Schumpeterian Entrepreneurship and the Taxation of Employee Stock Options[‡]

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Abstract: Capital tax policy long focused on the investment cost of large established firms with access to internal finance. We argue that the increased role of "Schumpeterian" entrepreneurship for innovation has increased the importance of individual level taxes relative to taxes on passively invested external capital. The importance of various taxes differs across firm type, where startups that rely more heavily on human capital are more sensitive to tax incentives affecting the occupational choice of founders, who typically must rely on external capital.

One response to the uncertainty and transactions costs facing VC-finance is to compensate founders and key personnel with stock options contingent on firm performance, vesting and other criteria. While most countries tax stock options as labor earnings, the United States allow them to be taxed at a low capital gains tax rate. The interaction of favorable tax treatment and inherent advantages has led to near universal use of stock options in U.S. VC deals, while this remains less common in Europe.

The effective tax treatment of stock options depends on tax practices and is not readily observed using statutory tax rates. We commissioned the local offices of the tax consultancy firm PwC to calculate the effective tax rate for a standardized entrepreneurial case in 22 countries. While the sample is small, explorative analysis suggests a positive relationship between favorable tax treatment and Schumpeterian entrepreneurial activity.

An unanticipated and often overlooked advantage of this tax policy is that it narrowly targets entrepreneurial startups without requiring broad tax cuts. Most firms are not entrepreneurial, but entrepreneurial firms are difficult to identify *ex ante* by policy makers. Favorable tax treatment of employee stock options almost exclusively benefits firms identified as entrepreneurial by venture capitalists. We argue that targeted tax cuts lead to less loss of revenue and less risk of increasing inequality than broad-based capital gains 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

For a long time it seemed that the best route to economic development was through mass production of relatively standardized products via specialized capital equipment and technology. The obtainable benefits through increased economies of scale, specialization and standardized mass production were considered greater than the cost increases resulting from weakened incentives, information problems and the bureaucratization of large organizations (e.g., Piore and Sabel 1984 and Audretsch 1995).

Large corporations were seen not only as more efficient producers but also as the leading engines of innovation and technological change. Even Joseph Schumpeter (1942, p. 106), previously the most forceful advocate of the importance of the individual entrepreneur, concluded: "What we have got to accept is that [the large-scale enterprise] has come to be the most powerful engine of progress." By means of new techniques and modes of organization, the innovation process was believed to become increasingly automated. Innovations would no longer be associated with the efforts and brilliance of specific individuals.

This view began to be challenged in the late 1970s. The changing nature of technological development, the growing importance of the service sector, and the lesser need for standardized mass production reduced the advantages of large corporations. Entrepreneurship and small business activity experienced a global resurgence (Brock and Evans 1986; Loveman and Sengenberger 1991). As a result, individual effort and hence individual incentives once more began to gain in importance.

We argue that this structural change from large firms to individual startups shifts the balance of optimal tax policy. A favorable tax policy for large existing firms focuses on profit and dividend taxation, whereas entrepreneurial startups rely on individual level taxes at the owner level. For large firms the critical dimension is the cost of capital and its influence on investments. By contrast, for Schumpeterian entrepreneurship the critical dimension is taxes on human capital which influence occupational choice. In particular, employee stock options have turned out to be critical for incentivizing the modern entrepreneurial sector.

Incumbent firms tend to excel in incremental innovation and cost reduction, while genuinely new innovations are often developed by startups. When such firms are motivated to grow they

are likely to play a particularly important role in the growth process.[1] We will use the term Schumpeterian to denote such innovative and growth-oriented entrepreneurship.

When innovation takes place in large incumbents, R&D projects are financed by retained earnings or by intra-firm cross subsidization. On the margin such projects may also be debt financed, since the large firm's positive cash flow and real assets can be used as collateral.

Matters are quite different when innovative activity takes place in newly founded firms. The initially negative cash flow cannot be financed by retained earnings or cross subsidization; equity financing is necessary, since debt financing is infeasible because of high uncertainty and the lack of collateralizable assets. Moreover, the innovators–entrepreneurs are unlikely to have the requisite personal assets to finance development from the original idea to commercializable product and to the point where the cash flow becomes positive.

Hence, external equity financing is likely to be required already early on in the life cycle of the innovative firm. The required external equity financing tends to be large relative to the capital infusion made by the founder(s). Their ownership stake is then sharply diluted and after some financing rounds it may be negligible. Equity owners are normally the residual claimants. This is ideal in the case the case when they are the ones that take entrepreneurial decisions, provide key competencies and bear uncertainty. In the early phases of industrialization R&D requirements were lower, domestic markets were more insulated from foreign competition, and the time span from innovation to positive cash flow was shorter, which implied lower risk and smaller capital requirements. Under those circumstances it was much easier for the original innovator–entrepreneur to remain a substantial residual claimant (ref. to be added).

External financiers who, because of the financing requirements, find themselves owning an overwhelming share of the equity in a highly uncertain innovative venture with a small chance of becoming extremely successful (and highly valued) are dependent on key individuals to maximize the probability of success. In other words, entrepreneurial decision making has to be largely delegated to key individuals with a dwindling or no ownership stake. In addition to the founder(s), the firm is likely to need individuals with other key

[1] A large number of studies have documented these structural changes; see, e.g., Baldwin and Johnson (1999) and Audretsch (1995).

competencies such as an experienced CEO and complementary specialists. Because the latter individuals are forsaking lucrative alternative careers, the transition to entrepreneurship involves significant opportunity costs (ref. to be added).

The contribution to value creation by equity financing provided by outside investors cannot be separated from the entrepreneurial insight, knowledge and effort supplied by the founder(s) and key employees. They constitute an *inseparable* bundle of inputs necessary to create value. Neither the entrepreneurial insight and effort, nor crucial human capital/management skills residing in a unique individual can be hired in the regular labor market at a market wage. Should the concerted effort of this inseparable bundle of inputs result in the emergence of a successful firm, it would be instantly capitalized as a sharp increase in the market value of the firm. To obtain efficient incentives, contractual terms are required that *ex ante* guarantee that all irreplaceable providers of inputs to the inseparable bundle will become residual claimants, i.e., receive a share of the capital value that may be created by building the firm. Such contracts emerged in Silicon Valley around 1980 and their use has then spread to other parts of the world. An essential component of virtually all such incentive contracts in the U.S. is employee stock options.

As there are no direct measures of Schumpeterian entrepreneurship, we have to rely on admittedly imperfect empirical proxies. As discussed in section 2 we will use VC investment as a share of GDP as our preferred measure of the extent of Schumpeterian entrepreneurship in developed countries.

The purpose of this paper is to examine whether the tax treatment of employee stock options is a major independent factor explaining cross-country differences in the extent of VC activity and thus of Schumpeterian entrepreneurship. 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.

We study the relationship between taxes on employee stock options and VC activity in 22 countries. Since the effective tax rate of stock option contracts is a matter of tax practice, effective rates are not immediately apparent from 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. Our results show that national tax rates vary enormously, ranging from 72 percent in Italy to 7 percent in Ireland. There is a strong cross-country correlation between the effective tax rate on employee stock options and the rate of VC activity. While this correlation does not prove a causal link and the sample size is too small for advanced analysis, the strength of the correlation is suggestive of the notion that low taxes on employee stock options promote VC-funded entrepreneurship.

Further support for our hypothesis is given by the fact that entrepreneurship with high growth aspirations correlates negatively with taxes on employee stock options, while no effect is detected for low-growth expectation entrepreneurship.

The remainder of the paper is structured as follows. Section 2 presents and motivates the proxies used to measure Schumpeterian entrepreneurship. The literature on the design and role of incentive contracts is reviewed in Section 3. Section 4 summarizes the theoretical explanations for the use of stock options. Section 5 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 6 presents cross-country regressions of the effective tax rate and VC activity, and to explore the robustness of our results we also present regressions results using two other indicators of entrepreneurship. Section 7 summarizes and concludes.

2. Measuring Schumpeterian Entrepreneurship

Innovative and growth-oriented startups that can be defined as Schumpeterian are 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 (e.g., Hurst and Pugsley 2011, Shane 2008, and Henrekson and Sanandaji 2014). Moreover, research has increasingly shown that innovative startups and other types of Schumpeterian entrepreneurship differ significantly in their behavior and tax responsiveness from self-employment small-firm activity.[2]

[2] See, e.g., Keuschnigg and Nielsen (2004), Chetty et al. (2011) and Kanniainen and Panteghini (2013).

As there are no direct measures of Schumpeterian entrepreneurship one has to use proxies. Venture capital (VC) funding only goes to around one to two thousand American firms every year – or a mere 0.1 to 0.2 percent of all firms (Puri and Zarutskie 2012). However, among the firms that are extremely successful and at some point are able to go public through an IPO, roughly two thirds received VC funding (Kaplan and Lerner 2010). This means that the subsample of firms that receive VC funding includes the majority of high-potential entrepreneurial firms. Therefore, we deem that VC funding is a reasonable (though of course incomplete) proxy that a firm is entrepreneurial, and we will use VC investment as a share of GDP as our preferred measure of the extent of Schumpeterian entrepreneurship in a country.

The emergence of venture capital (VC) funding represented a transformative change for entrepreneurship, in particular in high-tech sectors. However, the extent of VC activity varies greatly among industrialized countries. Especially in the United States, the VC sector remains significantly larger than in Western Europe and East Asia (*Table 1*). Another major difference is 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).

Table 1 Entrepreneurship in the United States, Wealthy Asian Countries and Western Europe According to Three Different Measures.

	Share of 100 largest firms founded by an entrepreneur since 1945	VC investment, % of GDP 2010	High-growth expect. TEA†	Self-employment
U.S.A.	34%	0.200	27.6%	7.5%
Asia*	13%	0.024	TBA	16%
Europe‡	7%	0.036	TBA	15%

Note: * Japan, South Korea, Taiwan, Singapore and Hong Kong
‡ Germany, France, United Kingdom, Italy, Spain, the Netherlands, Greece, Belgium, Portugal, Sweden, Austria, Denmark, Finland, Ireland, Luxembourg, Switzerland, Norway and Iceland.
† Defined as the average for the period 2008–2014. Data were missing for????
Source: Henrekson and Sanandaji (2014, 2015) and *Global Entrepreneurship Monitor Annual Reports*, 2008–2014, http://www.gemconsortium.org/report.

Business angels carry out a similar function to venture capitalists, generally in earlier phases. They are wealthy private persons with experience in entrepreneurial venturing and/or business leadership, who have the time, dedication and capital to invest in new, promising

business ideas. Through the business angel's network, the firm gains access to additional capital and skills (Kerr et al. 2010).

Business angels are especially important in terms of contributing seed capital and knowledge at an early stage of the firm's lifecycle—when obtaining financing from traditional sources, such as banks and venture capital firms, is difficult. Ideally, a business angel contributes both additional financing and entrepreneurial skills. Business angels also need to use incentive contracts. However, there is little reliable data available on the extent of angel activity in different countries. Although, to the extent that there is evidence this clearly indicates that business angel financing is by far the most important in the United States (Avdeitchikova and Landström 2016).

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

Total early-stage entrepreneurial activity or TEA is a widely used measure of business activity, collected by the Global Entrepreneurship Monitor (GEM) using annual surveys (Singer et al. 2015). TEA measures the share of the working-age population (aged 18–64) who is either in the process of creating a new business or is running a business less than three and a half years old.

TEA captures both innovative startups and the much larger number of regular small firms. One way to better distinguish between various types of entrepreneurship is to rely on the expectations of the founder (Koellinger 2008). GEM makes a distinction between High-growth expectation TEA and Low-growth expectation TEA. The former consists of those firms where the founders self-report that they expect to employ at least 5 employees five years from now whereas Low-expectation TEA consists of founders that do not except to create 5 jobs or more. 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.

If employee stock option taxation is an important determinant of Schumpeterian entrepreneurship we would expect a negative relationship between the extent of High-growth

expectation TEA and the stock option tax rate but no relationship with Low-growth expectation TEA.

In *Table 2* we report the extent of VC activity as well as the two GEM measures of entrepreneurial activity for the 22 countries included in our study.

Table 2 VC activity and High- and Low-growth expectation TEA in the 22 countries.

Country	VC-activity, % of GDP	High-growth expectation TEA	Low-growth expectation TEA
Australia	0.026		
Canada	0.040		
China	0.052		
Denmark	0.073		
Finland	0.021		
France	0.047		
Germany	0.014		
Hong Kong	0.227		
Ireland	0.072		
Israel	0.120		
Italy	0.001		
Japan	0.003		
Netherlands	0.020		
Norway	0.053		
Portugal	0.009		
Singapore	0.088		
South Korea	0.038		
Spain	0.012		
Sweden	0.100		
Switzerland	0.107		
United Kingdom	0.075		
United States	0.199		

Note: Data on VC activity is for 2010 and High- and Low-growth expectation TEA is the average for 2008–2014.
Source: Lerner and Tåg (2013) and *Global Entrepreneurship Monitor Annual Reports*, 2008–2014, http://www.gemconsortium.org/report.

3. The Use of Stock Options in VC Financing

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 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 American 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 American 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. The risk of failure is large; most of the aggregate returns emanates from a few successful cases. 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.

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

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

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 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).[4]

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 indicates that the differences in the type of instrument used reflect institutional differences in the tax and regulatory environment between the two countries rather than differences in traditions and corporate culture.

[4] 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).

Founders of entrepreneurial startups are not the only type of human capital for whom stock options are an advantageous compensation form. CEOs and certain key employees also commonly receive stock options. Moreover, 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 in 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.

The loss for individuals resulting from failed entrepreneurial startups includes the opportunity cost of giving up their alternative career (Kanniainen and Panteghini 2013). 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.

4. The Need for Well-Designed Compensation Contracts

Figure 1 provides a schematic overview of the argument while *Figure 2* describes phases in the evolution of an entrepreneurial startup as described by, among others, Fenn et al. (1995) and Gompers and Lerner (2001).

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 firm performs poorly but grants the entrepreneur more control right as performance

Figure 1 Schematic overview of the theoretical arguments.

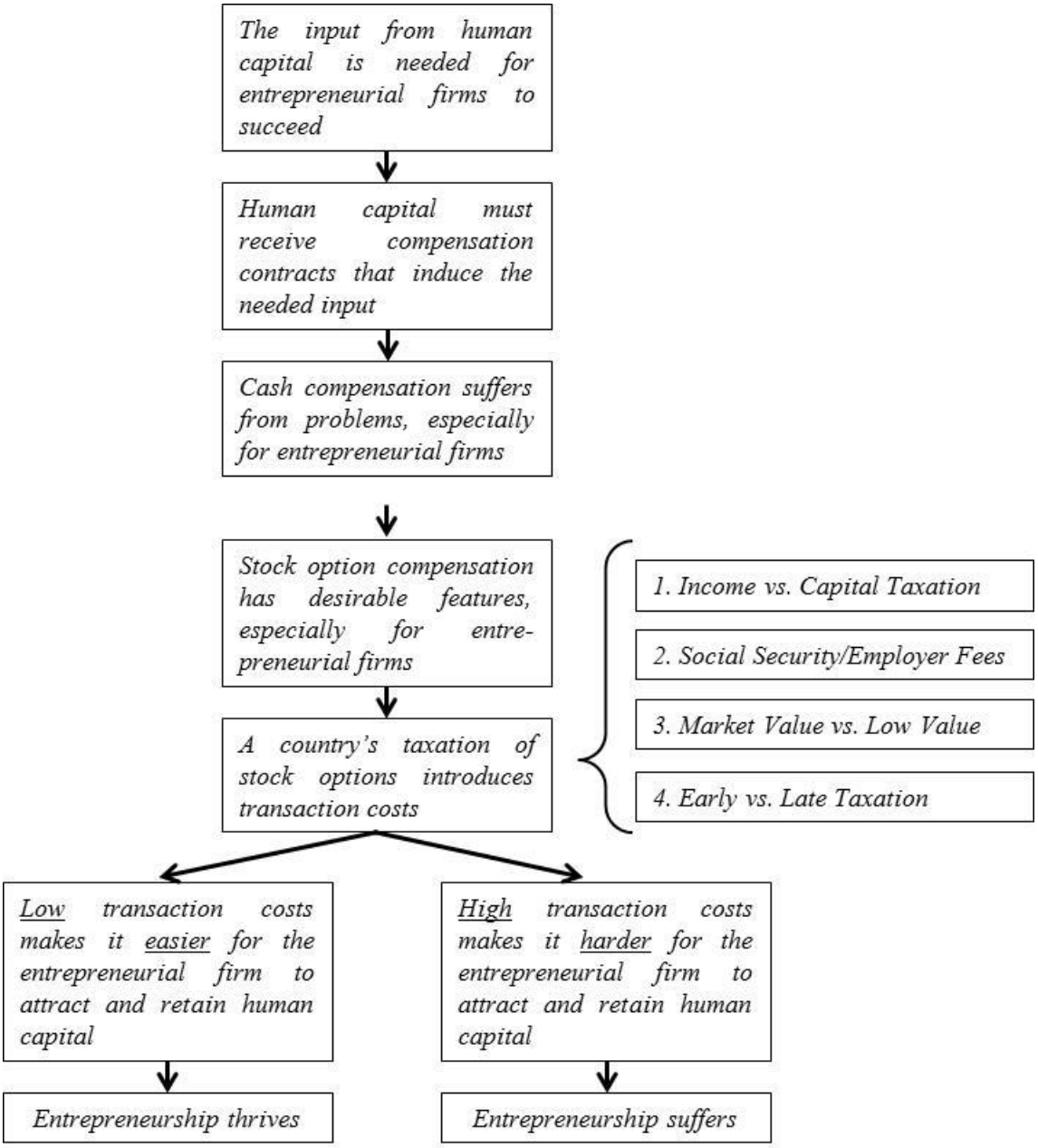
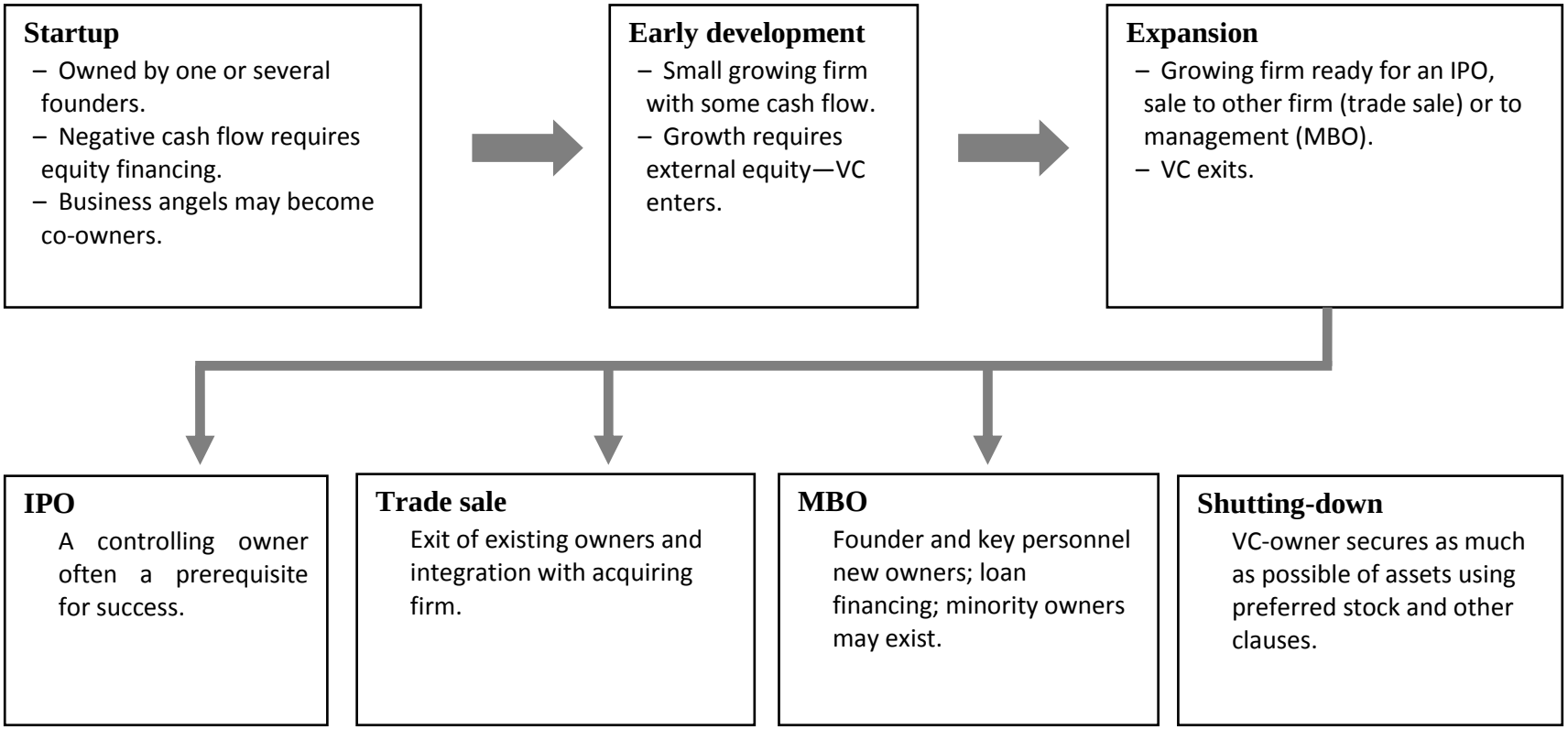


Figure 2 Central phases in the evolution of a firm.



improves. Given sufficient success, the VC firm retains its equity share but hand over most of the control rights.

A compensation contract 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, usually with higher upside compensation if the firm succeeds. Moreover, the contract must induce effort, formally "meeting the incentive constraint". Third, it must allocate risk optimally across employees and between employees and investors. In practice, high risk compensation to the investor means that the founder has to sell the firm cheaply to the investor, which reduces the incentive to start the firm in the first place. By contrast, a mature firm has more calculable risk, that is to say less uncertainty, as well as being able to substantially reduce the risk facing owners 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. Hand (2008) reports that the average vesting period for the employees of VC-funded firms who hold stock options is four years.

Another form of vesting, performance-based vesting, prescribes that options granted are lost if the firm does not meet certain performance milestones, for example an FDA approval for pharmaceutical drugs.

5. The Effective Tax Rate on Stock Options in Sample Countries and Other Variables Used

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 and includes most of the largest economies in the developed world: 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.

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 3* 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.

Table 3 Effective tax rate on stock options in 22 countries, 2012.

Country	Tax rate, %	Country	Tax rate, %
Australia	24.8	Japan	50.5
Canada	31.9	Netherlands	25.0
China	45.0	Norway	50.8
Denmark	55.3	Portugal	56.5
Finland	51.3	Singapore	20.0
France	29.9	South Korea	61.5
Germany	47.5	Spain	52.0
Hong Kong	15.0	Sweden	54.3
Ireland	7.4	Switzerland	51.5
Israel	25.0	United Kingdom	28.0
Italy	72.2	United States	15.0

Source: PricewaterhouseCoopers (PwC).

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.

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. Collecting more detailed international data on which financial instruments that are used in VC financing is an avenue for future research.

Table 4 presents the definitions and sources of the variables used and *Table 5* presents the correlations between all dependent and independent variables used in the regression analyses in the next section.

Table 4 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 in (average 2008–2014)	World Bank, http://www.doingbusiness.org/data
Profit tax	Tax rate on profits paid by a standardized small firm in (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). *Not used in the regressions.

Table 5 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

6. Empirical Results

Figure 3 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. The cross-country correlation is suggestive, but due to the small sample size and the non-

experimental variation in tax rates further empirical work is needed to draw more definitive conclusions.

Figure 3 Stock option taxation and venture capital investment as a share of GDP (%).

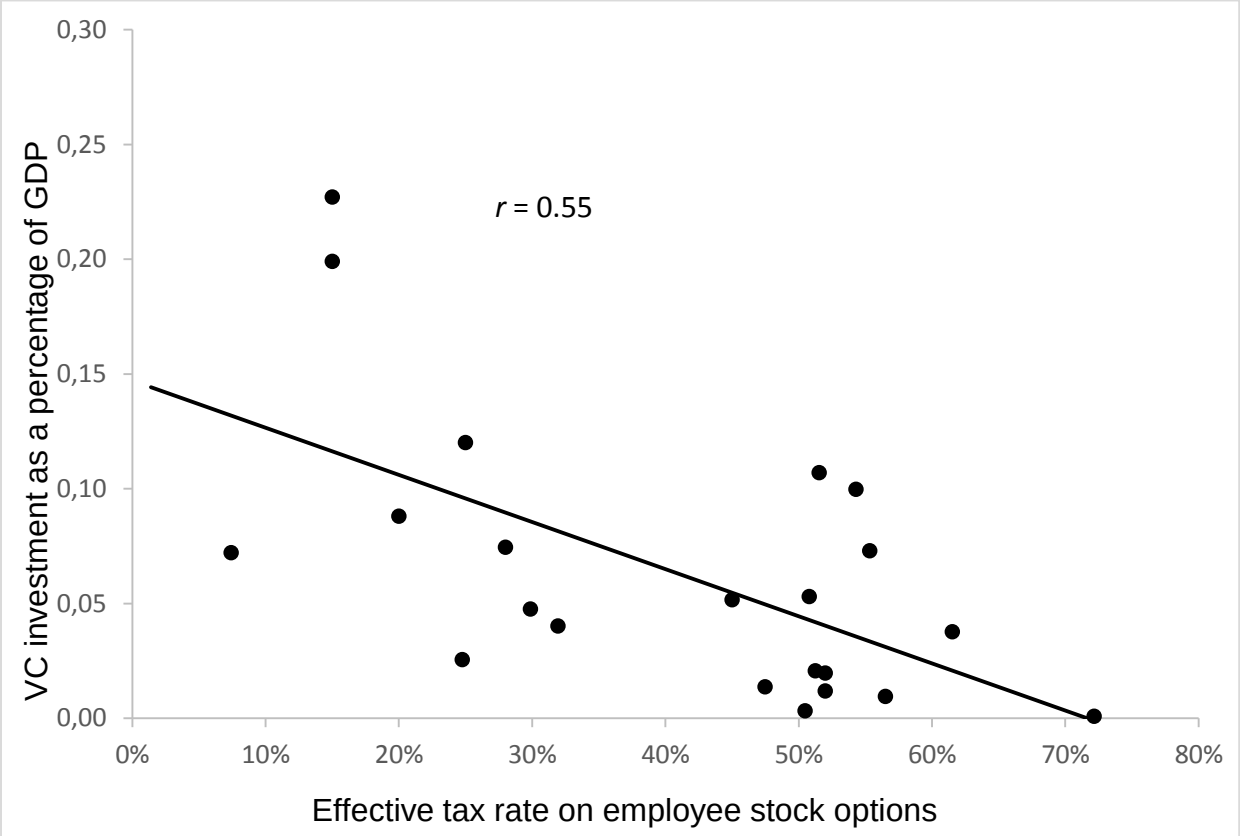


Table 6 presents our main regression estimates. In specifications 2–6 we add covariates. PPP-adjusted GDP per capita is a standard control. In order to control for human capital intensity and R&D we use the share with tertiary or college education and R&D activity as a share of GDP. Market capitalization of all listed firms as a share of GDP is used to control for financial sophistication. The index of regulation from the 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 implies an economy 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 6 Cross-country OLS regressions of VC activity as a share of GDP and stock option tax rates.

	(1)	(2)	(3)	(4)	(5)	(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)
World Bank 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	0.301	0.407	0.68	0.682	0.689	0.691

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 tax rates is associated with an increase of VC-activity of roughly 0.015% of GDP, or between one-fourth and one-third in the median country.

Table 7 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 it is now statistically significant at the 5% level or better 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 at least consistent with the view that high option tax rates reduce VC-backed entrepreneurship.

Table 7 Cross-country OLS 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**	−1.41**	−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 World Bank 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 differ significantly in their behavior and tax responsiveness from self-employment small-firm activity.[5]

To further explore whether stock option taxation is a likely determinant of Schumpeterian entrepreneurship we apply High-growth expectation TEA and Low-expectation TEA as collected by GEM (see section 2).

Regressions using these alternative measures are presented in *Table A1* to *Table A4*. The same controls are used as in the base regressions and we present both unlogged and logged specifications.

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

Option taxes correlate negatively with High-growth expectation TEA in all specifications, while it is insignificant in all specifications for Low-growth expectation TEA. This is consistent with the notion that option taxes matter for Schumpeterian entrepreneurship but not for small business activity.

For the logged variables, the coefficient can be interpreted as the elasticity of Schumpeterian entrepreneurship 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. For high-expectation TEA this elasticity is roughly one half.

7. 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). The United States is also generally considered to be the country with the highest rate of Schumpeterian entrepreneurship. As discussed in section 1 Schumpeterian startups almost invariably need external equity financing at an early stage, before they have a commercializable product and even longer before their cash flow has turned positive. External financiers are highly dependent on key individuals to maximize the probability of success. Entrepreneurial decision making has to be largely delegated to key individuals and to create efficient incentives, contractual terms are required that *ex ante* guarantee that these individuals also become residual claimants.

Experience from the United States indicates that convertible equity and stock options are widely used for this purpose when these instruments are advantageous from a tax perspective. Therefore, the effective tax treatment of option contracts may in itself be a major determinant of the size of the Schumpeterian/VC-funded entrepreneurial sector. This conclusion is given further support by the current study of 22 countries.

A central focus of tax policy is to promote innovation while minimizing the loss of revenue. A major advantage is that this policy narrowly targets the entrepreneurial sector rather than entailing broad capital tax cuts. Gilson and Schizer (2003) 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, it has arguably evolved into one of the most efficient ways to promote entrepreneurship; 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.

It is difficult, although not impossible, to *ex ante* separate innovative startups from non-entrepreneurial self-employment (Guzman and Stern 2015). However, VC-funded firms tend to represent a large segment of truly innovative firms which are screened by skilled professionals. Nevertheless, VC-funded firms constitute the majority of firms that are sufficiently successful to go public. Tax breaks targeting human capital is an effective way to promote innovative entrepreneurship without the high fiscal cost and controversial distributional effects of broad capital gains tax cuts (Auerbach and Hasset 2015; Piketty and Saez 2012).

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

High taxes may impede the accumulation of capital, but they may also lead existing assets to 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. In this sense targeted, strategic tax cuts may not only lead to far less loss of revenue, it may in fact be more effective. The favorable tax treatment for the entrepreneur and other employees with employee stock options shifts talent to the innovative entrepreneurial sector.

Potentially successful entrepreneurs are rare and tend to have well-paid jobs and career opportunities in incumbent firms. The risk of failure is invariably large, with most of the aggregate returns concentrated to a few successful cases. To lure a sufficient number of

talented people to incur this opportunity cost and assume the risks involved, economic incentives need to be sufficiently strong. Again, 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.

There is arguably a trend towards an increased role for Schumpeterian entrepreneurship relative than established firms and towards rare skills being the constraining factor in business activity. This paper has highlighted the role of employee stock options, but a more general point is that the type of tax policy designed for an economy centered on promoting investments in large, fairly stable firms differs from the tax policy focusing on providing skilled individuals incentives to create new ventures. The move towards skills rather than financial capital as the scarce resource makes it all the more important for capital taxation research to pay closer attention to individuals and their human capital as the essence of the entrepreneurial firm.

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Table A1 Cross-country OLS regressions of High-growth expectation TEA and stock option tax rates.

	(1)	(2)	(3)	(4)	(5)	(6)
Option tax	−0.028**	−0.036**	−0.037**	−0.036**	−0.034*	−0.033*
	(0.0099)	(0.013)	(0.015)	(0.015)	(0.016)	(0.017)
GDP per capita		−0.027	−0.025	−0.038	−0.026	−0.041
		(0.034)	(0.037)	(0.038)	(0.029)	(0.036)
Share with tertiary education		−0.0021	−0.0031	−0.0051	0.0059	0.0037
		(0.0453)	(0.0475)	(0.0498)	(0.0371)	(0.0385)
R&D share of GDP		0.0260	0.019	−0.014	0.010	−0.030
		(0.373)	(0.378)	(0.385)	(0.300)	(0.317)
Stock market capitalization as a share of GDP			−0.0006	−0.0010	−0.0007	−0.0012
			(0.0025)	(0.0028)	(0.0023)	(0.0025)
Regulatory burden on startups (higher less)				0.0244		0.0293
				(0.042)		(0.0423)
World Bank profit tax on small business					−0.0408	−0.0419
					(0.0385)	(0.0393)
Constant	3.16***	4.46**	4.53**	3.27	4.90**	3.37
	(0.48)	(1.59)	(1.68)	(3.11)	(1.75)	(3.09)
Observations	22	22	22	22	22	22
R-squared	0.219	0.279	0.280	0.289	0.357	0.369

Note: Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. See also notes to Table 6.

Table A2 Cross-country OLS regressions of the log of High-growth expectation TEA and the log of stock option tax rates.

	(1)	(2)	(3)	(4)	(5)	(6)
Log option tax	−0.433**	−0.594**	−0.524***	−0.487***	−0.485**	−0.443**
	(0.172)	(0.207)	(0.147)	(0.156)	(0.184)	(0.202)
Log GDP per capita		−0.415	−0.509	−0.832	−0.648	−1.007**
		(0.559)	(0.517)	(0.488)	(0.401)	(0.443)
Log share with tertiary education		−0.070	−0.068	−0.060	0.106	0.126
		(0.471)	(0.432)	(0.425)	(0.343)	(0.340)
Log R&D share of GDP		0.269	0.291	0.227	0.219	0.145
		(0.321)	(0.334)	(0.338)	(0.284)	(0.293)
Log stock market capitalization as a share of GDP			0.247	0.191	0.196	0.133
			(0.15)	(0.163)	(0.139)	(0.161)
Log regulatory burden on startups (higher less)				1.658		1.816
				(1.115)		(1.184)
Log World Bank profit tax on small business					−0.237	−0.246
					(0.167)	(0.168)
Constant	2.12***	4.20***	3.19***	−2.76	3.87***	−2.63
	(0.61)	(1.20)	(1.03)	(4.23)	(1.24)	(4.36)
Observations	22	22	22	22	22	22
R-squared	0.233	0.377	0.461	0.492	0.541	0.577

Note: Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. See also notes to Table 7.

Table A3 Cross-country OLS regressions of Low-growth expectation TEA and stock option tax rates.

	(1)	(2)	(3)	(4)	(5)	(6)
Option tax	−0.003	−0.028	−0.036	−0.036	−0.032	−0.037
	(0.024)	(0.036)	(0.037)	(0.038)	(0.039)	(0.040)
GDP per capita		−0.124*	−0.106	−0.084	−0.107	−0.088
		(0.065)	(0.068)	(0.083)	(0.070)	(0.088)
Share with tertiary education		0.021	0.011	0.015	0.024	0.026
		(0.075)	(0.077)	(0.079)	(0.069)	(0.070)
R&D share of GDP		−0.308	−0.378	−0.319	−0.390	−0.340
		(0.677)	(0.693)	(0.729)	(0.628)	(0.668)
Stock market capitalization as a share of GDP			−0.0059	−0.0051	−0.0061	−0.0054
			(0.0058)	(0.0060)	(0.0056)	(0.0057)
Regulatory burden on startups (higher less)				−0.043		−0.037
				(0.102)		(0.100)
World Bank profit tax on small business					−0.056	−0.055
					(0.075)	(0.077)
Constant	5.43***	10.99**	13.97*	12.20**	11.69**	14.12*
	(1.08)	(4.06)	(7.20)	(4.46)	(4.21)	(7.26)
Observations	22	22	22	22	22	22
R-squared	0.001	0.237	0.283	0.309	0.277	0.314

Note: Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. See also notes to Table 6.

Table A4 Cross-country OLS regressions of the log of Low-growth expectation TEA and the log of stock option tax rates.

	(1)	(2)	(3)	(4)	(5)	(6)
Log option tax	0.045	−0.108	−0.116	−0.125	−0.096	−0.105
	(0.164)	(0.153)	(0.147)	(0.160)	(0.174)	(0.187)
Log GDP per capita		−0.691*	−0.681*	−0.599	−0.750*	−0.681
		(0.346)	(0.367)	(0.440)	(0.419)	(0.494)
Log share with tertiary education		0.150	0.151	0.147	0.236	0.232
		(0.277)	(0.291)	(0.299)	(0.332)	(0.342)
Log R&D share of GDP		0.128	0.125	0.142	0.089	0.104
		(0.284)	(0.281)	(0.307)	(0.281)	(0.306)
Log stock market capitalization as a share of GDP			−0.027	−0.012	−0.052	−0.040
			(0.168)	(0.169)	(0.170)	(0.171)
Log regulatory burden on startups (higher less)				−0.423		−0.349
				(1.380)		(1.413)
Log World Bank profit tax on small business					−0.117	−0.115
					(0.173)	(0.177)
Constant	1.43**	3.81***	3.19***	5.44	4.25***	5.50
	(0.60)	(0.94)	(1.03)	(5.35)	(1.24)	(5.54)
Observations	22	22	22	22	22	22
R-squared	0.004	0.246	0.461	0.25	0.276	0.278

Note: Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. See also notes to Table 7.