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Document Identifier

D5.9 Stock Option Taxation: A Missing Piece in European Innovation Policy?

Version

1.0

Date Due

M18

Submission date

2nd May 2017

WorkPackage

5

Lead Beneficiary

Research Institute of Industrial Economics (IFN)

Content

Stock Option Taxation: A Missing Piece in European Innovation Policy?[‡]

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April 29, 2017

Abstract: Venture capital has become a dominant form of innovation finance, used by many high-tech startups. Europe lags the U.S. in both VC activity and the creation of successful startups, and has recently been surpassed by China. Few European countries have rates of VC activity commensurable to their deep financial markets, strong legal institutions and high R&D spending.

This paper points to the tax treatment of employee stock options as an important and neglected explanation. Innovative entrepreneurship is a complex activity that normally requires support structures and collaboration by actors providing financial and human capital to startups. As a response to high uncertainty and transaction costs, VC financiers developed a model where founders and key recruitments are compensated with stock options under complex contracts.

While most countries tax stock options as labor earnings, the U.S. allow them to be taxed at a low capital gains tax rate. This has led to near universal use of stock options in U.S. VC deals, while this remains less common in Europe. There is a strong correlation between favorable tax treatment of employee stock options and VC activity. We discuss the interaction between tax policy and contract theory to show why employee stock options are a suitable solution to agency and incentive problems in this sector. A major advantage of this tax policy is that it narrowly targets entrepreneurial startups without requiring broad tax cuts.

Keywords: Business taxation; Corporate governance; Entrepreneurship; Innovation; Institutions; Tax policy; Venture capital.

JEL *Codes*: L26 Entrepreneurship; H25 Business Taxes and Subsidies; H3 Fiscal Policies and Behavior of Economic Agents; K34 Tax Law.

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1. Introduction

The emergence of venture capital (VC) funding represented a transformative change for entrepreneurship, particularly in high-tech sectors. However, the extent of VC activity varies greatly among industrialized countries. Only a fairly small number of countries have been able to develop a significant VC sector, usually economies with high per capita GDP, strong property and contractual rights, advanced financial sectors and knowledge intensive industries. Interestingly, far from all economies fulfilling these prerequisites have developed vibrant VC sectors. This suggests that the aforementioned factors are necessary but not sufficient conditions for VC sectors to flourish, and that other factors such as taxation may play a role.

Especially in the United States, the VC sector remains significantly larger than in Europe and East Asia. This is so despite the fact that Western Europe has well developed financial markets and is not far behind the United States in terms of R&D spending, the high-tech sector share of the economy and the level of education of its workforce (Henrekson and Sanandaji 2015).

Compared to the early 1990s, the VC sector has grown in Europe, but as shown in *Figure 1* it remains far smaller than in the United States. This is particularly the case in Eastern Europe, where the VC industry remains miniscule. The newly emerged market economies in Eastern Europe still lack the mature financial sectors and the strong property and contractual rights required for a large venture capital sector (Elert et al. 2017; Åslund and Djankov 2017). These binding institutional constraints so far appear to have prevented the emergence of VC activity in Eastern European countries, despite the fact that owner-level taxes in many cases are low. In contrast to Eastern Europe, VC activity has increased significantly in China and the level is now on par with the level in Western Europe.

The U.S. VC sector is not only much larger than its European counterpart; it also differs regarding the compensation structure. The U.S. VC sector relies almost universally on stock options to compensate founders, CEOs and key employees. Stock options are far less common in other countries, where a mix of financial instruments tends to be used (Bascha and Walz 2001; Schwienbacher 2005; Hege et al. 2003; Cumming 2012).

Figure 1 Venture capital investment as a share of GDP in Western Europe, Eastern Europe, the U.S. and China, 1989–2015.

U.S. 1999 = 0.57
U.S. 2000 = 1.03

U.S.

Western Europe

Eastern Europe

China
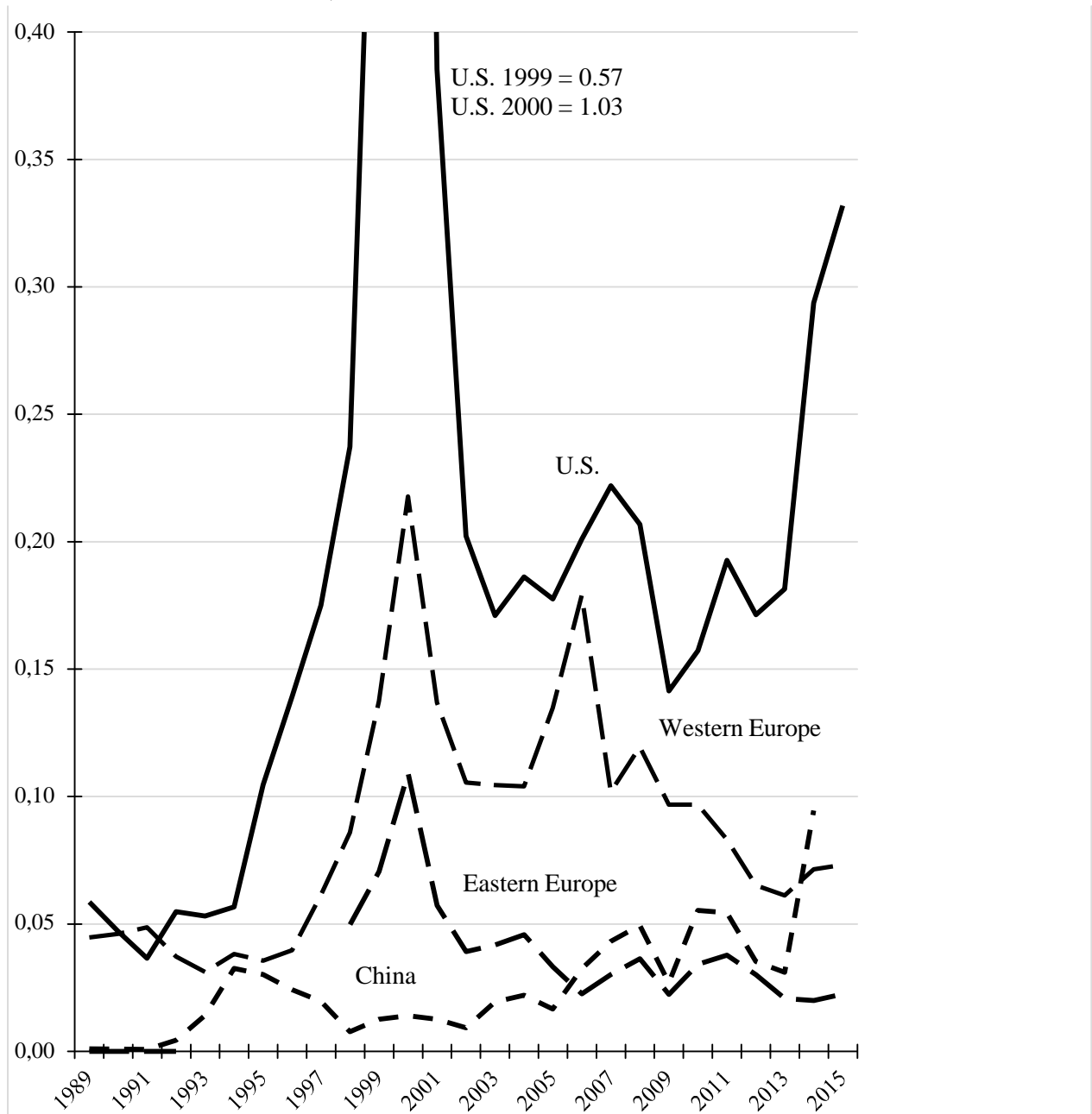
Note: Western Europe = the average for Germany, France, Italy, Spain, the Netherlands, Greece, Belgium, Portugal, Sweden, Austria, Denmark, Finland, Ireland, Luxembourg, Switzerland, Norway and Iceland. Eastern Europe = the average for Poland, Hungary, Romania, Bulgaria, Czech Republic, Slovakia, Slovenia, Estonia, Latvia and Lithuania.
Source: Eurostat for Eastern and Western Europe, National Venture Capital Association for the United States and the Asian Venture Capital Journal for China.

The stock options frequently used in VC-backed ventures are call options on the common stock of a company, granted to employees as part of their remuneration packages. The grantee obtains the options to acquire a pre-specified share of equity under certain well-specified circumstances. If the business is less successful or if the founder leaves the firm prematurely,

the option loses value. Economic theory offers elegant explanations for the complicated reward structure in entrepreneurial finance. Stock options have proven to be a suitable compensation form in VC finance, since it solves common contractual problems by efficiently allocating control between investor and entrepreneur (Gompers 1997; Black and Gilson 1998; Kaplan and Strömberg 2003).

Why then are not stock options used to the same extent in VC-backed ventures in Europe? Could there be some factor that dissuades the use of stock options in compensation contracts in some countries and that this effect is an important explanation for the smaller VC sectors in most wealthy countries compared to the United States? This paper argues that the tax treatment of employee stock options is a major independent factor explaining cross-country differences in the size of the VC sector.

The U.S. tax system by tradition treats income from exercised employee stock options as capital gains, allowing earnings to be postponed and taxed at a lower rate.[1] The favorable tax treatment of employee stock options bestows a sizable tax advantage to American entrepreneurs (Gilson and Schizer 2003; Cumming 2005a). No such advantage is enjoyed by individuals in most other sectors of the U.S. economy, and as we will show, neither are such tax advantages enjoyed by entrepreneurs in most other rich countries.

Our analysis will show that stock options are intrinsically advantageous in the VC sector. A favorable tax treatment has therefore led to widespread use and a *de facto* low effective taxation of VC-funded entrepreneurship as a whole. This helps explain not only why stock options are more commonly used, but also why VC activity is so high in the United States compared to virtually all other industrialized countries.[2]

We study the relationship between taxes on employee stock options and VC activity in 22 countries, 13 of which are in Western Europe. Since the effective tax rate of stock option contracts is a matter of tax practice, effective rates are not immediately apparent from

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[1] This is the case for so-called incentive stock options (ISOs), which are the type discussed here. In order to benefit from the favorable capital gains tax, the employee has to comply with certain additional tax code requirements. Most importantly, shares acquired upon exercise of ISOs must be held for at least one year after the date of exercise, and two years after the ISO was granted. If other conditions are satisfied, including a five-year holding period, the owner of stock in a small business is eligible for a further rate reduction. A holder of small business stock can also benefit from the "rollover" rule, under which tax that otherwise would be due from a sale of stock is deferred if the taxpayer reinvests sale proceeds in other qualifying stock (Gilson and Schizer 2003; Scholes et al. 2014).

[2] A new source of entrepreneurial financing is crowd funding. This has taken off to a much greater extent in the UK than in Continental Europe. Estrin et al. (2016) find that this is likely to be due to a more favorable regulatory environment, including a more supportive tax regime. This is quite in line with our findings for VC financing.

comparisons of statutory tax rates. Investors in each country tend to design their contractual agreements in ways that reduce the effective tax burden. We therefore estimate the effective tax rate based on a standardized case of a typical entrepreneurial startup using stock option contracts. We commissioned the tax consultancy firm PwC to estimate the "best practice" in each country with the help of local tax offices. Ideally, we would include more countries than 22, but the detailed estimate of effective tax rate by PwC rather than statutory tax rates made the cost of collecting data per country high. We therefore excluded Eastern Europe, smaller countries and middle income countries, which we hope to include in future studies. The expanded sample could also be used as a robustness check for the results from the core sample.

Our results show that national tax rates vary enormously, ranging from 72 percent in Italy to seven percent in Ireland. There is a strongly negative cross-country correlation between the effective tax rate on employee stock options and the rate of VC activity, both directly and when controlling for several alternative or complementary explanations. While this correlation does not prove a causal link, it is supportive of the notion that low taxes on employee stock options promote VC-funded entrepreneurship.

Hence, a more lenient taxation of gains on employee stock options may be a useful tool to achieve the policy goals of promoting entrepreneurship and the venture capital sector. Lowering these tax rates would narrowly target firms in the entrepreneurial sector able to attract venture capital, while broad tax cuts would result in large revenue losses and risk increasing inequality. This allows the state to promote a small but strategic sector of the economy without much loss of revenue or increase in inequality that would result from large general cuts in capital taxation.

The remainder of the paper is structured as follows: The literature on this topic is reviewed in Section 2. Section 3 summarizes the theoretical explanation for the use of stock options. Section 4 presents the effective tax rate for a stylized VC-funded entrepreneurial firm which uses employee stock options to compensate founders, hired CEOs and other key personnel. Section 5 presents cross-country regressions of the effective tax rate and VC activity, and to explore the robustness of our results we also present results using other indicators of entrepreneurship. Section 6 discusses policy implications and concludes.

2. Previous Studies

VC-backed deals in the United States almost always use stock options in the form of call options on the common stock of a company. VC firms typically invest in the form of convertible equity in order to secure priority in case of bad performance, and to achieve more favorable tax treatment for the entrepreneur and other portfolio company employees. In one representative sample, convertible preferred equity was used in 95 percent of rounds of financing in venture capital deals (Gilson and Schizer 2003). Kaplan and Strömberg (2003) similarly report that nearly 96 percent of all U.S. venture contracts used convertible preferred equity. Around 80 percent of the financing rounds in their sample were financed solely by convertible preferred equity. Hand (2008) reports that 89 percent of employees of VC-backed firms had stock options. While convertible securities contracts are also used as compensation by large public firms, they are far less important than in the VC sector. Gilson and Schizer (2003) estimate that around 10 percent of public firms in the United States have issued outstanding convertible preferred stock. According to Hand (2008), around 20 percent of large U.S. firms give their employees broad stock options programs.

The widespread use of these contracts in the United States has inspired a sizable literature. The popularity of stock options and convertible equity in VC-backed deals is believed to be fairly well explained by economic theory, as the allocation of control rights follows the theoretical prediction of the incomplete contracting approach in agency theory (Holmström 1979; Grossman and Hart 1986; Hart and Moore 1990; Aghion and Bolton 1992).

The fundamental explanation is that entrepreneurial finance is characterized by great uncertainty and high transaction costs (Kaplan and Strömberg 2003; Lerner and Schoar 2005; Cumming 2005b; Kaplan et al. 2007). Startups must attract and retain talented people with the right skills and offer a chance for high returns, despite being initially cash constrained. Assets are relation specific (Caballero 2007), with the success of startups hinging on successful cooperation between investors and founders whose interests do not perfectly overlap.

Contracts must thus deal with adverse selection, moral hazard and high monitoring costs. This is all the more difficult due to unusually high levels of uncertainty and ambiguity over future outcomes (Repullo and Suarez 2004). In this complex environment, contingent contracts have evolved to mitigate agency problems and align the interests of founders and investors. An influential study by Kaplan and Strömberg (2003) showed that contracts allocate control rights separately, including cash flow rights, board rights, voting rights and liquidation

rights.[3] Venture capitalists make use of tools such as contingencies, milestones to be reached and restricted property rules (notably vesting) to deal with various agency problems. By accepting a compensation form mostly contingent on success, entrepreneurs signal quality and motivation. Startups and high-growth firms are by nature cash-constrained while having a strong demand for skilled experts. Employee stock options allow them to lure away employees from well-paying jobs by offering a chance for future rewards (Core and Guay 2001; Yermack 1995).

It is difficult to obtain comprehensive country-wide data on the use of convertible contracts, but there are estimates based on various samples of VC transactions. Hege et al. (2003) conducted surveys of venture capitalists in the U.S. and Europe in 2001. In their sample, stock options were used in roughly 60 percent of the cases in the United States compared to a mere 20 percent of the cases in Europe. Using a somewhat different definition, Kaplan et al. (2007) found that 95 percent of the U.S. financings employed some type of convertible preferred stock, compared to fewer than 54 percent of the non-U.S. deals.

By issuing convertible preferred stock to VC firms, a more favorable tax treatment for the entrepreneur, the CEO and other key employees can be obtained. The latter are given claims on common stock for which the IRS permits the company to assign an artificially low value at the time of investment. As a result, the employee suffers negligible tax consequences upon granting or exercise of the option. The tax liability can be deferred until the shares are actually sold, and then the low capital gains rate applies (Gilson and Schizer 2003).

The fact that most deals include a combination of convertible preferred equity and call options on common stock does not imply that these are the only forms of equity or compensation used in the transaction. A mix of different financial instruments with various qualities increases flexibility to structure control rights and induce effort (De Bettignies 2008). Cumming (2005a) shows that U.S. venture capitalists active both in Canada and the United States are far less likely to use convertible equity in Canadian deals. This suggests that the differences in the type of instrument used reflect institutional differences in the tax and regulatory environ- ment between the two countries rather than differences in traditions and the corporate culture of venture capital firms.

Founders, CEOs and certain key employees of entrepreneurial startups may not be the only type of human capital for whom stock options are an advantageous compensation form. In

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[3] See Cumming (2012) for an exhaustive list.

fact, it is far more likely for entrepreneurial startups to grant stock options to a broader range of employees than for large established firms. Hand (2008, p. 388) summarizes the benefits: "[E]mployee stock options have long been seen by technology entrepreneurs and venture capitalists as being vital mechanisms through which high-risk, high-return startups are able to attract, compensate, incent, monitor, and retain the right kinds of employees."

CEOs in particular tend to be granted stock options corresponding to a sizable equity share, should the options be exercised. Bengtsson and Hand (2011, 2013) rely on the database VentureOne to study compensation programs in entrepreneurial firms during 2002–2007. Around 75 percent of VC-backed firms grant stock options to their employees. As expected, equity is found to be a common compensation form for CEOs of entrepreneurial firms. CEOs are found to hold an average of 9 percent of equity, mostly in the form of yet unexercised stock options. Another interesting finding is that founder employees hold larger equity compensation, but receive less cash pay, than people hired later. This indirectly supports the notion that employee stock options are more valuable for entrepreneurial firms in the startup phase. Bengtsson and Hand (2013) also report that hired-on employees in VC-dominated firms are given stronger cash- and equity-based incentives.

Cross-country differences in entrepreneurship have been tied to tax policy and the contractual structure of venture capital. Kanniainen and Keuschnigg (2003) point out that U.S. VC firms are more likely than their European counterparts to rely on equity financing rather than debt, and therefore may have stronger incentives to support the professionalization and growth of startups. Cumming (2005a) studies a panel of firms in Canada and finds that the reduction of taxes significantly increased the use of stock options. Lerner and Schoar (2005) show that the rule of law and the institutional quality of security regulation are important determinants of capital structure. Common law countries on average have better performing VC sectors, and it is suggestive that they also employ convertible securities more frequently. Bedu and Montalban (2014) find that European countries with more favorable tax treatment of managers tend to have more VC activity. Chang et al. (2015) report a positive correlation between innovativeness and the firm's use of employee stock options, though the methodology does not permit the establishment of a causal link. Kaplan et al. (2007, p. 289) compare VC investment contracts in 23 countries with the corresponding contracts in the United States. They distinguish between countries with favorable and unfavorable taxation of stock option gains. They do not find any significant difference in the use of stock options and vesting as a result of tax differences. However, they look at *existing* contracts irrespective of

the rules and regulations in the respective countries, while our concern here is to explain the large cross-country differences in VC activity. On the other hand, Cumming (2012), in his overview of the literature, shows that the use of convertible preferred equity is not as prevalent outside the U.S.

Finally, there is a classical and frequently adduced argument suggesting a positive effect of taxes on risk taking. Domar and Musgrave (1944) view taxes as a form of risk sharing with the state. Taxes reduce the return on successful investment, but combined with symmetric loss deduction taxes also cushion losses. High taxes can increase investments by risk-averse agents by compressing the distribution of after-tax returns. The Domar-Musgrave result hinges on the assumption that losses are fully tax deductible. This is sometimes a fair approximation for a marginal investment of large public firms, which can deduct losses on failed projects from profits on other projects. Full tax deductibility is rarely, if ever, an empirically valid assumption when it comes to investments in startups by individuals. Full deduction is also unlikely once occupational choice is taken into account (Kanniainen and Panteghini 2013). The loss for individuals resulting from failed entrepreneurial startups includes the opportunity cost of giving up their alternative career. While these earnings are taxed, there are no corresponding deductions that compensate failed entrepreneurs who become unemployed for their loss of earnings, human capital depreciation and lost career opportunities.

3. The Need for Well-Designed Compensation Contracts

Achieving success in innovative entrepreneurship is lucrative but also difficult and rare.[4] Innovative firms must overcome technological complexity, uncertainty, high initial investment costs as well as fierce competition from incumbent firms. Entrepreneurial firms therefore tend to require resources from a support structure of financial and human capital.

Economic activity does not only take place in firms but also through contracts with a broader network of agents with the firm as the nexus (Coase 1937; Jensen and Meckling 1976). The support structure using a contractual nexus is particularly important for innovative firms. Industrial R&D is highly specialized, and has in recent decades witnessed a structural shift towards open innovation models with a large number of partners (Mowery 2009).

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[4] Hall and Woodward (2010) report that 75 percent of the VC-funded entrepreneurial ventures produced no profit for the founder and only ten percent led to sizable profits.

Contrary to the perception of solitary actors going at it alone, successful entrepreneurial firms tend to be collaborative efforts. Although the entrepreneur holds center stage, it is still true that (s)he can generate far more economic activity when leveraged by other complementary actors in an appropriately composed support structure.

Other key actors include active venture capitalists (business angels and/or VC firms), investors, key employees and customers. Venture capitalists offer funds but also contribute key competencies, such as business networks, management expertise, and market knowledge. Capital holders (private individuals and/or portfolio managers) both provide the funds managed by venture capitalists as well as larger injections in later stage expansion and IPOs for firms that achieve substantial growth. Startups with potentially valuable ideas increase their chances of success by early recruitment of top-skill staff in R&D, management and sales.

Figure 2 provides a schematic overview of our argument and *Figure 3* illustrates the complexity of the many relations of the agents in the competence structure, and their respective resource contributions in order to turn an innovation or a new venture idea into a growing and eventually large firm (as described by, among others, Fenn et al. 1995 and Gompers and Lerner 2001).

Successful entrepreneurial firms thus benefit from low transaction costs with the rest of the support structure – both in terms of trust, administrative costs and taxes. The entrepreneurial support structure is less likely to succeed if taxes increase the cost of contract with venture capitalists and key personnel (Keuschnigg and Nielsen 2003, 2004).

In each phase, there are typical problems that must be handled. For portfolio investment in public firms, historical data offer a basis for calculating the expected risk–return relationship reasonably well. By contrast, the risk pertaining to innovative entrepreneurship is rarely calculable (Knight 1921). An entrepreneurial firm typically lacks the necessary capital to fully compensate its employees using cash payments alone. Mature firms, on the other hand, can bear the cash flow risk at relatively low cost by virtue of dispersed ownership and a lower variance in their cash flow.

Because of the founder's superior information and control of the company, the investors' investment is non-fungible. The investment is relation-specific as the value of equity would drop significantly if the founders were replaced or decided to leave. The founders and key

personnel must in turn make relation-specific human capital investments. The high degree of uncertainty and asset specificity makes it costly to formulate explicit contracts that give parties the right incentives in all contingencies. It becomes especially important to protect oneself against opportunistic behavior by other parties. One salient example is the risk that the founders are outmaneuvered by the external investors and forced to leave the firm prematurely (Bolton and Dewatripont 2005, Ch. 11). The investors in turn face the risk of investing in "lemons", or in firms where founders shirk or pursue personal goals that are not aligned with that of financers. Board representation and liquidation rights are often separated from cash-flow rights, with the VC firm obtaining a board representation greater than their equity share. Typically, the contract is structured in a way that gives the VC firm full control if the startup performs poorly, but grants the entrepreneur more control rights as performance improves. Given sufficient success, the VC firm retains its equity share, but hands over most of the control rights.

Figure 2 A schematic overview of the theoretical arguments.

The input from human capital is needed for entrepreneurial firms to succeed

↓

Human capital must receive compensation contracts that induce the needed input

↓

Cash compensation suffers from problems, especially for entrepreneurial firms

↓

Stock option compensation has desirable features, especially for entrepreneurial firms

↓

A country's taxation of stock options introduces transaction costs

1. Income vs. Capital Taxation

2. Social Security/Employer Fees

3. Market Value vs. Low Value

4. Early vs. Late Taxation

Low transaction costs makes it easier for the entrepreneurial firm to attract and retain human capital

↓

Entrepreneurship thrives

High transaction costs makes it harder for the entrepreneurial firm to attract and retain human capital

↓

Entrepreneurship suffers

Figure 3   Necessary actors in value creation.

Wealthy individuals

Savers (future pensioners etc.)

Portfolio managers

Capital holders

Business angels

VC-firms

Agents in secondary markets

Investors

Financial resources combined
with complementary competencies

Idea/innovation

New firm

Growing firm

Large firm

Entrepreneur

Key employees
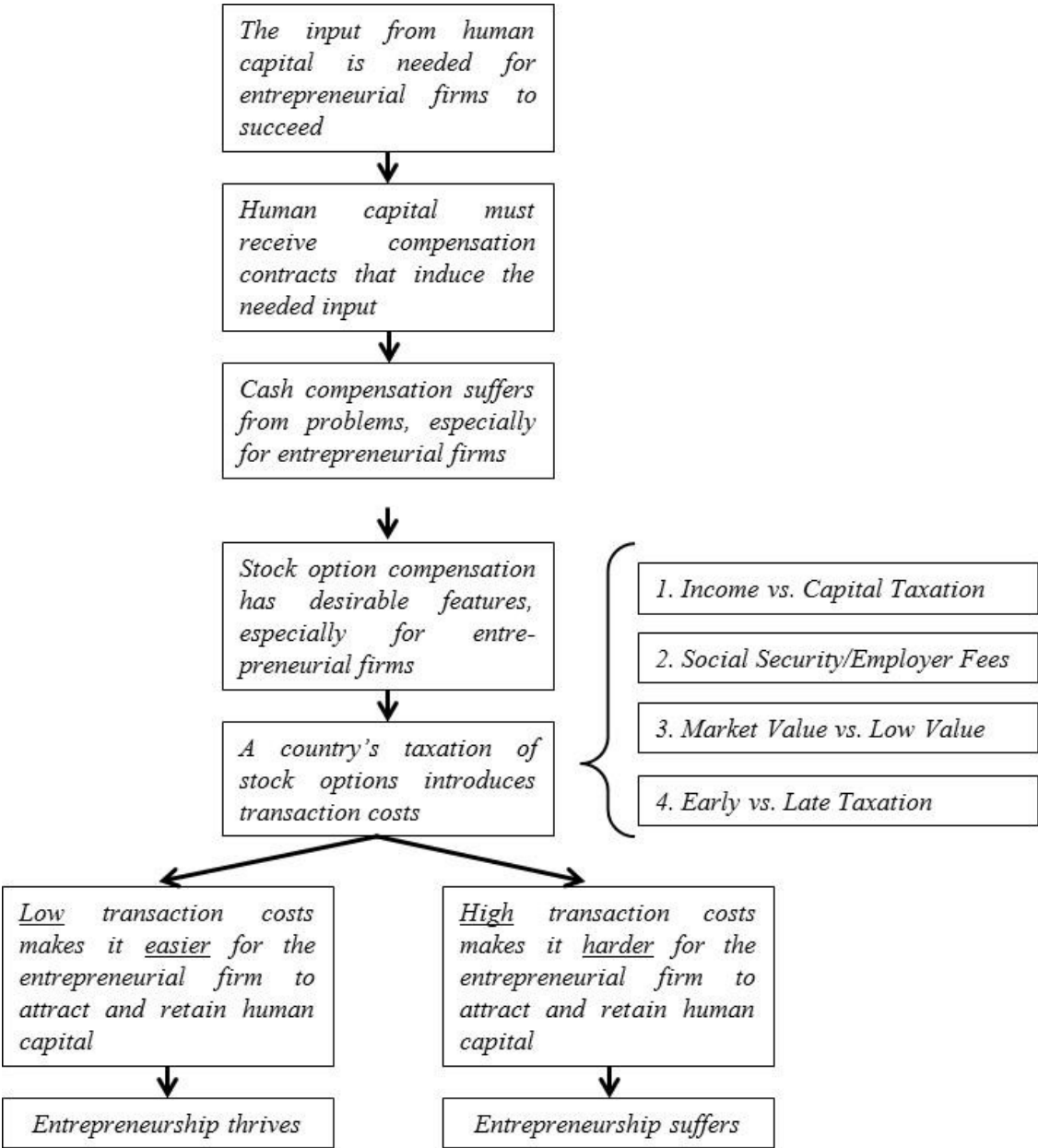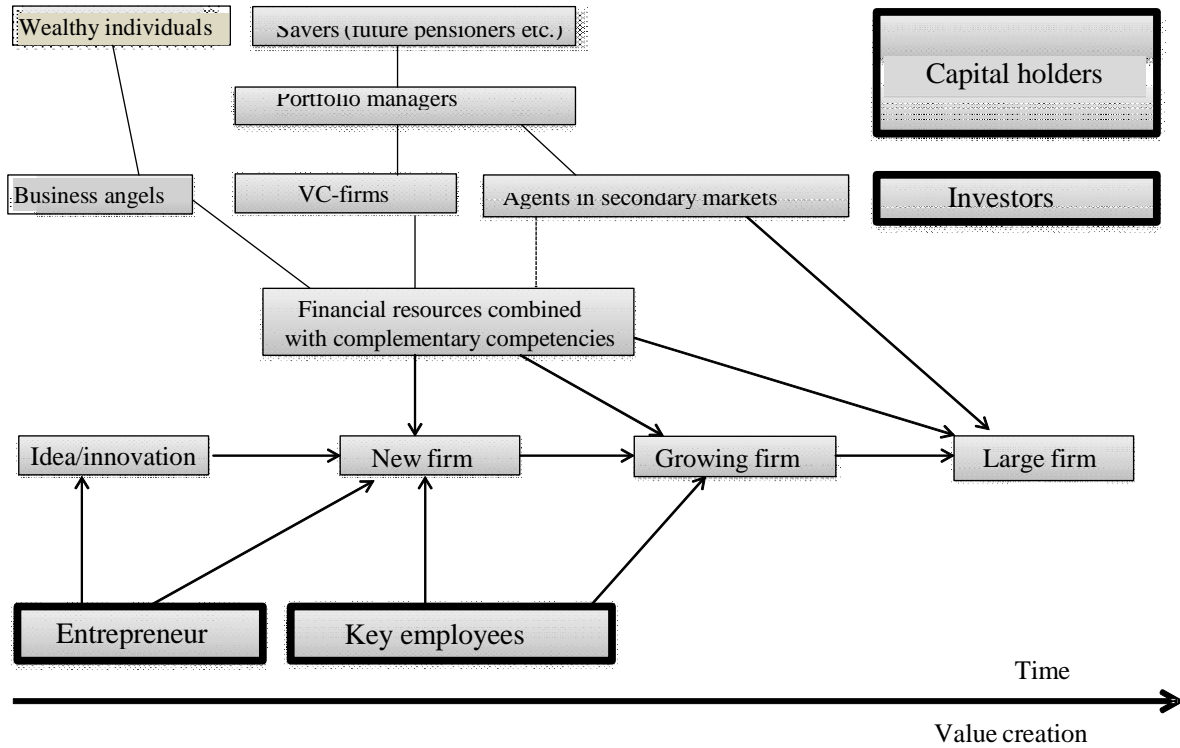
Time

Value creation

12

A compensation contract must meet several requirements. First, it must ensure that the founder or employee receives sufficient compensation to make employment in the entrepreneurial firm attractive, formally "meeting the participation constraint". Potential employees must be compensated for the unusually high risk of failure among entrepreneurial firms, conventionally with higher upside compensation if the firm succeeds. Second, it must induce effort, formally "meeting the incentive constraint". Third, the compensation contract must allocate risk optimally across employees and between employees and investors. A typical investor in an entrepreneurial firm is not willing to bear all such risks and uncertainties unless she receives adequate compensation. In practice, high risk compensation to the investor means that the founder has to sell the firm at a cheap price to the investor, which lowers or may even eliminate the incentive to start the firm in the first place. By contrast, a mature firm has lower and more calculable risk, that is to say less uncertainty. Most importantly, investors in publicly traded firms can substantially reduce this risk through diversification.

A further advantage of stock options is that they facilitate additional layers of state-contingent contracting through vesting. The basic mechanism of vesting is that the firm grants options to a founder or employee. However, the individual only gets to keep these options contingent on certain outcomes. One form of vesting, time vesting, prescribes that the individual loses all or part of the options granted if he or she leaves the firm before some specified date.

Another form of vesting, performance-based vesting, prescribes that options granted are lost if the firm does not meet certain performance milestones. Examples of milestones include a product that works, a pharmaceutical drug that gets FDA approval, or a completed round of VC financing. Hand (2008) reports that the average vesting period for the employees of VC-funded firms that hold stock options is four years.

4. Estimating the Effective Tax Rate on Stock Options in Various Countries

We next provide an empirical analysis of the correlation between stock option taxation and VC activity. A major challenge is that it is difficult to compare the tax rates on employee stock options across countries. The statutory tax rate rarely reflects the true rate, which depends on a myriad of complex rules. Moreover, there is no single tax rate, with the effective tax rate depending, *inter alia*, on the type of firm. In order to be able to reliably compare countries, we constructed a representative firm and asked the accounting firm PricewaterhouseCoopers (PwC) to calculate the tax rate for employee stock options for a sample of countries. PwC in part specializes on tax issues and relied on their tax experts in

each country to estimate the stock option tax rate for the year 2012. Income taxes, capital gains taxes and payroll taxes were included where applicable.

Our sample consists of 22 industrialized countries and includes most of the largest economies in the developed world:[5] Australia, Canada, China, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, South Korea, the Netherlands, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom and the United States.[6]

The effective tax rate is calculated for the following case or scenario. The representative firm is founded in a home or in an incubator by a founder with little initial capital needs. After one year of growth, a further expansion requires an equity infusion that the founder is unable to meet. A VC firm buys the entire firm, simultaneously giving the founder the option to buy back 25 percent of the firm after seven years. The options are priced as the nominal stock value of the firm that applies at year one, which is negligible. After three years, a CEO is hired. He or she is given the option to purchase 10 percent of the firm. The firm is at this point valued at $5 million. After eight years, the firm is bought for $20 million in a trade sale. Immediately before the sale the stock options are exercised and the founder and CEO come to possess 35 percent or $7 million worth of stock which they sell to the purchasing firm.

For some countries, there exist alternative and more favorable tax rates under the representative firm scenario, given that certain additional requirements were fulfilled. When this applies, we rely on the alternative lower tax rate, which real-life firms are likely to take advantage of. *Table 1* reports the tax rates that were calculated by PwC's tax experts. The tax rate is reported as a share of total compensation and the incidence of any payroll taxes is assumed to fall on the recipient of the option.

The tax rates on the options range from 72 percent in Italy (assuming that, if the gains are taxed as labor income, they are taxed at the highest marginal rate) to 7 percent in Ireland. Although the calculated tax rates cannot be said to apply automatically to all entrepreneurial firms, we deem that the representative firm is a sufficiently good proxy for the transaction costs associated with stock option taxation for entrepreneurship more generally.

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[5] Strictly speaking, Hong Kong is a special administrative region and not a country.
[6] Since Eastern European countries lack the mature financial sectors and the strong property and contractual rights required for a large venture capital sector, these countries are excluded due to the high cost of collecting the data.

Table 1 Effective tax rate on stock options in 22 countries, 2012.

Country	Tax rate, %	VC-activity, % of GDP
Australia	24.8	0.026
Canada	31.9	0.040
China	45.0	0.052
Denmark	55.3	0.073
Finland	51.3	0.021
France	29.9	0.047
Germany	47.5	0.014
Hong Kong	15.0	0.227
Ireland	7.4	0.072
Israel	25.0	0.120
Italy	72.2	0.001
Japan	50.5	0.003
Netherlands	25.0	0.020
Norway	50.8	0.053
Portugal	56.5	0.009
Singapore	20.0	0.088
South Korea	61.5	0.038
Spain	52.0	0.012
Sweden	54.3	0.100
Switzerland	51.5	0.107
United Kingdom	28.0	0.075
United States	15.0	0.199

Source: PricewaterhouseCoopers (PwC) and Lerner and Tåg (2013).

We rely on Lerner and Tåg (2013) for the rate of VC activity as a share of GDP. The preferred outcome variable is of course using VC investments that use stock options rather than all VC activity. To our knowledge, there does not exist any systematic cross-country data for this variable, and instead we report results for the VC sector as a whole. *Figure 4* provides a scatterplot of the stock option tax rate and VC investments as a share of GDP. There is a negative, statistically significant correlation between these variables.

Figure 4 Stock option taxation and venture capital investment as a share of GDP (%).
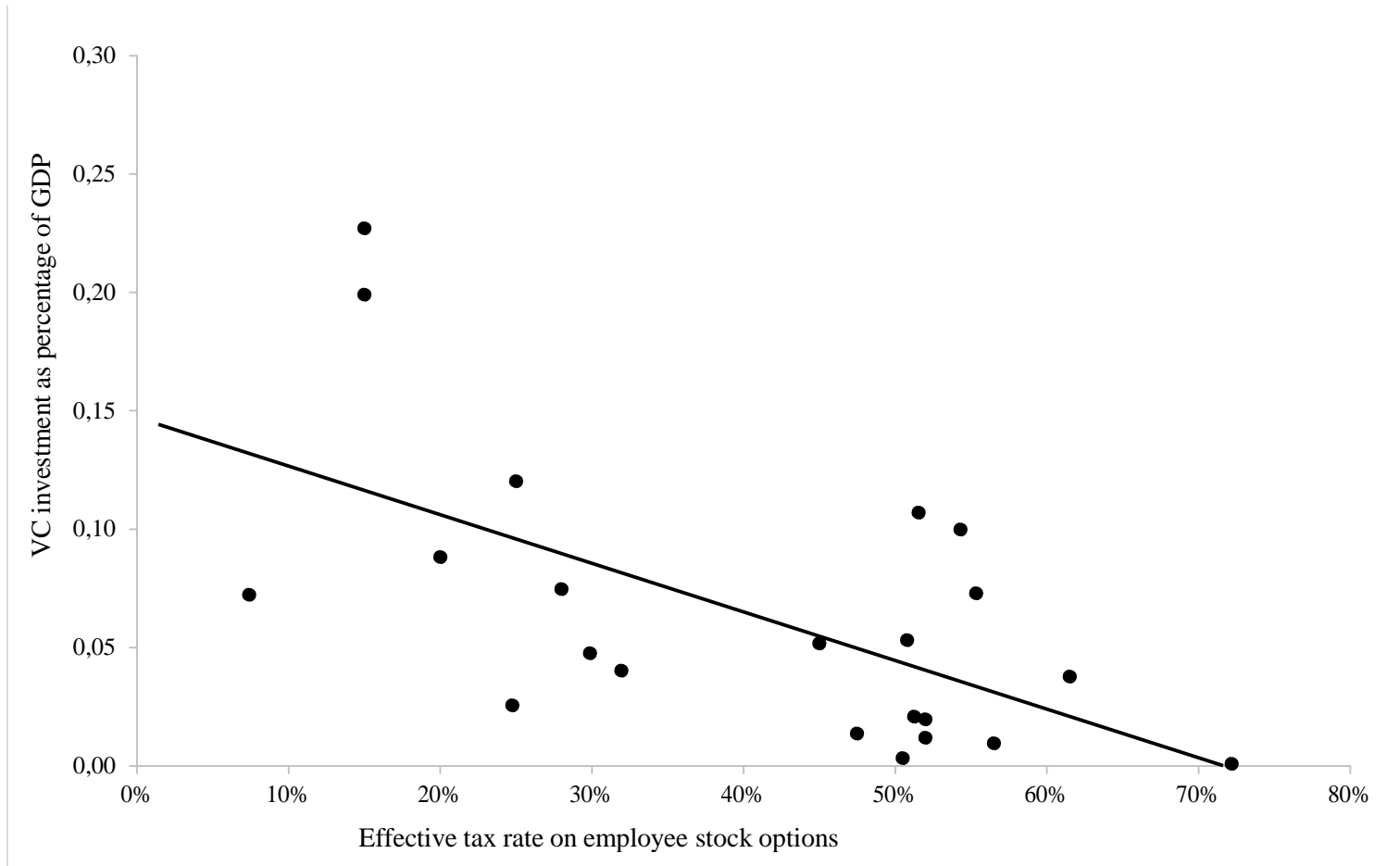
5. Regression Results

Table 2 presents the definitions and sources of the variables used and *Table 3* presents the correlations between all dependent and independent variables used in the regression analyses below. VC activity is positively correlated with per capita GDP, index of business-favorable regulation, market capitalization of listed firms as a share of GDP and with high-growth expectation entrepreneurial activity and the education level of the workforce. VC activity is negatively correlated with option taxes and low-growth expectation entrepreneurial activity. There is no clear correlation with R&D investment as a share of GDP or the profit tax on small firms.

Table 4 presents our main regression estimates. In specifications 2–6 we add several covariates. PPP-adjusted GDP per capita is a standard control. In order to control for human capital intensity and R&D, we use the share with tertiary or college education and R&D activity as a share of GDP. Market capitalization of all listed firms as a share of GDP is used to control for financial sophistication. The index of regulation from the Ease of doing business series is a cardinal estimate of regulations on startups. The World Bank's "Distance to frontier" index benchmarks the regulatory environment in each country and estimates a distance to the best performing country, which allows the regulatory burden to be quantified. The distance to frontier is measured on a scale from 0 to 100, where 0 represents the lowest performance and 100 represents the frontier. For example, a score of 75 means an economy was 25 percentage points away from the frontier. Lastly, we include the profit tax, an estimate of the amount of taxes on profits paid by a standardized small firm.

Table 5 reports the same regressions in a log-log specification where both VC activity and the covariates are logged. The association between the option tax rate and VC activity remains negative and statistically significant in all specifications, with an estimated elasticity ranging from 1 to 1.4. Needless to say, the lack of an exogenous source of variation of tax rates precludes a causal inference. However, the strong negative correlation between tax rates and VC activity is suggestive, and consistent with the view that high option tax rates reduce VC-backed entrepreneurship.

Table 2   Variable definitions.

Variable	Definition	Source
VC/GDP	Venture capital investment as a share of GDP in 2010	Lerner and Tåg (2013)
Option tax	Harmonized effective tax rate on stock option gains in 2012	PwC (see text for details)
GDP/cap	PPP-adjusted GDP per capita in 2010	IMF, http://www.imf.org/external/data.htm
Tertiary educ.	Share of population aged 25–64 with tertiary or college education in 2010	World Bank, http://www.doingbusiness.org/data
R&D/GDP	R&D expenditure as a share of GDP (average 2008–2012)	World Bank, http://www.doingbusiness.org/data
Regul. burden	Index of regulation; a cardinal estimate of regulations on startups (average 2008–2014); scale 0–100, where higher score means less regulation	World Bank, http://www.doingbusiness.org/data
Market cap/GDP	Market capitalization of all listed firms as a share of GDP (average 2008–2014)	World Bank, http://www.doingbusiness.org/data
Profit tax	Tax rate on profits paid by a standardized small firm (average 2008–2014)	World Bank, http://www.doingbusiness.org/data
TEA	Total entrepreneurial activity, share of population aged 18–64 in the process of creating a new business or running a business less than 3.5 years old (average 2008–2014)	*Global Entrepreneurship Monitor Annual Reports*, 2008–2014, http://www.gemconsortium.org/report
High TEA	Subgroup of TEA expecting to employ ≥ 5 people in 5 years (average 2008–2014)	See TEA
Low TEA	Subgroup of TEA expecting to employ < 5 people in 5 years (average 2008–2014)	See TEA

Note: The World Bank data we use was collected within the *Doing Business* project which published its first report in 2004; see World Bank (2015).

Table 3 Correlation matrix of all variables used.

	VC/ GDP	Option tax	GDP/ cap	Tertiary educ.	R&D/ GDP	Regul. burden	Market cap/GDP	Profit tax	High TEA
Option tax	−0.549**								
GDP/cap	0.442**	−0.437**							
Tertiary educ.	0.123	−0.272	0.475**						
R&D/GDP	−0.019	0.195	−0.027	0.500**					
Regul. burden	0.449**	−0.399**	0.812**	0.516**	0.135				
Market cap/GDP	0.723**	−0.388*	0.370*	−0.027	−0.286	0.413*			
Profit tax	−0.002	0.096	0.038	0.247	0.175	0.091	−0.111		
High TEA	0.225	−0.468**	−0.014	0.027	−0.097	0.059	0.092	−0.330*	
Low TEA	−0.100	−0.025	−0.418	−0.169	−0.102	−0.412	−0.260	−0.206	0.688**

Note: * and ** denote significance at the 10 and 5 percent, respectively.

Table 4 Cross-country regressions of VC activity as a share of GDP and stock option tax rates.

	(1)	(2)	(3)	(4)	(4)	(6)
Option tax rate	−0.185**	−0.176**	−0.121*	−0.121*	−0.126*	−0.127*
	(0.073)	(0.065)	(0.059)	(0.061)	(0.065)	(0.067)
GDP per capita		0.216	0.0931	0.121	0.0947	0.127
		(0.138)	(0.103)	(0.117)	(0.094)	(0.116)
Share with tertiary education		−0.176	−0.108	−0.103	−0.124	−0.119
		(0.126)	(0.086)	(0.090)	(0.082)	(0.084)
R&D share of GDP		1.648	2.136**	2.210**	2.152**	2.238**
		(1.250)	(0.934)	(0.924)	(0.889)	(0.881)
Stock market capitalization as a share of GDP			0.041***	0.042***	0.041***	0.043***
			(0.006)	(0.0065)	(0.0062)	(0.0065)
Regulatory burden on startups (higher less)				−0.0545		−0.063
				(0.143)		(0.15)
Profit tax on small business					0.074	0.076
					(0.139)	(0.144)
Constant	13.64***	7.21	2.33	5.17	1.66	4.95
	(3.62)	(5.14)	(3.20)	(9.24)	(3.50)	(9.30)
Observations	22	22	22	22	22	22
R-squared	0.30	0.41	0.68	0.68	0.69	0.69

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Since VC activity is a small share of GDP, it is expressed as dollars in VC investments per $10.000 units of GDP. Each unit thus represents 0.01% of GDP. In median countries in our sample VC investments were around 0.05% of GDP, ranging up to around 0.2% in the United States and Hong Kong.

Taxes are measured in percentage, so that an increase from 20 percent to 21 percent represents a one unit increase in the tax rate. In all specifications, a ten percentage point increase in the option tax rate is associated with a decrease in VC-activity of roughly 0.015% of GDP, or between one-fourth and one-third in the median country.

Table 5 Cross-country regressions of VC activity as a share of GDP and the log of stock option tax rates.

	(1)	(2)	(3)	(4)	(5)	(6)
Log option tax rate	−1.256**	−1.410**	−1.071***	−1.010**	−1.062***	−0.998**
	(0.516)	(0.589)	(0.339)	(0.349)	(0.333)	(0.346)
Log GDP per capita		0.665	0.215	−0.314	0.183	−0.364
		(1.059)	(0.884)	(1.063)	(0.911)	(1.067)
Log share with tertiary education		−0.538	−0.526	−0.506	−0.485	−0.455
		(0.766)	(0.585)	(0.624)	(0.538)	(0.564)
Log R&D share of GDP		1.066	1.176**	1.070**	1.159**	1.047**
		(0.694)	(0.405)	(0.421)	(0.412)	(0.428)
Log stock market capitalization as a share of GDP			1.191***	1.099***	1.179***	1.083***
			(0.266)	(0.259)	(0.266)	(0.258)
Log regulatory burden on startups (higher less)				2.715		2.759
				(2.893)		(2.992)
Log profit tax on small business					−0.055	−0.069
					(0.241)	(0.266)
Constant	5.73***	4.90	0.062	−9.69	0.22	−9.65
	(1.74)	(3.55)	(2.01)	(11.2)	(2.39)	(11.62)
Observations	22	22	22	22	22	22
R-squared	0.286	0.359	0.644	0.656	0.645	0.657

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

This table reports standard cross-sectional regressions where the dependent variable is log of VC investment as a share of GDP. The covariates are also logged.

Research has increasingly shown that innovative startups and other types of "Schumpeterian" entrepreneurship (Schumpeter 1934 [1911]) differ significantly in their behavior and tax responsiveness from self-employment small-firm activity.[7]

To further explore whether stock option taxation is a likely determinant of innovative entre-preneurship – which is the main target of venture capitalists – we apply two other measures of entrepreneurship as dependent variables.

In order to check the robustness of our results we also use an alternative measure of innovative entrepreneurship, namely High-growth expectation total early-stage entrepreneurial activity (High-growth TEA), which consists of the share of all new firms where the founders self-report that they expect to employ at least five employees five years from now. This measure is collected by the Global Entrepreneurship Monitor using annual surveys (Singer et al. 2015). In our data, the share of high-growth expectation TEA ranges from 17 percent in Italy to 49 percent in Hong Kong, with a median of 25 percent.

We run regressions using this alternative measure of innovative entrepreneurship using the same controls (with both unlogged and logged specifications). Option taxes correlate negatively and significantly with high-growth expectation TEA (just as with VC activity), but not with low-growth expectation TEA.[8] This is consistent with what we would expect, as this variable measures low-impact entrepreneurship rather than high-impact/Schumpeterian entrepreneurship.

For the logged variables, the coefficient can be interpreted as the elasticity of business activity with respect to the option tax rate. For VC activity, the tax elasticity is around one, i.e., a one percent (not percentage point) decrease in the tax rate stimulates VC activity by one percent, if the association represents a causal relation.

Stock market capitalization as a share of GDP and R&D activity tend to be positively correlated with VC activity. It should be noted that the power is low in our regressions since the sample

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[7] See, e.g., Keuschnigg and Nielsen (2004), Chetty et al. (2011), and Kanniainen and Panteghini (2013). Henrekson and Sanandaji (2016) offer a survey of the evidence.

[8] These regression results are available on request.

size is small. Moreover, we use VC activity as a share of GDP as the outcome variable for VC activity, which indirectly takes GDP into account.[9]

The regulatory burden on startups is not statistically significant, and not robustly correlated with the dependent variables. One explanation may be the difficulty in quantifying regulation and high noise and variance in that variable. Another possible interpretation is that regulation on small business startup activity is not a major determinant of VC activity.

The World Bank measure of the profit tax facing small businesses is not robustly correlated with VC activity. This is consistent with our thesis that small business tax rates are not closely linked to VC activity.

Option taxes are calculated for the year 2012. High and low TEA and most covariates are based on the average for 2008 to 2014. For TEA and most covariates, it is necessary to average over a few years in order to avoid missing variables in an already small sample of 22 countries. VC investment as a share of GDP is for the year 2010, since this is the year used in our source (Lerner and Tåg 2013). Data for TEA are available up to 2016, which allows us to vary the years used in the outcome variable as a robustness check. Using later years such as the average for 2014 to 2016 produces similar results. Interestingly, when using older TEA rates, such as 2001 to 2003, as the outcome variable, the 2012 stock option tax no longer has a statistically significant relationship with high-growth expectation entrepreneurial activity. The fact that the 2012 option tax cannot "explain" past entrepreneurial activity but has a robust association with concurrent and future rates suggest that the results are not driven by reverse causality, though this alone is of course not conclusive evidence.

6. Discussion and Conclusions

The modern VC sector first emerged in the United States and it still has by far the world's largest VC sector; indeed larger than the rest of the world combined (Lerner and Tåg 2013). VC activity is far smaller in most European countries, despite the high rates of R&D spending in Western Europe. Experience from the history of the U.S. VC sector indicates that convertible equity and stock options are widely used when these instruments are advantageous from a tax perspective. This is likely because the contractual design of the financial instruments constitutes a good fit for

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[9] GDP per capita is positively correlated if we were to use absolute VC activity per capita.

the issues facing the VC-funded entrepreneurial sector. Therefore, the effective tax treatment of option contracts may in itself be a major determinant of the size of the VC-funded entrepreneurial sector.

Taxes are of course not the only explanation for cross-country differences in VC activity or innovative business activity more broadly. The United States and Continental European countries such as Germany represent different varieties of capitalism with major differences in ownership structures, financing methods, the role of banks and ownership groups and so on. The observed differences between tax rates and the level of VC activity in part reflect more fundamental economic differences. Even if the role of option taxes for VC activity is correctly identified in the United States, this may not guarantee that lower taxes have the same effect in Europe. Nevertheless, there has been a move towards the American model of VC and entrepreneurship also in Europe, in part because this model appears to have performed better. It should also be noted that the results in the already small sample hold when excluding the United States.

Interestingly, the favorable tax treatment for the entrepreneur and other employees with employee stock options in the United States was not initially planned and emerged over time as the VC sector gradually developed its contractual model. A major advantage is that this policy narrowly targets the entrepreneurial sector rather than entailing broad tax cuts. Gilson and Schizer (2003, p. 878) write that "[a]s a practical matter, only companies that can attract venture capital investment receive this tax subsidy." U.S. tax policy does not explicitly connect the employee's tax treatment to the use of convertible preferred equity and stock options. Rather, the favorable tax treatment is part of tax practice. Although this policy was not intentional in the United States, we argue that it has nevertheless developed into one of the most efficient ways to promote entrepreneurship. The reason is that the tax break targets startups receiving VC funding – a small but strategic sector of the economy. The policy lowers the effective taxation of startups that are screened by venture capitalists willing to invest their own funds without requiring the government to determine which firms are entrepreneurial.

Another major benefit is that innovative startups can be given a tax break without the need for broad capital gains tax cuts. It should be noted that innovative startups that can be defined as Schumpeterian entrepreneurs constitute a tiny percentage of firms and even a small share of new firms. Most new firms are best described as "mom-and-pop" operations without the ambition to

grow or innovate (Hurst and Pugsley 2011; Shane 2008; Henrekson and Sanandaji 2014). It is difficult to *ex ante* separate innovative startups from non-entrepreneurial self-employment. However, VC-funded firms tend to represent a large segment of truly innovative firms which are screened by skilled professionals. A mere 0.1 to 0.2 percent of all firms in the U.S. receive early-stage financing from specialized venture capitalists (Puri and Zarutskie 2012). Nevertheless, VC-funded firms constitute the majority of firms that are sufficiently successful to go public (Kaplan and Lerner 2010). A tax break that targets human capital in this segment is an effective way to promote innovative entrepreneurship without the high fiscal cost of broad capital gains tax cuts.

There is also a more subtle reason why lower taxes on employee stock options is preferable to broad tax cuts as a way to promote entrepreneurship: It is not only the absolute tax rate that matters; taxes relative to other sectors also matter. Entrepreneurial startups are extremely important, but they only constitute a small share of the entire stock of financial and human capital. Entrepreneurial firms compete for investments and talent with other sectors of the economy, most importantly with large incumbent firms but also with academia, non-entrepreneurial small businesses, non-profit organizations and government.

Capital may not be invested at all due to high taxes, but it can also be invested passively in the stock market rather than in private equity. Broad-based capital gains taxes do not shift capital from passive investments to private equity, unlike tax breaks on stock options and other instruments widely used by the VC sector.

Perhaps most importantly, the favorable tax treatment for the entrepreneur and other employees with employee stock options shifts talent to the innovative entrepreneurial sector. Recent research has shown that the effect of owner-level taxes on occupational choice is of first-order importance (Henrekson and Sanandaji 2016). Potentially successful entrepreneurs are rare and tend to have well-paid jobs and career opportunities in incumbent firms. The risk of failure is large and most of the aggregate return is concentrated to a few successful cases. To attract a sufficient number of talented people to incur this opportunity cost and assume the risks involved, economic incentives must be sufficiently strong. Broad-based tax cuts on all income earners will be less potent in making it more attractive to found or work for a startup, while resulting in far larger reductions in tax revenue.

This may help explain why the U.S. and other countries with lower tax rates on employee stock options have larger VC sectors as a share of GDP. This policy helps the VC sector compete for limited resources within each country, most importantly top talent, in turn awarding the VC sector of the country a competitive advantage relative to other nations.

We have shown that the possibility of using stock options to reward entrepreneurial effort depends greatly on the tax code. Our results suggest that the rules pertaining to the granting and gains on employee stock options is likely to have inhibited innovative entrepreneurship in Western Europe. Entrepreneurial startups are of disproportionate importance for innovation and renewal, but since they, at any point in time, only constitute a small share of the economy, they are of minor importance as a source of government revenue. A well-designed reform of the taxation of stock options (and similar instruments) along the lines of the U.S. reform around 1980 would therefore cost the government very little in terms of foregone tax revenue. In short, it would be both an inexpensive and efficient reform for improving the European ecosystem for new high-growth firms.

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