting up a firm in the first place. Thereby, mature firm value determines the incentives of entrepreneurs and their financiers in the preceding start-up phase.

2.3 VC Financed Start-ups

The entrepreneur's interest in starting a firm and the VCs willingness to finance such a venture depend on the value of the firm at the beginning of the start-up phase and the terms of the financial contract. Since young firms survive the start-up phase only with probability p, the expected value of going ahead with the project is pV minus various costs. A start-up succeeds with probability p, leaving a value of V, and fails with $1-p$, leaving nothing. The success probability $p = p(e,a)$ increases with the entrepreneur's effort e and the VC's managerial support a. Both inputs are subject to decreasing returns. For simplicity, we specify

$$p = p(e,a) = e^{\epsilon} a^{\alpha}, \quad \epsilon + \alpha < 1. \tag{4}$$

VCs and entrepreneurs share expected firm value by means of a simple equity contract where the VC acquires a profit share $1-s$ at a total price of $B + (1-z)I$. The subsidy z stands for the variety of government programs such as interest subsidies, credit guarantees or outright investment subsidies that are all intended to reduce the cost of capital to young entrepreneurial firms. While the part $(1-z)I$ of the VC's payment is spent on capital equipment, the entrepreneur possibly retains an upfront compensation B that makes her more willing to forego alternative opportunities. With such a contract that will be optimally chosen, the expected incomes accruing to entrepreneurs, VCs and the government are

$$\begin{aligned} \pi^E &= (1-\tau)[spV + B], \\ \pi^F &= (1-\tau)[(1-s)pV - B - (1-z)I], \\ \pi^G &= \tau[pV - (1-z)I] - zI, \\ \pi &= \pi^E + \pi^F + \pi^G = pV - I. \end{aligned} \tag{5}$$

Note that τ stands for the uniform capital gains tax on VCs and entrepreneurs. The government's surplus π^G corresponds to the *net* tax revenue extracted from the project.

To raise the chances of the firm's success, the entrepreneur and the VC must incur effort costs βe and γa, respectively. Since these costs are non-pecuniary, effort cannot be veryfied and, therefore, cannot be secured by explicit contracting. The contract must

thus allow both the entrepreneur and the VC to participate in the upside potential of the firm by allowing them to share in the extra profit derived from their effort. Define the entrepreneur's profit net of effort cost as $\Omega^E \equiv \pi^E - \beta e$ and the VC's surplus per venture as $\Omega^F \equiv \pi^F - \gamma a$. The entrepreneur proposes a contract that maximizes her surplus Ω^E subject to two considerations. First, the contract must be sufficiently profitable for the VC to assure her willingness to finance the venture ($\Omega^F \geq 0$, participation constraint PC^F). Second, the entrepreneur must anticipate how the proposed profit sharing rule will affect her own and the VC's incentives to provide effort *after* the contract is signed (incentive compatibility constraints IC^E and IC^F). Formally, the entrepreneur's problem is

$$\begin{aligned}
\Omega^E &= \max_{s,B} (1-\tau)\left[p(e,a)\, sV + B\right] - \beta e \qquad s.t. && (6)\\
PC^F &: \Omega^F = (1-\tau)\left[p(e,a)(1-s)V - B - (1-z)I\right] - \gamma a \geq 0, && \text{(i)}\\
IC^E &: \Omega^E_e = p_e(e,a)(1-\tau)sV - \beta = 0, && \text{(ii)}\\
IC^F &: \Omega^F_a = p_a(e,a)(1-\tau)(1-s)V - \gamma = 0. && \text{(iii)}
\end{aligned}$$

At effort stage, where the agreed profit share s is already fixed, optimal levels of efforts are determined by the two incentive compatibility constraints. Figure 2 illustrates the simultaneous choice of effort, using the functional form for $p(e,a)$ in (4). Both reaction curves $e(a)$ and $a(e)$ are positively sloped, implying that entrepreneurial effort and VC advice are strategic complements. According to Figure 2, a larger expected IPO value boosts both the entrepreneur's effort and the VC's managerial support and thereby raises the firm's survival chances. An increase in the symmetric capital gains tax reduces the reward for effort and yields the opposite effects. Finally, inspection of (6.ii-iii) shows how the contract allocates incentives for effort by specifying the profit sharing rule. The higher is the entrepreneur's share s, the larger are her marginal returns to effort, and the more effort she will supply. At the same time, a higher s is at the expense of the VC's share $1-s$. In this case, the VC will be less keen to support the venture with her advice and

contacts which reduces the firm's survival chances.

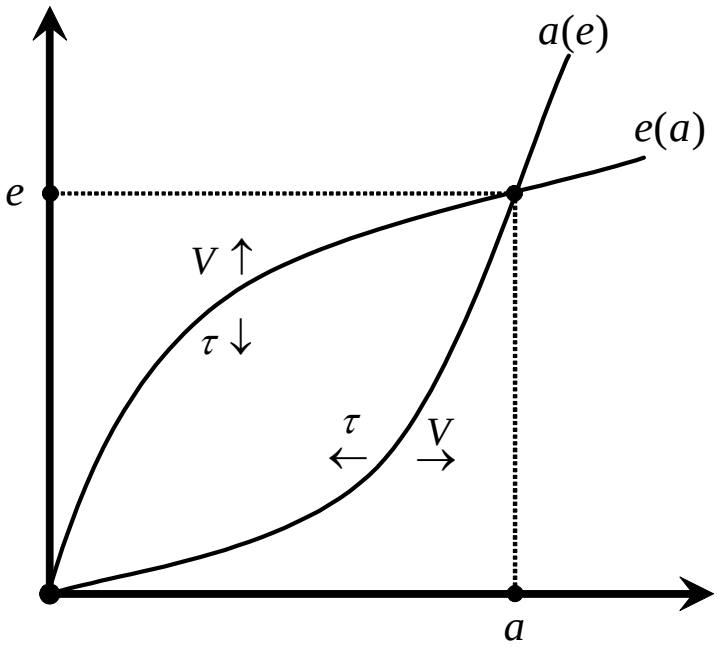


Figure 2: Effort and Advice

Anticipating effort choices during the start-up phase, the entrepreneur proposes a deal that maximizes her own surplus but at the same time assures that the VC is willing to finance the investment expenditure. In assuming competitive VCs, we allocate all bargaining power to the entrepreneur. Accordingly, the VC's surplus per venture, $\Omega^F \equiv \pi^F - \gamma a$, is squeezed to zero.[5] The entrepreneur can raise her own expected profit by keeping either a larger share s or demanding a higher upfront payment B by asking for a higher price for the VC's profit share. Note a fundamental difference between the

[5]For simplicity, we assume away any other cost of VC entry, thus making VC financing perfectly competitive and allowing no more than zero profits. Keuschnigg (2003) considers search costs of VCs and entrepreneurs in the seed phase prior to entering a financing relationship. To cover these costs, both agents must earn strictly positive rents during the start-up phase. In Kanniainen and Keuschnigg (2004), we assume fixed entry costs of VC firms. This allows to contrast a short-run equilibrium with a fixed number of VCs and positive rents with a long-run equilibrium with free entry and zero profits (see the graphical analysis of Gompers and Lerner, 2002, with a similar distinction of short- and long-run equilibrium). These extensions do not affect our basic conclusions. We thus focus only on the perfectly competitive, long-run equilibrium in this chapter.

two instruments s and B. Claiming a higher s reduces the VC's share and destroys her incentives to add value, while the upfront payment B does not. The latter merely redistributes lump-sum across the two parties. The entrepreneur will therefore first choose s to maximize joint surplus. Having found this Pareto optimal share s, she then requests a maximum upfront payment B that allows the VC no more than to break even. In this way, the entrepreneur acquires the entire joint surplus $\Omega = \Omega^E + \Omega^F$. Substituting B from (6.i) into (6) yields the entrepreneur's problem of choosing s, anticipating the incentive effects for later stage effort e and a as determined by (6.ii-iii):

$$\Omega \underset{+}{\left[V, \tau, z \right]} = \max_{s} (1-\tau) \left[p(e,a) V - (1-z) I \right] - \gamma a - \beta e \quad \text{s.t. (6.ii-iii).} \tag{7}$$

With a symmetric capital gains tax on both entrepreneurs and VCs, the Pareto optimal profit share s becomes independent of taxes and of venture returns V. We can thus take s as a fixed constant, beyond the influence of policy.[6]

2.4 Entry To Entrepreneurship

An entrepreneur's expected surplus is the utility difference between entrepreneurship and employment and reflects not only income differences but also various effort costs. First, seed investment is interpreted as a non-pecuniary private research effort which is required to prepare a business plan. Agents are taken to be distributed uniformly in the unit interval with respect to research ability and associated effort cost, h^i in monetary equivalent. Once this effort is sunk and the alternative wage income is foregone, all start-up firms are assumed to be of uniform quality and to yield the same remaining surplus Ω.[7] The expected surplus must be sufficiently large to compensate entrepreneurs for any foregone outside opportunity $\left(1 - t^W\right) W$, and the initial effort cost $h^i = h \cdot i$ during the seed phase

[6] See Keuschnigg and Nielsen (2004a) for this result. There, we show that the privately optimal equity share s changes only when there are differential capital gains taxes on entrepreneurs and VCs, or when the tax treatment of the upfront payment B is different from the capital gains tax.

[7] This symmetry assumption excludes problems of adverse selection and helps to focus on the moral hazard during the start-up phase.

prior to VC finance. Entry of entrepreneurs occurs as long as $\Omega - h \cdot i > \left(1 - t^W\right) W$, until the marginal entrepreneur just breaks even.[8] Entrepreneurial entry is, thus, governed by

$$\Omega \left[\underset{+}{V}, \underset{-}{\tau}, \underset{+}{z} \right] = hE + \left(1 - t^W\right) W. \tag{8}$$

On the left hand side, entrepreneurial surplus increases in mature firm value V and start-up subsidy z, but falls in the tax rate τ that diminishes the expected capital gains of start-up investment. Note that start-up firms prior to production stage do not generate any profits and therefore do not pay corporate income tax. However, since corporate taxes reduce mature firm value as in (3), they nevertheless reduce the expected reward from start-up entrepreneurship.

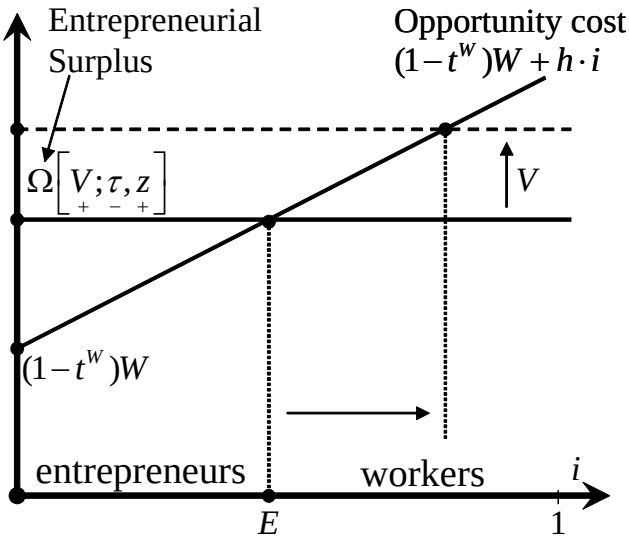


Figure 3: Start-up Decision

Figure 3 illustrates the relation between venture returns and the number of entrepreneurs. A higher venture return V, consisting of a higher IPO value of a maturing firm, raises the returns to start-up activity and leads more agents to choose an entrepreneurial career. The other policy effects are directly inferred from the Figure.

[8] In the discussion paper version (Keuschnigg and Nielsen, 2004c), the entry decision is reconciled with consumption and savings choice . Given a simple specification of preferences, any differences in life-time welfare among alternative occupations are exclusively due to effort adjusted income differences as in (8).

2.5 Industry Equilibrium

Equilibrium in the venture capital based industry reflects the demand for and supply of entrepreneurial firms.[9] While supply of start-up entrepreneurs result from the agent's occupational choice as illustrated in Figure 3, demand stems from the economy's need of mature firm output. We have chosen a very simple formulation of demand. Depending on their income, workers and entrepreneurs spend on first and save for second period consumption. In postulating linear and separable preferences, we cut out any complicating income effects. Thus, demand for second period consumption exclusively depends on the interest rate. With a higher interest rate, agents save more and demand more of second period consumption D, with $D'(R) > 0$. Therefore, demand for mature firm output, equal to $f(k)$ per firm as indicated in Figure 1, increases with the interest rate. As this must be covered by successful start-up firms, it ultimately creates demand for more entrepreneurs. By the law of large numbers with independent risks, the number of mature firms is $N = pE$. Demand for entrepreneurship thus reflects demand for second-period consumption D and the number and size of mature firms. Hence,

$$D = f(k) \cdot p(e, a) \cdot E^D. \tag{9}$$

On the right-hand side, second-period production is the product of output per firm, the number of start-ups (entrepreneurs), and the success rate of start-ups. The equation can be solved for the number of entrepreneurs demanded E^D which is easily shown to be an increasing function of the interest rate as indicated in Figure 4. First, a higher interest rate raises demand for entrepreneurs because it boosts savings and thus demand for

[9] Poterba (1989a,b) and Gompers and Lerner (1998, 2002) introduced a graphical supply and demand analysis, albeit without an explicit structural model. In Gompers and Lerner (2002), the expected return on VC investments adjusts to establish equilibrium in the VC industry by reconciling the willingness of investors to supply capital with the number of entrepreneurial firms meeting the return requirement (see their Figure 5). In contrast to these authors, we assume the supply of financial capital to be perfectly elastic and thus do not consider it as a bottleneck of the VC industry. In our model, the number of firms demanded stems from price elastic demand for the output of VC backed firms.

mature firm output D. Second, a higher interest rate depresses mature firm investment k and thereby reduces output $f(k)$ per mature firm. With smaller size, more of them are required to serve the market which again contributes to more demand for entrepreneurship. Third, a higher interest rate depresses the value of successful new firms V as in (3). Lower venture returns dampen the incentives for joint effort as indicated in Figure 2 and thereby reduce the success rate $p(e,a)$ of new firms so that more of them must start up to serve the market. Note that both e and a and thus p symmetrically increase with V but fall with τ as indicated in Figure 2. Consider further the factors determining mature firm value as listed in (3). Put all the information together and solve (9) for the required number of entrepreneurs. It is then seen how demand for start-up entrepreneurship increases with the interest rate and shifts with tax rates as indicated in Figure 4. Formally, the demand for entrepreneurs is

$$\underset{+\ +\ -\ +}{E^D\left[R;\ t,\theta,\tau\right]} = \frac{1}{p\left(V\left(R,t,\theta\right),\tau\right)} \cdot \frac{D\left(R\right)}{f\left(k\left(R,t,\theta\right)\right)}. \tag{10}$$

Tax parameters shift the demand schedule for entrepreneurs. An increase in the corporate income tax t lowers investment in all firms, necessitating more firms to meet demand. Moreover, the higher tax lowers the price of successful new firms. This depresses efforts and the probability of success of new firms so that more of them have to start up to meet demand for second period goods. As a result, a higher corporate income tax moves the demand schedule up. The opposite effects can be registered for an increase in the depreciation parameter θ. Finally, a higher capital gains tax τ raises the demand for entrepreneurship since the tax reduces the returns to effort and thus cuts into the success rate, so that more firms must be created to satisfy any given demand for second period output. Again, the demand schedule shifts up.

The supply schedule in Figure 4 results from the occupational choice decision in (8). It slopes down with the interest rate. Since an increase in interest lowers venture returns V, the entrepreneur's surplus Ω is reduced, so that fewer people find it worthwhile to incur the seed investment $h^i = h \cdot i$ as is illustrated in Figure 3. More formally, the free

entry condition (8) yields

$$E^S\left[\underset{-}{R};\underset{-}{\tau},\underset{-}{z},\underset{+}{t^W},\underset{+}{t},\underset{-}{\theta},\underset{+}{}\right], \quad \frac{dE^S}{dR}=\frac{1}{h}\cdot\frac{\partial\Omega}{\partial V}\frac{dV}{dR}<0. \tag{11}$$

Apart from the negative interest rate effect on the supply of entrepreneurship, the capital gains tax likewise tends to reduce entrepreneurship on account of its negative effect on entrepreneurial surplus. In contrast, a higher start-up capital subsidy and a higher wage tax both stimulate entrepreneurship, since they respectively boost the surplus created by entrepreneurial firms and lower the opportunity cost of entering into entrepreneurship. Finally, the corporation tax subtracts from mature firm value V and thereby the reward to entrepreneurship. Tax depreciation adds value and consequently encourages start-up activity which shifts up the entrepreneurial supply schedule.

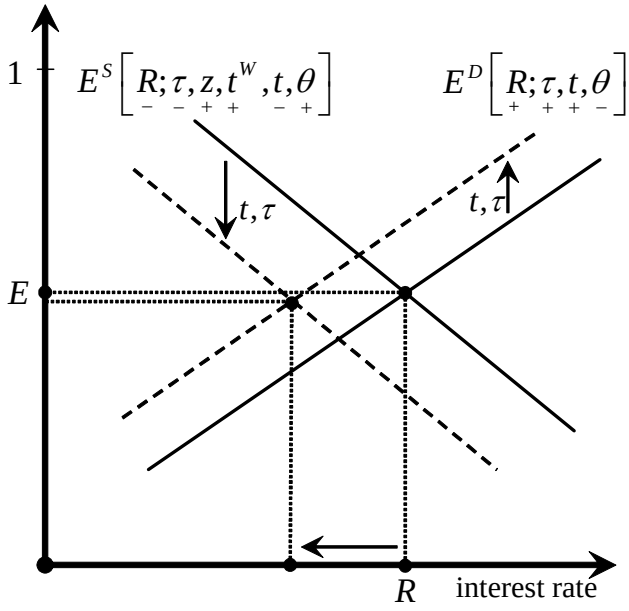


Figure 4: Equilibrium Entrepreneurship

Equating demand and supply yields the equilibrium level of start-up entrepreneurship with the gross interest rate R being the equilibrating price. Figure 4 illustrates. The comparative static effects of tax/subsidy changes follow from simple graphical arguments and will be discussed in the following section. The model also helps to develop a welfare based policy perspective towards the VC industry. Our welfare measure is the sum of individual utilities. It fully takes account of all non-pecuniary effort costs and also reflects

the government budget constraint. It thereby appropriately considers the cost of public funds that might be channelled to the VC industry.

2.6 Efficiency

Our previous theoretical work has identified the double moral hazard in the relationship between the entrepreneur and the VC as a source of inefficiency while all other behavioral margins such as occupational choice and entrepreneurial entry are free of distortions.[10] Since efforts are assumed not verifiable and not contractible, neither the entrepreneur nor the VC is able to commit to first best effort but will choose their inputs according to the incentive constraints (6.ii-iii). Both agents must share the return on their effort within the team, but must fully bear their own cost, implying that entrepreneurial effort and VC advice are too low in the private equilibrium.[11] As a consequence, and starting from an untaxed state, welfare is positively related to marginal increases in entrepreneurial effort or VC advice. Even small taxes can thus give rise to first order welfare changes. To obtain strictly positive welfare gains relative to the laissez faire equilibrium, one must look for policies that boost entrepreneurial effort and VC support rather than entry. In our framework, policy should not so much focus on the quantity but rather on the quality of VC financing.

How robust is this bias towards low entrepreneurial effort and managerial support which contributes to lower quality of VC financing? Our assumption that the VC and entrepreneur jointly determine the success probability and must exercise effort simultaneously, is important. Schmidt (2003), for example, assumes sequential efforts where in a first phase only the entrepreneur's effort is required while in a second stage the further

[10] If we had combined the model with horizontal product differentiation in the output market as in Keuschnigg (2003), there would also be a reason to additionally encourage entry to enlarge product variety. In this case, entry subsidies would help to internalize the technological spillovers from launching new products. See the analysis of Keuschnigg (2004b) within an endogenous growth framework.

[11] Such incentive problems in teams have been first analyzed by Holmstrom (1982) and were applied, among others, by Aghion and Tirole (1994) to analyze output of innovation teams.

increase in the value of the firm depends exclusively on the VC's managerial input. With this sequential effort choice, Schmidt (2003) is able to explain the use of convertible debt. In particular, he shows that convertible securities serve to obtain a first best outcome in his framework. While convertible debt is certainly a more flexible financial instrument and may allow parties to attain a superior outcome relative to straight equity finance, the first best result hinges critically on the fact that efforts are never required simultaneously but only sequentially, see Schmidt (2003, section III.G). Different from Schmidt, we stress the fact that the entrepreneur's effort is critical throughout the company's life. In reality, most business failures are ultimately due to some entrepreneurial management mistake. When the joint efforts of entrepreneur and financier overlap and are required simultaneously, the possible advantage of convertible securities relative to (mixed) equity contracts is reduced. In this case, the basic inefficiency noted above emerges again.

Compared to our simplified model, real world VC contracts contain of course many additional elements such as staging and syndication of venture capital investments (Lerner, 1994; Cornelli and Yosha, 2003) or the use of control rights (Hellmann, 1998; Gompers and Lerner, 1996). This extra contractual flexibility should make VC contracting more efficient in reality. However, these non-monetary incentives may be considered more like complements rather than substitutes to the incentives provided in a financial contract (see Hart, 2001). Neglecting them in our analysis should thus not affect the basic policy conclusions.

3 Policy and the Venture Capital Sector

The model presented in the preceding section is well suited to study how fiscal policy might affect the joint efforts of entrepreneurs and VCs in new firms, the success probability of these, the level of entrepreneurship, venture returns, and welfare. The following analysis will emphasize intuitive explanations. For a more formal analysis of the proposed policy experiments we refer to Keuschnigg and Nielsen (2004b,c). Table 1 provides an overview

of the main results.

Type of tax	R	E	N	V	e	a	U^*
mature firms							
corporate tax$^{\#)}$ t	$-$	$-$	$-$	$-$	$-$	$-$	$-$
tax depreciation$^{\#)}$ θ	$+$	$+$	$+$	$+$	$+$	$+$	$+$
young firms							
capital gains tax τ	$-$	$\pm$	$-$	$-$	$-$	$-$	$-$
start-up subsidy z	$+$	$+$	$+$	$-$	$-$	$-$	$-$
occupational choice							
wage tax t^W	$+$	$+$	$+$	$-$	$-$	$-$	$-$

Note: R interest factor, E young firms, $N = p(e,a)E$ mature firms, V value of mature firm, e entrepreneurial effort, a venture capital advice, U^* welfare.
#) The change in the interest rate is unambiguous.

Table 1: Effects of Taxes and Subsidies

3.1 Corporate Taxation

The effects of taxes are best understood in terms of the demand and supply curves for entrepreneurial firms. The supply side reflects the occupational choice of entrepreneurs. An increase in the corporate tax directly reduces the value of a mature firm which diminishes the entrepreneurs' surplus from creating a new one. Fewer entrepreneurs will want to incur the opportunity costs and give up alternative wages. Accordingly, the supply curve in Figure 4 shifts down.

For any given size of the output market, the demand for entrepreneurship follows from the number of mature firms N needed to supply the market, $D = f(k)\,N$. A first policy effect derives from its impact on output per firm. Since the corporate tax impairs expansion investment and thereby erodes output per mature firm, a larger number N of them is needed to serve the market which enhances demand for entrepreneurship. Second, since only a fraction p of new companies actually mature to production stage, $N = pE$, the

number of young firms must necessarily be larger than the mass of established businesses. As the corporate tax diminishes the value of a mature firm, it erodes the incentives for entrepreneurial effort and managerial advice and leads to an increased rate of business failure. Everything else equal, more new firms must be started for any given mass of mature firms serving the demand for second period output. Both effects shift up the demand schedule in Figure 4.

To eliminate the resulting excess demand for entrepreneurship, the interest rate must fall. Along the supply curve, entrepreneurship picks up, since a lower rate of interest raises mature firm value which creates a larger surplus from business creation and thereby attracts more entrepreneurs to set up their own firm. Turning to the demand side, we find that a lower interest rate depresses savings and demand for second period output. Moreover, a lower interest rate boosts expansion investment, making mature firms bigger and thereby requiring fewer of them to serve the market. Further, the increased firm value boosts joint effort and thereby survival rates so that fewer start-ups are needed for any given number of mature firms. All three effects, i.e. smaller market, bigger mature firms, and a higher survival rate of young firms, add up to reduce demand for entrepreneurship along the demand curve.

Apparently, the equilibrium effect on entrepreneurship is ambiguous when both curves shift as illustrated in Figure 4. In Keuschnigg and Nielsen (2004c) we derive a sufficient condition for the net effect to be negative as stated in Table 1.[12] The corporate income tax discourages entrepreneurial effort and VC support and thereby contributes to a higher rate of business failure. While a falling interest rate boosts firm value, a higher tax reduces it. The direct tax effect dominates to reduce the value of a mature firm and thereby

[12] The corporate tax reduces entrepreneurship if the tax is neutral with respect to expansion investment ($\theta = 1$), or if the interest elasticity of (second period) output demand σ_0 exceeds the elasticity η of capital demand per firm with respect to the user cost, $\sigma_0 \geq \eta$. In Figure 4, a large σ_0 implies that any given interest increase triggers a large increase in market size, leading to a steep slope of the demand schedule. A small capital demand elasticity η leads to a relatively smaller upwards shift of the demand curve. It can thus be illustrated graphically that this condition works to erode entrepreneurship.

diminishes the returns to effort during the start-up phase. The corporate tax thereby leads to a first order welfare loss since efforts are already too low and the rate of business failure too high 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 that would disappear for small taxes. We summarize:

Proposition 1 ***(Corporate Tax on Mature Firms)*** *(a) The corporate income tax reduces market size and the equilibrium interest rate. (b) The corporate tax decreases the number of start-up and mature firms and lowers firm value. (c) It impairs incentives for effort and advice and reduces the success probability. (d) A small tax increase entails a first order welfare loss.*

The tax allowance θ, i.e. the share of investment outlays immediately deductible from the current tax base, allows us to portray different systems of corporate income taxation. Note that we have assumed full depreciation of capital in each production period. Setting the tax allowance to zero corresponds to a Schanz-Haig-Simons corporate income tax with tax depreciation equal to economic depreciation in the second period, see section 2.2. In contrast, immediate expensing of investment outlays corresponding to $\theta = 1$ represents a cash flow tax. Having undertaken an immediate write-off prevents, of course, further tax depreciation in the second period when capital actually depreciates economically. The cash flow tax is well known to be neutral with respect to investment, resulting in a *marginal effective tax rate* on expansion investment equal to zero. In this case, the user cost of capital in (1) exclusively depends on the rate of interest but is independent of the tax rate. However, the *average effective tax rate* of the cash flow tax (i.e. the share of corporate income paid in tax) is strictly greater than zero since the it continues to tax economic rents unrelated to the returns on marginal investments. Notwithstanding the neutrality of the cash flow tax with respect to marginal expansion investment, the tax burden is capitalized in a lower firm value. In reducing the IPO price, the cash flow tax does distort against discrete start-up investment. It also impairs the incentives of

entrepreneurs and VCs to engage in their firms and thereby contributes to more frequent business failure. Given that joint efforts are already too low from a social perspective, the cash flow tax diminishes welfare and efficiency as in Proposition 1.

Consider now the effects of more favorable tax depreciation or tax allowance for expansion investment, i.e. an increase in θ, and keep the tax rate constant. Of course, investment expensing is valuable only if the tax rate is positive already. A more generous allowance promotes expansion investment and, by reducing the average effective tax rate, boosts firm value. Given a larger value to be realized at IPO, entrepreneurs can expect a larger surplus from business creation and will accordingly start businesses more often. In consequence, the supply schedule in Figure 4 for young entrepreneurial firms shifts up (to be drawn by the reader). At the same time, the expectation of larger IPO values invigorates the joint effort in the start-up phase and contributes to improved survival rates. With higher survival chances, fewer firms need to be started if any given number of them must reach the production stage. The increased tax allowance further raises expansion investment and production in mature firms which likewise reduces the demand for entrepreneurship. The demand schedule in Figure 4 thus moves down for both reasons.

Obviously, to eliminate the resulting net supply of entrepreneurial firms, the interest rate must rise to force exit. Although a higher interest rates erodes firm values, it does not overturn the positive direct effect of the tax allowance. The net effect is an increase in IPO value which boosts the return to effort and encourages VCs to advise more intensively. Start-up firms accordingly benefit from this extra effort in terms of improved survival chances. Given that joint effort is too low initially, the tax allowance results in a first order welfare gain. Finally, the rate of business creation and the number of mature firms result from offsetting influences. First, the higher equilibrium interest rate reflects larger market size due to higher demand for second period output which expands the demand for both types of firms. Second, the tax allowance boosts marginal investments and makes mature firms bigger. The market supports a smaller number of them which negatively feeds back on the rate of business creation as well. The analysis in Keuschnigg and Nielsen

(2004c) finds the net effect to be positive. Third, given that start-ups are more likely to mature to production stage, fewer of them are needed for any given number of firms on the product market. Again, our computations report a net positive effect.

Proposition 2 ***(Tax Allowance for Expansion Investment)*** *(a) With a corporate tax in place, a more generous tax allowance for expansion investment raises equilibrium interest and boosts market size. (b) The tax allowance boosts firm values and raises the number of young and mature firms. (c) In raising firm values, the allowance sharpens incentives for effort and advice and boosts the success probability. (d) By raising mature firm values, the tax allowance stimulates effort and leads to first order welfare gains.*

3.2 Capital Gains Taxes and New Firms

The immediate effect of a capital gains tax on young firms, given expected IPO values V, is to subtract from returns to effort and advice. The tax does not directly affect mature firm value which is exclusively determined by corporate taxes and the market interest rate. As illustrated in Figure 2, the tax discourages entrepreneurial effort and managerial advice and consequently results in a higher failure rate among start-up firms. The increased risk affects both the supply and demand schedules for entrepreneurship. In reducing the expected surplus from entrepreneurship, fewer agents find it worthwhile to start their own firm. The supply curve thus shifts down as indicated in Figure 4. On the demand side, the tax has no direct impact on market size and expansion investment of mature firms. However, on account of the reduced success probability of young firms, more entrepreneurs are required for any given number of firms to mature to production stage. The demand curve thus shifts up.

In face of the emerging excess demand for entrepreneurship, the interest rate must fall to reestablish equilibrium. The lower interest rate leads to lower savings and second period demand for goods, shrinking the market size. It also encourages mature firm investment and boosts firm values which, in turn, stimulate the returns to joint effort

in the start-up phase. For all three reasons – smaller market size, larger mature firms, and a higher survival rate among start-ups – the demand for new firms falls and reduces entrepreneurship. The increase in firm values on the other hand boosts entrepreneurial surplus and stimulates the supply of new entrepreneurs along the supply curve. The net effect on the equilibrium number of start-up entrepreneurs remains ambiguous. The ambiguity arises despite the tax leading to a smaller number of mature firms. Mature firms also grow bigger since the falling interest rate spurs expansion investment. More entrepreneurs might nevertheless be needed since a lower success rate requires more start-ups for enough of them to mature to production stage.

While the tax discourages joint effort for any given IPO value V, the falling interest rate raises mature firm value and thereby sharpens incentives for effort. In Keuschnigg and Nielsen (2004c) we show that this price adjustment cannot dominate over the direct tax effect, implying lower effort and VC support and, hence, a lower success rate in equilibrium. The reduction in entrepreneurial effort and VC support leads to a welfare loss.

Proposition 3 ***(Capital Gains Tax on Start-up Firms)*** *(a) A symmetric capital gains tax reduces the interest rate and market size. (b) On account of a lower rate of interest, the tax boosts mature firm value, raises expansion investment but reduces the number of mature firms. The change in the number of start-up firms is ambiguous. (c) The tax impairs incentives for effort and advice and reduces the survival probability. (d) Introducing a small capital gains tax on start-up firms entails a first order welfare loss.*

A corollary of this proposition is that a small negative capital gains tax – or a revenue subsidy – for young firms will encourage effort and VC support and thereby contribute to higher welfare. However, a possible tax break in capital gains taxation must be limited to young VC backed firms only. We have also assumed full loss offset in capital gains taxation. The results on the capital gains tax are robust to restrictions on loss offset. Interestingly, the loss offset limitation can itself strengthen incentives for VC support in

that the tax penalty arising from a limited loss offset makes business failure more costly (Keuschnigg and Nielsen, 2003b).

3.3 A Subsidy to the Cost of Capital

Most real world policies to encourage business creation allow for interest subsidies, loan guarantees to facilitate access to cheaper bank loans, or direct subsidies to investment spending. All these measures subsidize the cost of capital and are largely unrelated to firm performance. They can thus be understood as a subsidy to the cost of start-up investment, captured by z in our model. The only direct effect of an increase in the investment subsidy is to raise the entrepreneur's surplus from starting the firm and thereby to encourage entry, see (7) and (11). There are no other direct effects neither on effort and advice nor on the demand for start-up firms. In Figure 4, the subsidy thus shifts up the supply schedule, creating excess supply of entrepreneurs. The adjustment mechanism is well known by now. The interest rate must rise to stimulate savings and demand for second period output which leads to more demand for mature and young firms. At the same time, the increase in the interest rate erodes firm value and entrepreneurial surplus which cuts back on entry and supply of new firms. The new equilibrium is characterized by a higher interest rate, larger market size and supports a larger number of entrepreneurs and mature firms. The higher interest rate retards mature firm investment and erodes firm values, see Table 1.

The undesirable side effect of start-up subsidies is that they impair incentives for entrepreneurial effort and VC advice. The success probability correspondingly declines. The more successful these subsidies are in stimulating entry, the more likely should be the decline in venture returns and the stronger the negative welfare consequences. Note, however, that the welfare loss results from a general equilibrium effect rather than any direct impact. In a small open economy with a fixed interest rate, mature firm value should remain constant. In this case, the incentives for joint effort would remain untarnished and the subsidy would only produce increased entry. Since the entry margin is not distorted,

the subsidy would entail a zero welfare effect in this case.[13]

Proposition 4 ***(Capital Subsidy to Start-ups)*** *(a) A subsidy to start-up capital cost raises the interest rate and expands market size. (b) The subsidy expands the number of young and mature firms, but erodes mature firm value. (c) It impairs incentives for effort and VC advice and reduces the survival rate. (d) Introducing a small subsidy entails a first order welfare loss.*

The fact that a start-up subsidy and the capital gains tax both reduce welfare suggests the following strategy that would countribute to a more active VC industry, yet avoid any high cost to the general tax payer. Impose a tax $z < 0$ on start-up investment cost and use the proceeds to finance a narrow tax break $\tau < 0$ on capital gains to young VC backed firms. Since the entrepreneur is wealth-constrained, the start-up tax must be paid by the VC who should have no difficulty in raising capital and who will share the revenue subsidy with the entrepreneur when the venture succeeds. Being self-financed, the policy provides a *net* tax or subsidy equal to zero. A small start-up tax thus finances a cut in the capital gains tax rate by $(pV - I)\, d\tau = I dz$.

Consider first the direct impact for a given mature firm value V.[14] The direct effects on entrepreneurial surplus from the investment tax and from the revenue subsidy exactly cancel out because the policy is constructed to be self-financing. However, the tax break on τ strengthens incentives, thereby boosting joint effort as illustrated in Figure 2, and consequently increases the success rate as well. As a result, the project surplus increases and encourages entry of entrepreneurial firms. The supply schedule in Figure 4 shifts up. At the same time and for any given V, the tax cut τ reduces the demand for entrepreneurship because it makes start-ups more successful by inducing more effort. Fewer firms are needed to satisfy goods demand if more of them mature to production stage.

[13] Assuming a fixed interest as in a small open economy would not change the qualitative results of propositions 1 to 3 which do not hinge on the general equilibrium effects on the interest rate.

[14] For a more formal exposition of the effects of the self-financing policy we refer to Keuschnigg and Nielsen (2004a).

The demand schedule shifts down. The equilibrium effect on entrepreneurship remains ambiguous, but the interest rate goes up to close the gap between demand and supply. Furthermore, it is easily shown that *net* venture values $(1-\tau)V$ increase on account of the tax cut. Accordingly, the self-financing policy stimulates joint effort and raises the survival rate in equilibrium as well. This brings about an improvement in welfare.[15]

Our framework hence essentially implies that public policy should not aim at more, but at more successful VC backed firms. Policy should not aim at the volume, but at the quality of VC investments. This conforms quite well with the conclusions of Bottazzi and Da Rin (2002) and Hege et al. (2003) about VC in Europe. They argue that in Europe VC has expanded quite impressively over the last decade, but the impact on firm performance seemingly remained rather limited. If anything, this calls for a policy that sharpens incentives for more entrepreneurial effort and more active VC involvement. In our framework, the entry margin is undistorted, but the double moral hazard between entrepreneurs and VCs works to erode incentives for value creating effort. While in many countries current policy vis-a-vis start-up firms essentially consists in a series of subsidies to investment in these firms, coupled with taxation of capital gains, our analysis suggests that scaling down these subsidies and using the budget savings to finance a narrow tax break for capital gains on VC backed investments would be beneficial.

3.4 Wage Taxation

The rate of business creation depends not only on the surplus created by new entrepreneurial firms but also on 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 implications of wage taxation in our model are easily inferred. The wage tax exclusively influences the occupational choice decision. In reducing the opportunity cost of entrepreneurship, it stimulates entry of new entrepreneurs and

[15] Note that the policy would work even better in an open economy where any adjustment in the interest rate and mature firm value is limited.

thereby shifts up the supply schedule in Figure 4. To equilibrate demand and supply of new entrepreneurial firms, the interest rate must rise. The higher interest rate presses down the value of new firms at IPO. Lower venture returns, in turn, hurt effort and advice in start-up firms, harm their survival prospects and ultimately reduce welfare. The effects are qualitatively identical to the capital cost subsidy.

Proposition 5 ***(Wage Tax)*** *(a) A higher wage tax raises the interest rate and expands market size. (b) The tax expands entrepreneurship and the number of mature firms, but erodes firm value. (c) It impairs incentives for effort and advice and reduces the survival probability. (d) Introducing a small wage tax leads to a first order welfare loss.*

As a corollary, a *subsidy* to wage income would restrict entry, leading to fewer firms with higher values. The subsidy could raise welfare since increased firm values sharpen incentives for joint effort. The start-up investment tax in the preceding subsection and the wage subsidy in this subsection can be compared to DeMeza and Webb (1987) who argue, for entirely different reasons, that entrepreneurial entry should be discouraged.

4 Conclusions

This chapter has proposed an equibrium model of the venture capital industry and has investigated the consequences and appropriateness of fiscal policy for the quality and quantity of venture capital financed entrepreneurship. Such an analysis is important for several reasons. First, the creation of young entrepreneurial firms is a significant factor in promoting employment and innovation in a growing economy. Second, venture capital has become an increasingly important source of finance for start-up firms over the last decades in virtually all industrial countries. In combining financing of new firms with active advice and networking support, venture capital can help the professionalization of their portfolio companies and add value to the investments. For this reason, venture capital backed firms appear to outperform similar firms without access to venture capital,

making them a particularly important source of job growth and innovation in the economy. Empirical research for the U.S. such as Kortum and Lerner (2000) has shown indeed that a disproportionately large share of industrial innovation in the U.S. originates with venture capital backed firms. Policy makers are thus much concerned about creating the right policy environment for a dynamic venture capital industry.

Third, the business community at large as well as the venture capital industry itself have repeatedly questioned whether existing public policies are sufficiently conducive to the development of start-ups firms. For instance, the European Venture Capital and Private Equity Association has twice issued a benchmarking report on the conditions for entrepreneurship in its member countries. These reports define a favorable environment by low corporate income taxes and taxes on capital gains on individual investments in entrepreneurial firms. They also point to the importance of fiscal subsidies to research and development and other early stage investment cost. It is therefore important to scrutinize the economic rationale as well as the effectiveness of these policies in stimulating the venture capital sector.

Rather than simply arguing for high subsidies and low taxes to stimulate entrepreneurship, as is often done, a stringent theoretical framework is called for in order to appropriately assess the role of relevant taxes and subsidies in determining the level and quality of venture capital backed entrepreneurship and economic efficiency. We have proposed a structural equilibrium model of the venture capital industry that emphasizes the need for outside risk capital and points to the importance of incentive problems that entrepreneurs and financiers may face in a typical, innovative start-up company. With this formal framework at hand, we have derived some important policy implications.

Our results imply that the taxation of capital gains derived from young firms may be quite harmful to the quality of venture capital financed entrepreneurship and may diminish welfare. Further, and perhaps surprisingly, corporate taxes are not only harmful to the expansion investment and value of mature firms but could be equally harmful to start-up firms which have not yet begun to actually pay the tax. In reducing mature

firm value to be realized at the end of the start-up phase, the corporate tax impairs the incentives of entrepreneurs and venture capitalists for effort and active advice at the early stage of the firm's development. It may therefore contribute to an overly high failure rate and harm the quality of venture capital backed firms. Our analysis thus 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 venture capital 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 to the tax payer that much reduce the actual tax burden. Second, there might be some practical difficulties in selectively applying a tax break to venture capital backed firms only.

Most of the real world programs to stimulate business creation involve a subsidy to the cost of capital in one or the other form. However, since these subsidies are given early on and are not success-related, they are not useful for sharpening incentives for effort and advice. Because they boost the rate of business creation, they may actually reduce equilibrium venture returns and thereby discourage effort and advice within VC-backed start-ups. When reducing the quality of entrepreneurship this way, investment subsidies may turn out to be quite undesirable.

Our insights as to the role of taxes and subsidies show that they can be combined in a self-financing way to improve the quality of venture capital investments. Instead of a subsidy, a tax on start-up capital cost is proposed with the revenue used to finance a selective tax cut on the capital gains derived from venture capital backed investment. This package replaces a non-performance related subsidy with a success related tax cut, sharpens incentives within start-up firms and should thereby contribute to a more active style of venture capital financing. Very importantly, this package implies a zero net tax or subsidy per project and thereby does not come at the expense of the general tax payer.

There are, of course, other arguments such as the possibility of new innovative firms creating spillovers to other firms may be relevant in designing an appropriate policy vis-

a-vis high-technology start-ups. Such technological spillovers might call for a net subsidy to the sector (see Keuschnigg, 2003). However, even in this case our analysis implies that the subsidy should be given in form of a selective tax break which strengthens incentives by rewarding success. In contrast, a subsidy to the cost of capital is given irrespective of the ultimate performance of the company and is therefore not suitable to strengthen incentives for better survival chances of start-up investments.

As always, the results of policy analysis must be seen in light of the specifics of the theoretical model used. We have chosen to focus on what we believe are important incentive (moral hazard) problems related to value generation in start-up firms. Other information problems (of the adverse selection type) may be relevant as well in designing an appropriate policy vis-a-vis high-technology start-ups. This literature, as summarized by De Meza (2002) among others, partly argues for a tax on entry such as an interest tax on capital investment to offset a tendency for entrepreneurial overinvestment. Quite reassuringly, there seems no important conflict with our analysis. Our framework does *not* call for a *net* subsidy to encourage entry but only recommends a restructuring of existing taxes and subsidies to strengthen incentives and thereby raise survival prospects of start-up firms. In this sense, our analysis argues not for more, but for more successful venture capital backed firms. Hopefully, these issues will be further addressed in future research within a unified framework that considers both the screening and value added activities of venture capitalists.

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