IFN Working Paper No. 813, 2009

Taxation and the Quality and Quantity of Entrepreneurship

Andrea Asoni and Tino Sanandaji

Research Institute of Industrial Economics
P.O. Box 55665
SE-102 15 Stockholm, Sweden
info@ifn.se
www.ifn.se

Taxation and the Quality and Quantity of Entrepreneurship

Andrea Asoni and Tino Sanandaji*

The University of Chicago and

the Research Institute of Industrial Economics (IFN)

July 21, 2011

Abstract

We study the effect of taxation on entrepreneurship, taking into account both the amount of entry and the quality of new ventures. We show that even with risk neutral agents and no tax evasion progressive taxes can increase entrepreneurial entry, while reducing average firm quality. So called "success taxes" increase startup of lower value business ideas by reducing the option value of pursuing better projects. This suggests that the most common measure used in the literature, the likelihood of entry into self-employment, may underestimate the adverse effect of taxation.

Key Words: Taxation, Entrepreneurial Entry, Quality of Entrepreneurial Firms

JEL Classification: H24, H25, L26

*We thank Henrik Horn, Lars Persson, Raaj Sah and the participants in the IFN Brown Bag seminar for valuable comments. All remaining errors are ours. Financial support from the Jan Wallander and Tom Hedelius Foundation is gratefully acknowledged. Send any comments to asoni@uchicago.edu or tino@uchicago.edu.

1 Introduction

Entrepreneurship is generally viewed as an important determinant of innovation and growth. For this reason public policy has focused on entrepreneurial activity and on the organizational form in which it often takes place; self-employment. One of the main components of entrepreneurial public policy in all developed countries is the taxation of the self-employed. However, the impact of taxation on entrepreneurial activity is not very clear. The empirical evidence for the impact of taxation on the level of entrepreneurship is generally inconclusive (Bruce and Schuetze 2004). One reason is that entrepreneurship is a somewhat vague concept, hard to exactly define and harder yet to measure. Another reason is that the theory on the relationship between taxation and entrepreneurship is ambiguous.

There are at least four ways in which taxation can affect entrepreneurial entry (Bruce and Gurley 2004). Most straight-forward, the effect of taxes is to lower returns from effort and risk taking; personal taxes on entrepreneurs are bound to reduce investments, hiring and firm growth (Carroll et al. 2000a, 2000b, 2001). On the other hand, taxes can stimulate risk taking activities by compressing the distribution of after-tax returns, at least for the marginal investment, when losses are fully deductible (Domar and Musgrave 1944). Taxes can also increase self-employment if entrepreneurs face lower taxes than employees or if self-employment make it easier to evade taxes (Gordon and MacKie-Mason 1991, 1994; Gordon 1998; Bruce 2000; Cullen and Gordon 2002, Stenkula 2009).

Since entrepreneurial returns are more dispersed than wages, the progressivity of the tax schedule matters as well as the level of taxation. In an influential paper Gentry and Hubbard (2000) demonstrate that high marginal tax rates discourage entry into self-employment. The result that these "success taxes" discourage entrepreneurial entry is consistent with the risk-sharing framework of Domar and Musgrave (1944), since high marginal taxes enhance the

asymmetry in a tax system where losses below bankruptcy level are not tax-credited.

The policy interest in taxes is not only in the number of self-employed but also in the value of the firms they create. Previous research however has focused only on the effect of taxes on the *quantity of entrepreneurship*, such as the share of entrepreneurs (or self-employed) or the probability that an individual enters entrepreneurship. However another interesting margin in terms of social and private value is the *quality of the entrepreneurial firms*. This depends on the importance of the innovation and of the class of the entrepreneur, and can also be a function of entrepreneurial effort. Clearly not all firms are equally successful or contribute equally to the general welfare of society.

In this paper we analyze the effect of taxes jointly on quality and quantity of entrepreneurship; we use a dynamic forward-looking framework where individuals decide to create firms by taking into account all future utilities and options. In various specifications we include progressive and proportional taxes, the relative tax rate on workers and the self-employed, the choice of effort given entry, and the importance of commitment to any given startup. Our results indicate that in a dynamic setting with a high level of commitment progressive taxes can increase entry into self-employment, while reducing average quality of the firm. These findings are in contrast to the theoretical prediction of success taxes on entrepreneurship from Gentry and Hubbard (2000). The source of potential increase in self-employment due to taxes is also novel. It happens not through risk smoothing or tax evasion, but because progressive taxes reduce the alternative cost of pursuing a mediocre business idea rather than searching for a better one. If the start-up decision requires commitment and is associated with an alternative search cost for other (better) business ideas waiting has an option value[1]. Progressive taxes reduce this option value by disproportionately taxing the most successful firms. One implication of these results is that empirical investigation of the effect of taxation

[1]We abstract from the possibility that the worker might sell his/her entrepreneurial idea.

on self-employment can underestimate the distortionary effects of progressive taxes if (as is generally the case) only the quantity but not the quality of self-employment is studied.

Our results have parallels in the theory of equilibrium unemployment (Pissarides 1990; Ljungqvist and Sargent 1995) and in the investment under uncertainty literature (Dixit and Pindyck 1994). With risk and irreversible investments the issue of timing becomes important. There is an option value of waiting for better market prospects, similar to the entrepreneur in our model that can wait for a business idea with higher potential. While entrepreneurial entry is not touched upon by Dixit and Pindyck (1994), Panteghini (2007) uses this framework to analyze entrepreneurial investment decisions in a recursive setting, with the firm payoff follows a Brownian motion. The effect of progressive taxes on the quantity and quality of entry in our model are thus more broadly interpretable than entrepreneurial entry, and apply to any situation where investment now implies an alternative cost in terms of investment in the future.

2 Quality and Quantity of Entrepreneurship

Entrepreneurship is a multifaceted phenomenon, distinct from other economic activities with respect to aspects such as risk, its dynamic nature (Schumpeter 1934), uncertainty (Knight 1921), alertness to change (Kirzner 1967) and managerial talent (Lucas 1978). The multiple aspects that distinguish entrepreneurship in general and the effects of taxation on entrepreneurial activity in particular have been proved difficult to capture with any one economic model (Henrekson and Sanandaji 2011). To the extent neoclassical economists have successfully modeled entrepreneurship they have highlighted a few of entrepreneurial characteristic in any single models, aware that this does not constitute a complete model of entrepreneurship (Lucas 1978; Kihlstrom et al. 1979; Kanbur 1982; Aghion and Howitt

1992; Cagetti and De Nardi 2006). Our focus will be on the effect of taxes on the timing of entry and how this impacts the total amount of self-employment and the average quality of the entrepreneurial firm. The potential entrepreneur decides whether to start a firm with a given entrepreneurial innovation or business idea or to remain employed and search for a new idea. Arguably the most important role entrepreneurs assume in the economy is that of innovators which is a motivation for our focus on the quality of the business idea. The quality of the firm also depends on the entrepreneurial effort exerted given startup which we will examine separately.

The first important decision any prospective entrepreneur has to make is whether to start a firm or work for someone else. In our model each period the individual discovers an "entrepreneurial idea"; he then decides whether to use it to start a firm or to continue searching while remaining employed. The values of these innovations or business ideas differ, which represents the quality of entrepreneurship in our model. If the prospective entrepreneur does not act on the idea in a certain period it is assumed to be lost, reflecting the role of the entrepreneur as reacting to business opportunity in changing markets. Once a person decides to start a firm he will earn profits that depend on the quality of the business idea. The share of workers that decide to start firms represents the quantity of entrepreneurship.

Quality can be thought of as representing the social value created by the firm. This can be through new technological innovations, new or improved goods or a more efficient ways of producing existing products. What is central is the recognition that entrepreneurial ventures differ in value generated for society. Identifying a market niche and opening a new restaurant in a neighborhood can be valuable entrepreneurship, but not as valuable as creating new concept that that leads to an entire chain of restaurants. From the perspective of policy makers it is not only important how many people become entrepreneurs. It also matters

that these individual pursue the best possible ideas, exert high effort, bring together factors needed for successful ventures and create fast growing firms that create as many jobs and as much consumer surplus as possible. A proxy for entrepreneurial quality is the market value of the firm that they create[2]. Policymakers who wish to encourage entrepreneurship are seeking both quantity and quality. One "Google" is worth thousands of smaller entrepreneurial firms in terms of jobs, added value to gross domestic product or most other economic metrics of entrepreneurship.

We assume initially that the entrepreneur cannot search for new business ideas while managing his firms; this is the alternative cost of pursuing one project. In the Appendix we relax this assumption and discuss how our results change. For simplicity we abstract from learning by doing: ideas cannot be improved upon once the project is pursued. Entrepreneurial ideas are not correlated over time. We also abstract from any general equilibrium considerations; in particular workers' wages are not determined in equilibrium but are given. This is not unreasonable as the entrepreneurial sector in most western economies is small and thus unlikely to affect equilibrium wages through the supply of labor (although the effect on the demand of labor can be much more important). Lastly the behavior of other entrepreneurs does not change the returns faced by other potential entrants [3].

People who choose not to enter entrepreneurship and search for better ideas will earn a fixed wage and receive another entrepreneurial idea next period. Each period a certain fraction of entrepreneurs fails or quits and returns to the pool of workers. The wage rate

[2]Admittedly this proxy is not faultless since, for example, markets are not perfect and not all consumer surplus is captured. It is however in our opinion a good first approximation.

[3]There is a theoretical justification for this assumption. Entrepreneurship is innovative in nature, and can open up new markets and opportunities for other entrepreneurs. For this reason, and in contrast to other factors of production, a higher level of preexisting entrepreneurship does not necessarily diminish the marginal return for other entrepreneurs (Henrekson 2007).

is the same for all and can be interpreted as the relative advantage of employment vs. self employment. Crucially, the value of remaining as worker is the sum of wage income and the discounted option value of possibly discovering a better entrepreneurial idea in the future.

2.1 The Environment

The economy is populated by a continuum of infinitely lived agents of measure one. Each individual maximizes the discounted value of his life time utility, $\sum \beta^t u(c_t)$, where c_t denotes consumption in period t and β is the discount factor; β is strictly greater than zero and smaller than one. We will not analyze savings decision and further assume that agents are risk neutral. The utility function has the form $u(c_t) = c_t$, so that the problem facing the agent is to maximize the discounted value of consumption at present. Because of risk neutrality the Domar and Musgrave (1944) style variation smoothing effect of taxes on marginal investment are not included in the model, and are therefore not a driving mechanism for the results.

At the beginning of each period every individual receives an exogenous entrepreneurial idea, θ, drawn from a generic distribution, $F(\theta)$, defined over the positive interval $[\theta_l, \theta_h]$. Upon observing the value of θ the agent chooses between working on the market for wage w while looking for a better entrepreneurial idea or using the business idea to start a firm and earn the profit generated. Entrepreneurs receive the profits made by their firm, $Y_t^e = f(\theta_t)$; in our simplified economy $Y_t^e = \theta_t$.The value of the entrepreneurial idea, θ_t, is identically and independently distributed over time. Because there is no capital nor savings in the model $c_t = w$ for workers and $c_t = \theta_t$ for entrepreneurs.

2.2 Equilibrium

The problem can be written in a recursive form:

$$V(\theta) = \max\{V^e(\theta), V^s(\theta)\}$$

where $V^s(\theta)$ is the value function for the worker, and $V^e(\theta)$ is the value function for the entrepreneur. These value functions can be expressed as follows:

$$V^s(\theta) = w + \beta \int_\theta V(\theta) dF(\theta) \tag{1}$$

$$V^e(\theta) = \theta + \beta \left[pV^s(\theta) + (1-p) V^e(\theta) \right] \tag{2}$$

In formula (1) the integral value on the right hand side (RHS) is the discounted option value of waiting one more period and drawing one more time from the distribution of entrepreneurial ideas. Since θ is independently distributed over time this value is constant. This implies that $V^s(\theta)$ is constant with respect to θ.

The value function for the entrepreneur is the discounted value of the profit earned in the current period and of the profits earned in future periods, if the entrepreneurial acivity continues. With probability p in fact the entrepreneur might be forced out of business and into the salaried-workers segment of the economy. As dependent worker however he might still be looking for a new entrepreneurial idea to create a new firm. The value function for the entrepreneur might be rearranged as:

$$V^e(\theta) = \frac{\theta}{1 - \beta(1-p)} + \frac{\beta p}{1 - \beta(1-p)} V^s(\theta) \tag{3}$$

notice that $V^e(\theta)$ is strictly increasing (linear) in θ.

We define θ^* as the "reservation entrepreneurial idea". It represents the level of entrepreneurial idea such that below it the agent will find it optimal to work in the market; for every idea above this level the agent will prefer to start a firm and earn a profit. In particular θ^* is defined as

$$\theta^* : \{\theta \in [\theta_l, \theta_h] : V^s(\theta) = V^e(\theta)\}$$

which implies:

$$\begin{aligned} V^s(\theta^*) &= \frac{\theta^*}{1-\beta(1-p)} + \frac{\beta p}{1-\beta(1-p)} V^s(\theta^*) \\ V^s(\theta^*) &= \frac{\theta^*}{1-\beta} \end{aligned} \tag{4}$$

Using the reservation value, θ^*, and (3) we can rewrite (1) as:

$$V^s(\theta) = \frac{1-\beta(1-p)}{1-\beta} \frac{w + \frac{\beta}{1-\beta(1-p)} \int_{\theta^*}^{\theta_h} \theta dF(\theta)}{1+\beta p - \beta F(\theta^*)} \tag{5}$$

θ^* will then be the solution to

$$w + \gamma \int_{\theta^*}^{\theta_h} \theta dF(\theta) = \frac{\gamma}{\beta} \theta^* \left[1 + \beta p - \beta F(\theta^*)\right] \tag{6}$$

with $\gamma = \frac{\beta}{1-\beta(1-p)}$. In the appendix we discuss the conditions required for the existence and uniqueness of this equilibrium.

The partial equlibrium model outlined above has certain useful features that will allow us to capture important determinants of entrepreneurial entry. This is not to deny some limitations, such as not taking into account the effects of entrepreneurs' decisions on the rest of the economy. As we explained above this is a smaller problem if the entrepreneurial sector is small with respect to the rest of the economy *in the mechanism investigated*, such as the supply of workers (entrepreneurs probably have a more important role in determining productivity growth and the demand for labour). One could expand the model with an additional sector, such as a traditional corporate sector, and set the wage equal to the marginal product of that sector. The agent will then have to allocate labor between the two

sectors and this will determine an equilibrium value for the wage. We do not think that this would add much to the intuition contained in the following sections, especially since the self-employed (of which only some are truly entrepreneurial firms) constitute no more than around one tenth of all workers in the United States and most advanced countries.

3 Taxation and Entrepreneurial Entry

This section investigates the effect of taxation on the decision of starting a firm. We consider proportional and progressive taxes on business and labor income. Taxes on the self-employed should be interpreted as the effective personal tax rate of the proprietor from all income from business activity. Likewise, personal taxes should be broadly interpreted.

A first result is that proportional taxes do not affect entrepreneurial entry if the tax rates on business and capital income are equal (since other margins such as leisure are excluded). Our main result is that progressive taxes do have an effect on entrepreneurial entry even when the labor and business tax schedules are identical. In particular progressive tax schedules that decrease the workers' option value of waiting for a better idea result in a decline in the average quality of entrepreneurial firms accompanied by a reduction in the wait time to enter entrepreneurship, which increases the number of entrepreneurs in the economy.

3.1 Proportional Taxation

Let's call the proportional tax rate applied to business income τ_π and the proportional tax rate applied to labor income τ_w. The value functions (3) and (5) become

$$V^s(\theta) = \frac{1-\beta(1-p)}{1-\beta} \frac{(1-\tau_w)\, w + (1-\tau_\pi)\, \frac{\beta}{1-\beta(1-p)} \int_{\theta^*}^{\theta_h} \theta dF(\theta)}{1+\beta p - \beta F(\theta^*)} \tag{7}$$

$$V^e(\theta) = \frac{(1-\tau_\pi)\,\gamma\theta^*}{\beta} + \gamma p V^s(\theta^*) \tag{8}$$

and θ^*_τ is defined analogously to θ^* by:

$$(1-\tau_w)\,w + (1-\tau_\pi)\,\gamma \int_{\theta^*_\tau}^{\theta_h} \theta dF(\theta) = (1-\tau_\pi)\,\frac{\gamma}{\beta}\theta^*_\tau\left[1+\beta p - \beta F(\theta^*_\tau)\right] \tag{9}$$

From (9) we immediately derive the two following propositions.

Proposition 1 *If $\tau_w = \tau_\pi = \tau$ then θ^*_τ does not depend on τ and $\theta^*_\tau = \theta^*$. Hence when business and labor income are subject to proportional taxation and the tax rates are identical, the equilibrium in the economy is the same as in the case with no taxes.*

Proof. The result follows immediately from (9). When $\tau_w = \tau_\pi = \tau$ equation (9) simplifies to equation (6). ■

Proposition 2 *With proportional taxation when the tax rate on wages is higher than the tax rate on business income there will be more entrepreneurial entry in equilibrium. Moreover, an increase in the tax rate on wages decreases further the threshold level for entrepreneurial entry. Similarly, when the tax rate on business income is higher than the tax rate on wages there will be less entrepreneurial entry in equilibrium. Moreover, an increase in the tax rate on business income will increase further the threshold level for entrepreneurial entry.*

Proof. See Appendix. ■

Obviously when the tax rate on business income is higher than the tax rate on wages there will be less entrepreneurial entry and fewer entrepreneurs in equilibrium than when the tax rates are the same. The opposite is true when the tax rate on business income is lower that the tax rate on wages. The previous proposition also suggest that an increase in the tax rate

on wages will increase entrepreneurial entry in the economy, while an increase in business income tax rates will decrease entrepreneurship. Notice moreover that in this model, an increase in entrepreneurial entry is associated with a decrease in the average quality of the firms since the individuals who are entering entrepreneurship are the marginal ones, those whose entrepreneurial ideas are of worse quality than the existing firms. The opposite is true when entrepreneurial entry decreases. A decrease in the number of entrepreneurs in the economy is associated to an increase in the average quality of the firm.

3.2 Progressive Taxation

Let us now consider the effect of a progressive tax schedule. Consider a simple progressive structure for taxation and call T_w the progressive schedule for labor income and T_π the progressive schedule for business income. Higher levels of income will be taxed with higher tax rates. In particular

$$\begin{aligned} T_w &= 0 \qquad w < \hat{w} \\ &= \tau_w \qquad w \geq \hat{w} \end{aligned} \tag{10}$$

$$\begin{aligned} T_\pi &= 0 \qquad \theta < \hat{\theta} \\ &= \tau_\pi \qquad \theta \geq \hat{\theta} \end{aligned} \tag{11}$$

where $\tau_w > 0$, and $\tau_\pi > 0$. To further simplify the problem and allow us to make some interesting comparisons, let's assume that $\tau_w = \tau_\pi = \tau$ and $\hat{\theta} = \hat{w}$. The tax schedules are the same for labor and business income. We illustrate now different cases that may arise depending on the shape of the tax schedule, i.e. the relative position of $\hat{\theta}$, θ^* and w. Figure 1 illustrates graphically the equilibrium point θ^* when $\theta^* < \hat{\theta}$.

3.2.1 Case 1: $\hat{\theta} > \theta^*$

In this case the value functions can be written as

$$V_\tau^s(\theta) = w + \beta V_\tau^s(\theta) F(\theta_\tau^*) + \gamma p V^s(\theta) + \frac{\beta}{1-\beta} \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau \frac{\beta}{1-\beta} \int_{\hat{\theta}}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) \quad (12)$$

$$\begin{aligned} V_\tau^e(\theta) &= \frac{\gamma\theta}{\beta} + \gamma p V^s(\theta) && \text{for } \theta < \hat{\theta} \quad (13) \\ &= \frac{\theta - \tau(\theta - \hat{\theta})}{1-\beta} + \gamma p V^s(\theta) && \text{for } \theta \geq \hat{\theta} \end{aligned}$$

and θ_τ^* is the solution to:

$$w + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\hat{\theta}}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) = \frac{\gamma\theta}{\beta} \theta_\tau^* \left[1 + \beta p - \beta F(\theta_\tau^*)\right] \quad (14)$$

In this case the effect of an increase in the tax rate is summarized by the following proposition.

Proposition 3 *With a progressive tax schedule when the marginal entrepreneur earns less than the top marginal tax rate bracket, an increase in the top marginal tax rate causes a decrease in the reservation entrepreneurial idea, hence an increase in entrepreneurial entry and a decrease in the average quality of the firms in the economy.*

Proof. See Appendix. ■

The previous proposition states that even if business income and wages are taxed at the same level, the "reservation entrepreneurial idea" in this case is lower than in the case with no taxes or equal proportional tax rates for business and wage incomes. Two identical economies, one with a progressive tax schedule with equal marginal rates on business and wage incomes and one with a proportional tax schedule with equal marginal rates on business and wage incomes, will have different levels of entrepreneurial activity. In particular the

former will have more entrepreneurs but the average quality of the firm will be lower. Moreover, as the top marginal rate increases more agents will choose to become entrepreneurs and the lower the average quality of entrepreneurial firms.

The intuition behind this result is that convex taxes disproportionally decrease option value of working and searching for new ideas. Since the most successful businesses will be taxed at a higher rate the incentive to wait for better entrepreneurial ideas are diminished. Some workers with medium value ideas prefer to start a firm, and thus give up the chance of waiting and finding a better idea. Figure 2 illustrates graphically this mechanism.

Waiting for an entrepreneurial idea can be viewed as a form of passive search. In that case our model predicts that an increase in the convexity of the tax schedule can decrease search activity and make people more likely to hold on to their current occupation. Gentry and Hubbard (2004) empirically demonstrate that tax progressivity decreases job turnover.

3.2.2 Case 2: $\theta^* > \hat{\theta} > w$

In this case the equilibrum is defined by:

$$w + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\theta_\tau^*}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) = \frac{\theta_\tau^* - \tau(\theta_\tau^* - \hat{\theta})}{1 - \beta(1-p)} \left[1 + \beta p - \beta F(\theta_\tau^*)\right] \tag{15}$$

The effect of a top marginal tax rate increase in this case is summarized by the following proposition.

Proposition 4 *With a progressive tax schedule when the marginal entrepreneur earns more than the top marginal tax rate bracket and more than the average worker, the effect of an increase in the top marginal tax rate on entrepreneurial activity is uncertain.*

Proof. See Appendix. ■

The effect of an increase of the top marginal rate on entrepreneurial activity is uncertain when the marginal entrepreneur is in the top bracket (i.e. the bracket at which the change is occurring). The reason is that there are two effects that work in opposite directions. First, there is the decrease in the value of being a worker due to the decrease in the option value of searching for a better idea, as described in the previous section. Second, there is a decrease in the value of being a (successful) entrepreneur due to an increase in the share of income taxed away by the government.

Let us ignore for now the effect on the option value of being a worker and only look at the direct effect of an increased tax rate on the marginal entrepreneur. For entrepreneurs in the top tax bracket, an increase in the marginal tax rate they face (from τ to τ') decreases the value of being an entrepreneur vis-a-vis the value of working. Since this is true for all the ideas above $\hat{\theta}$, it also holds for the marginal entrepreneur earning a pre-tax profit equal to $\theta^*_\tau > \hat{\theta}$. However the marginal entrepreneur was by definition indifferent between salaried work and entrepreneurship when the tax rate was τ. Since the tax rate has now increased, the after-tax profit is lower and the former marginal entrepreneur is no longer indifferent between being an entrepreneur and a worker. Instead he or she strictly prefers being a worker.

In other words, since taxes have increased the pre-tax profit that an entrepreneur needs to earn in order to be indifferent between working and starting a firm has to go up. Because of the decrease in after tax profits, the reservation entrepreneurial idea must increase following an increase in the top marginal tax rate for the agent to remain indifferent. Figure 3 illustrates this effect on θ^*.

Since this effect and the effect on the search option go in opposite directions the overall impact of an increase in the top marginal tax rate on entrepreneurial activity cannot be

determined without further assumptions on the distribution of the thetas and the relative positions of θ^* and $\hat{\theta}$.

3.2.3 Case 3: $\theta^* > w > \hat{\theta}$

We consider the case in which labor income is taxed. As in the previous section we consider the case in which the kink in the entrepreneurial value function is below the value of searching. The situation when it is above the equilibrium is exactly as in Case 1.

The value function for the entrepreneurs is still the one described in (13) while the value function for the worker becomes

$$V_\tau^s(\theta) = w - \tau(w - \hat{w}) + \beta V_\tau^s(\theta) F(\theta_\tau^*) + \gamma p V^s(\theta) + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\theta_\tau^*}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) \tag{16}$$

θ_τ^* is the solution to

$$w - \tau(w - \hat{w}) + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\theta_\tau^*}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) = \frac{\theta_\tau^* - \tau(\theta_\tau^* - \hat{\theta})}{1 - \beta(1-p)} \left[1 + \beta p - \beta F(\theta_\tau^*)\right] \tag{17}$$

Again the effect of an increase in the top marginal tax rate is summarized by the following proposition.

Proposition 5 *With a progressive tax schedule when the marginal entrepreneur earns more than the top marginal tax rate bracket but less than the average worker, the effect of an increase in the top marginal tax rate on entrepreneurial activity is uncertain.*

Proof. See Appendix. ■

As in previous case the effect of an increase in the top marginal tax rate is uncertain. The reason is similar. The opposite effects on θ_τ^* described above are still at work: an increase in

the top marginal tax rate decreases both the value of being an entrepreneur (which should increase the reservation entrepreneurial idea) and the value of being a worker (which should decrease the reservation entrepreneurial idea). The only difference is that the value of being a worker decreases more than in the previous case; this time it is not only the decrease in the option value of searching for a new idea that pushes down the value of being a worker but also a decrease in earnings associated with higher taxation.

As before, the final effect of an increase in tax rates on entrepreneurial activity depends on the distribution of the thetas and on the relative positions of θ_τ^* and $\hat{\theta}$. Without any further assumptions on the value of the parameters, we cannot predict how θ_τ^* changes with the tax rate nor the relative position of θ_τ^* to θ^*.

The three cases just discussed suggest that the effect of an increase in the top marginal tax rate depends on the position of the marginal entrepreneur. If the income of the marginal entrepreneur is not directly affected by the change in tax rates then an increase in marginal tax rates will undoubtedly lead to an increase in entrepreneurial activity and a decrease in the average quality of firms. The reason for this result is that "success taxes" will decrease the value of waiting for a better idea, so that some people will settle down for lower quality ideas. If the income of the marginal entrepreneur instead is the top bracket then the final result depends on the relative strength of two opposite effects. On the one hand there is the decrease in the option value of being a worker; on the other hand there is the decrease in the earnings of the marginal entrepreneur which will cause only those with better entrepreneurial ideas to become entrepreneurs.

Some of our results, such as the reduction in average quality of entrepreneurial firms and the entry of lower quality entrepreneurs following an increase in progressive taxes, hinge on the "persistent" nature of the entrepreneur's business idea once the entry decision has

been made. If we instead assume that each period not only the workers but also existing entrepreneurs can receive a new entrepreneurial idea, the effect of higher taxes, proportional or progressive, will depend on the correlation of ideas across time. We work out the details of this modification in the Appendix.

3.3 Empirical Implications

With taxes some individuals that otherwise would aim for high quality ideas enter self-employment earlier. Since progressive taxes compress the return to ideas, the minimum quality of a business idea worth pursuing decreases. Because high marginal taxes reduce the private value of top quality projects, potential entrepreneurs may settle for medium quality business projects rather than pursuing the small chance of a brilliant idea in the future.

The individual welfare effect of taxes is negative, since it leads to a distorted choice between search and entry and reduces quality. However the societal welfare implications may be even more important, if we believe that high quality entrepreneurial ideas are disproportionally important, for example for technological progress. Economists such as Nordhaus (2004) and Kaplan et al. (2009) estimate that entrepreneurs only capture a small fraction of the surplus they create, which may be even more true for very important innovations.

From an empirical standpoint, measuring the impact of taxation on entrepreneurial activity and quality of the firms in particular is a difficult task, due both to a lack of data on entrepreneurial quality and the absence of reliable policy experiments. The evidence presented here should therefore be viewed as suggestive, rather than definitive. We first discuss the evidence provided by other articles, then discuss the results we obtain by using the data collected by the Global Entrepreneurship Monitor, the World Bank and Eurostat.

Sanandaji (2010) measures high quality entrepreneurship as billionaires who become rich

through founding their own firms. Relying on the Forbes list of billionaires and investigating their source of wealth, he identified 996 billionaire entrepreneurs in 53 countries. Lower quality entrepreneurship is measured as non-agricultural self-employment. He finds that high and low quality entrepreneurship are negatively correlated, with a statistically significant negative relationship both in OECD-countries and in a broader sample of Nations. Countries with higher rates of self-employment tend to have lower per capita numbers of billionaire entrepreneurs. More importantly, high taxes on firms are negatively correlated with high-quality entrepreneurship and positively related to self-employment. The latter result is in line with the idea proposed in this article that higher marginal taxes might increase the number of entrepreneurs but decrease their quality.

Another empirical study finds results which correspond strongly with the theoretical predictions in this paper. Kneller and McGowan (2011) study the effect of a change in marginal corporate taxes in advanced economies. They suggest that the effect of an increase in taxes depends on the income bracket at which the tax change occurs. Increases in marginal tax rates applied at low income levels negatively affect entry, while the opposite is true when the change happens at higher income levels. These empirical findings can be interpreted in light of our model. Tax increases on top earners likely apply to income brackets well above the one where the marginal entrepreneur is located. In this case proposition (3) suggests that the effect on the entrepreneurial entry rate from tax increases should be positive. This counterintuitive result (from the point of view of the standard model) is precisely what Kneller and McGowan find. When the change in the marginal rate is at lower levels it is more likely that it is directly affecting the earnings of the marginal entrepreneurs. In this case propositions (4) and (5) suggest that the effect is indetermined and depends on the distribution of entrepreneurial talent and the relative distance between the income of the marginal entrepreneur and the income level at which the change is taking effect. Kneller

and McGowan find that the effect on entrepreneurial entry of an increase in marginal tax rates at lower income levels is negative. It seems that the direct effect on the income of the entrepreneurs is stronger than the indirect effect on their search option. Kneller and McGowan (2011) do not investigate the quality of entrepreneurial firms.

We now discuss some additional empirical evidence. In particular we present two sets of data; the first combines data from the Global Entrepreneurship Monitor (GEM) and the World Bank; the second, uses information obtained from Eurostat and the World Bank.

For the first empirical exercise we rely on data on high and low-quality entrepreneurship as measured by the Global Entrepreneurship Monitor (GEM). The GEM "Total Entrepreneurial Activity rate" (TEA) is one of the most widely used measures of entrepreneurship and self-employment (e.g. Bygrave et al. 2001, Acs and Szerb 2009, Ardagna and Lusardi 2010, Lerner 2009). The Total Entrepreneurial Activity rate estimates "the Percentage of 18-64 population who are either a nascent entrepreneur or owner-manager of a new business". Though it includes both high and low quality entrepreneurs, as an empirical matter the overwhelming majority of start-ups are small scale, in the sense of having very few employees and low growth ambitions. For instance, several years after startup over 90% of American new ventures were either out of business or still had fewer than 5 employees. (Sanandaji 2010). Hurst and Pugsley (2011) moreover suggest that most small firms have no interest in growing or producing significant innovations.

The Global Entrepreneurship Monitor also collects a measure of entrepreneurship that better corresponds with high quality entrepreneurs, so called "High-Growth Established Entrepreneurs" (Aotio 2007). This refers to the share of owner-managers of firms that are at least 42 months old and have at least 20 employees. The GEM also provides data for the share of established businesses who have 20 or more employees.

We will use the Total Entrepreneurial Activity rate as a proxy for low quality entrepreneurship and the High-Growth Established Entrepreneurs rate as a proxy for high quality entrepreneurship. Another closely related measure of high-quality entrepreneurship is the share of business-owners who employ 20 or more employees.

Measuring the quality of firms is not the only challenge. We also need to summarize the progressivity of the tax code for each country in one rate. Generally, entrepreneurs pay many different taxes, with the tax rate depending on the earnings of the firm. Fortunately the World Bank reports data on the highest marginal tax rate faced by firms for most countries of the world. This is not a perfect measure of the top marginal tax rate faced by entrepreneurs, as many business owners are taxed as employees. However in many countries firms, and in particular successful firms are subject to this tax rate. Furthermore, the highest marginal tax rate on firms tends to be positively correlated with the level and progressivity of taxation in general. Some or all data on entrepreneurship and data on taxes is available for 72 countries, which are a mix of high, middle and low income countries.

Our first findings are illustrated in figures (5), (6) and (7). Countries with a high marginal tax rate on firms have a smaller share of the working age population that are high quality entrepreneurs (the relationship is statistically significant at a p-value of 0.07). By contrast, countries with high top marginal tax rates tend to have a higher number of low quality entrepreneurs (p-value 0.04). Lastly the share of business owners who employ at least 20 workers is lower in countries with high top marginal tax rates (p-value 0.09). All these results are robust to controlling for per-capita income, although the p-value increases to 0.12 for the number of high-quality firms and 0.13 for the share of high-quality firms. The small size of the sample should be taken into account when interpreting these p-values.

Another way to approximate for the quality of entrepreneurship is the education level of

entrepreneurs. In order to better correspond with entrepreneurship theory we will use data on self-employed individuals with at least one employee (other than the business owner), as provided by Eurostat. For the United States, where such data is not readily available, we discuss incorporated firms. The incorporated self-employed are much more likely to have employees than unincorporated firms, two thirds of which have zero employees in the United States (Sanandaji 2010).

The United States tend to have business owners that are more educated than the overall workforce; in Western Europe, characterized by a higher average tax rate, the education of the self-employed is no different than employees. In 2009 48% of the incorporated self-employed in the U.S. had tertiary education, compared to 34%of the U.S. workforce. Meanwhile merely 4% of incorporated self-employed lacked high school degrees, compared to 9% in the entire workforce. The rate of incorporated self-employment was 5.6% among those with tertiary education and only 1.7% among those with less than a high school degree; hence the ratio of the self-employment rate of those with more education to those with less was 3,25.

In Western Europe by contrast those with tertiary education were approximately as likely to be self-employed (with employees) as those who lack high school degrees, with the ratio of the self-employment rate in the two groups at 1.06. In Sweden, Norway and several other high tax countries the ratio is lower than one, so that the highly educated are less likely than those with little education to be entrepreneurs[4].

We include as entrepreneurs only those with at least one employee other than the business owner herself. In part to account for differences in education levels between countries, we

[4]The American data is from Hipple (2010) while the European data is from the Eurostat database. The U.S. data refers to individuals older than 25, while the data from Eurostat is for those between 20-64 years old.

compare the self-employment rate of those with tertiary education with the self-employment rate of those without high school degrees. The ratio of the two rates is a measure of (relative) entrepreneurial quality. Figure (8) relates this measure of the quality of entrepreneurship with the highest corporate tax rate in 31 European countries.

The highest marginal tax rate of firms is negatively correlated with the relative quality of entrepreneurship. On average countries with high tax rates tend to have lower self-employment rate among the most educated compared to those with little education. Patterns presented in figure (8) are another indication that highly taxed countries tend to have a lower quality entrepreneurs but not necessarily fewer entrepreneurs overall. We should again point out that these results are by nature suggestive. Even if the relationship between taxes and entrepreneurial quality is interpreted as causal, the mechanism which causes it may be different than the one outlined in our model. There are other possible reasons why countries with high marginal taxes would have more entrepreneurs but of lower quality, such as tax evasion. Another possible explanation is that high taxes shift the distribution of entrepreneurs from those motivated in pecuniary rewards to those with non-pecuniary motivation. Non-pecuniary benefits of self-employment have recently been emphasized by Hurst and Pugsley (2011). These include being one's own boss, "hobby"-entrepreneurship and greater flexibility over hours, which is especially important for women. Needless to say non-pecuniary benefits are not subject to taxes. Higher taxes could therefore cause a higher share of the self-employed in a country to consist of entrepreneurs who are less interested in growth and in earning profits, rather than in fewer entrepreneurs.

When relying on cross-country evidence the risk is always present that the relationships are not causal, and instead the results of omitted variables, such regulations or the rate of other taxes. While the data does not allow us to establishing a clear causal relationship,

the empirical patterns observed across countries are consistent with the theory proposed, as high marginal tax rates are associated with more entrepreneurs, but of lower average quality. While far from causal the correlations reported suggest that empirical evaluations of the relationship between taxes and entrepreneurship need to take the quality margin into account.

4 The Effect of Taxes on Entrepreneurial Effort

A second component of the quality of entrepreneurial firms focuses on the level of effort entrepreneurs exert in their firms. For any given level of entrepreneurial idea firm value increases because of the entrepreneur's hard work (this can be interpreted broadly, both including more hours or higher intensity). When incorporating this margin in our model we consider the version where both the entrepreneurs and the workers receive a new entrepreneurial idea every period. We also introduce a modification to the search problem, by introducing a cost for seeking new ideas. Agents who do not work in a firm and instead choose to search for an entrepreneurial idea pay a fixed search cost, $b > 0$, as opposed to the previous cases where they earned wages. This ensures that there are indeed two different levels of optimal effort (with no search cost and a positive wage the entrepreneurs will only either choose high effort or remain employed. With no wage and no search cost the agent will work when θ is low, will be indifferent between high and low effort at one threshold point and choose high effort above this point)

Entrepreneurial effort will enter the production function of the entrepreneur, $Y_t^e = \theta_t \epsilon_t$ and their utility function $u(c_t) = \theta_t \epsilon_t - \alpha \epsilon_t$, where ϵ_t is the effort and α a parameter that captures the marginal disutility from effort. In particular we assume that there are only two possible levels of effort, low effort ϵ_ℓ and high effort, ϵ_h where $\epsilon_h > \epsilon_\ell > 0$. With these

modifications we proceed to the calculations of the equilibrium of the model.

4.1 Modified Model and Equilibrium

The problem for the entrepreneur can be written in a recursive form:

$$V(\theta) = \max\{V^h(\theta), V^\ell(\theta), V^s(\theta)\}$$

where $V^s(\theta)$ is the value function for the entrepreneur who is searching for a better entrepreneurial idea, $V^h(\theta)$ is the value function for the entrepreneur who decides to exert high effort and $V^l(\theta)$ is the value function for the entrepreneur who exerts low effort.

Using the information in the previous section we can write:

$$V^h(\theta) = \theta\epsilon_h - \alpha\epsilon_h + \beta \int_\theta V(\theta) dF(\theta) \tag{18}$$

$$V^\ell(\theta) = \theta\epsilon_\ell - \alpha\epsilon_\ell + \beta \int_\theta V(\theta) dF(\theta) \tag{19}$$

$$V^s(\theta) = -b + \beta \int_\theta V(\theta) dF(\theta) \tag{20}$$

Notice that $V^h(\theta)$ and $V^\ell(\theta)$ are strictly increasing in ϵ_h and ϵ_l while $V^s(\theta)$ is a constant.

In this version of the model the equilibrium will be completely described by two levels of entrepreneurial ideas. Let's call θ_1 the level of entrepreneurial idea such that for any θ smaller than θ_1 it it's optimal to pay the fixed cost and search for a better idea. The entrepreneurial idea θ_2 instead is defined as threshold that makes the individual indifferent between exerting high or low effort. Notice that by monotonicity of $V^h(\theta)$ and $V^l(\theta)$, for

all θ greater than θ_2 it is optimal to exert high effort rather than low. These two threshold levels are defined formally as follows:

$$\begin{aligned} \theta_1 &: \inf\{\theta : V^s(\theta) = V^i(\theta)\} \qquad i = h, \ell \\ \theta_2 &: \{\theta : V^\ell(\theta) = V^h(\theta)\} \end{aligned}$$

Given the continuity and monotonicity of the three value functions, the sufficient condition for the existence and uniqueness of θ_1 is:

$$\theta_l < \frac{\alpha\epsilon_\ell - b}{\epsilon_\ell}$$

Existence and uniqueness of θ_2 is guaranteed by the assumptions on the effort level, $\epsilon_h > \epsilon_\ell > 0$, and by the monotonicity of $V^h(\theta)$ and $V^\ell(\theta)$.

The equilibria are calculated as follows:

$$\begin{aligned} \theta_1 \quad &: \quad V^s(\theta) = V^\ell(\theta) \\ &\implies \theta_1 = \frac{\alpha\epsilon_\ell - b}{\epsilon_\ell} \end{aligned} \tag{21}$$

$$\begin{aligned} \theta_2 \quad &: \quad V^h(\theta) = V^\ell(\theta) \\ &\implies \theta_2 = \alpha \end{aligned} \tag{22}$$

With simple algebra one finds (as expected) that $\theta_2 > \theta_1$. The policy function, $h(\theta)$, can then be summarized as follows

$$
\begin{aligned}
h(\theta) = \quad & \text{search} && \text{if } \theta \in [\theta_l, \theta_1) \\
= \quad & \epsilon_\ell && \text{if } \theta \in [\theta_1, \theta_2) \\
= \quad & \epsilon_h && \text{if } \theta \in [\theta_2, \theta_h]
\end{aligned} \tag{23}
$$

4.2 Proportional Taxes

As usual we consider the effect of both proportional and progressive taxes on business income. Let's start with a proportional tax rate on firm's profits. Equation (20) does not change while (18) and (19) are re-written as:

$$V_\tau^h(\theta) = (1-\tau)\,\theta\epsilon_h - \alpha\epsilon_h + \beta \int_\theta V(\theta) dF(\theta) \tag{24}$$

$$V_\tau^\ell(\theta) = (1-\tau)\,\theta\epsilon_\ell - \alpha\epsilon_\ell + \beta \int_\theta V(\theta) dF(\theta) \tag{25}$$

The equilibrium then changes as follows:

$$\theta_1^\tau = \frac{\alpha\epsilon_\ell - b}{(1-\tau)\,\epsilon_\ell} = \frac{\theta_1}{(1-\tau)} \tag{26}$$

$$\theta_2^\tau = \frac{\alpha}{(1-\tau)} = \frac{\theta_2}{(1-\tau)} \tag{27}$$

and the new policy function is

$$
\begin{aligned}
h_\tau(\theta) &= \text{search} && \text{if } \theta \in [\theta_l, \theta_1^\tau) \\
&= \epsilon_\ell && \text{if } \theta \in [\theta_1^\tau, \theta_2^\tau) \\
&= \epsilon_h && \text{if } \theta \in [\theta_2^\tau, \theta_h]
\end{aligned} \tag{28}
$$

Since $(1-\tau) < 1$ we find that both $\theta_1^\tau > \theta_1$ and $\theta_2^\tau > \theta_2$. Due to taxes fewer people will become entrepreneurs and fewer of those that become entrepreneurs will exert high effort. Moreover, since $\theta_2^\tau - \theta_1^\tau = (\theta_2 - \theta_1) / (1-\tau)$ we know that $\theta_2^\tau - \theta_1^\tau > \theta_2 - \theta_1$. This is an interesting finding with a clear-cut empirical prediction: taxes will not only reduce the absolute number of entrepreneurs with high effort, but also lead to a reduction of the high effort type as a share of self-employed. Figure 4 depicts the effect of proportional taxes.

4.3 Progressive Taxes

We will consider the same tax schedule as in (10) and (11), distinguishing three different cases as before. Since in this framework the workers and entrepreneurs have the same option value of waiting, the effect of progressive taxes will be similar to those of proportional taxes (note that the models exclude tax distortions in the choice of leisure). The difference between progressive and proportional taxes depends on the income level at which the higher tax bracket kicks in. With proportional taxes both equilibrium points always change. With progressive taxes, depending on the level of the bracket, both, one or none of the equilibria may be affected.

Let us start by rewriting the value functions for the entrepreneurs. They are as follows:

$$
\begin{aligned}
V_\tau^h(\theta) &= \theta\epsilon_h - \alpha\epsilon_h + \beta \int_\theta V(\theta) dF(\theta) && \text{for } \theta < \hat{\theta} \\
&= \theta\epsilon_h - \tau(\theta - \hat{\theta})\epsilon_h - \alpha\epsilon_h + \beta \int_\theta V(\theta) dF(\theta) && \text{for } \theta > \hat{\theta}
\end{aligned} \tag{29}
$$

$$
\begin{aligned}
V_\tau^\ell(\theta) &= \theta\epsilon_\ell - \alpha\epsilon_\ell + \beta \int_\theta V(\theta) dF(\theta) \qquad \text{for } \theta < \hat{\theta} \\
&= \theta\epsilon_\ell - \tau(\theta - \hat{\theta})\epsilon_\ell - \alpha\epsilon_\ell + \beta \int_\theta V(\theta) dF(\theta) \qquad \text{for } \theta > \hat{\theta}
\end{aligned} \tag{30}
$$

4.3.1 Case 1: $\hat{\theta} > \theta_2$

When the increase in the tax rate starts at a bracket above θ_2 nothing happens to the equilibrium. Both equilibrium points are below the threshold and none of them changes because of taxes.

4.3.2 Case 2: $\theta_2 > \hat{\theta} > \theta_1$

In this case only θ_2 changes. θ_2^τ is defined by $V_\tau^h(\theta) = V_\tau^\ell(\theta)$

$$
\theta_2^\tau = \frac{\alpha - \tau\hat{\theta}}{(1-\tau)} \tag{31}
$$

and with simple algebra one can prove that $\theta_2^\tau > \theta_2$. The effect of progressive taxes is to decrease the number of entrepreneurs that exert high effort (both as proportion of all entrepreneurs and in absolute terms).

4.3.3 Case 3: $\theta_1 > \hat{\theta}$

In this case both θ_1 and θ_2 change. θ_1 will be defined by $V_\tau^s(\theta) = V_\tau^\ell(\theta)$ and θ_2 by $V_\tau^h(\theta) = V_\tau^\ell(\theta)$; hence θ_2 is as in (31) while θ_1 can be calculated as:

$$
\theta_1^\tau = \frac{\alpha\epsilon_\ell - \tau\hat{\theta}\epsilon_\ell - b}{(1-\tau)\epsilon_\ell}
$$

For θ_1^τ to be positive we require $\alpha\epsilon_\ell - \tau\hat{\theta}\epsilon_\ell - b > 0$. This last condition also insures that $\theta_1^\tau > \theta_1$. Moreover also in this case $\theta_2^\tau - \theta_1^\tau = (\theta_2 - \theta_1)/(1-\tau)$ and $\theta_2^\tau - \theta_1^\tau > \theta_2 - \theta_1$. Once again the effect of taxation is to decrease the number of entrepreneurs in the economy and to reduce the absolute number as well as share of hard working business owners.

Some firms that could have been successful do only moderately well in a high tax environment because of reduced effort. Taxes lead to fewer firms, a smaller total number of high effort type, and also a reduction in the share of firms where the owners exert high effort. These results are intuitive. For entrepreneurial firms to be successful it is generally needed that the owner works hard in developing the firm. It is a common result across countries that the self-employed tend to work more hours than the employed. The relation between effort and firm success has been empirically demonstrated by Bitler et al. (2005).

5 Conclusions

We study the effect of taxes on entrepreneurial entry in a dynamic setting that takes into account both the number of entrepreneurs and the quality of their firms. A novel finding is that when entry is associated with an opportunity cost in terms of searching for better ideas, progressive taxes can decrease the average quality of startups while increasing their number. Progressive taxes compress the returns to entrepreneurial activity, thus lowering the reward of the high quality ideas relative to mediocre ones. While the paper focuses on entrepreneurship, the model can be interpreted as the impact of taxes on any investment choice which involves taking irreversible decisions at the cost of pursuing better options.

In various specifications higher taxes are found to reduce high quality entrepreneurship, but may at the same time increase the number of new (lower quality) entrants. Empirical

studies typically do not take into account the quality of entrepreneurship, and mainly focus on quantity measures, such as the probability of entry. Since we show that quality and quantity can go in opposite directions as a result of higher marginal taxes, this standard empirical framework risks leading to misguided policy conclusions. The result that high marginal taxes leave unchanged or encourage entrepreneurial entry should not be interpreted as a sign of small distortions, if quality is not taken into account. This is especially true if the value of entrepreneurship from a social welfare perspective mainly comes from high quality ventures and innovations.

When allowing for the choice of effort as well as entry decision we find that taxes both discourage entry and reduce entrepreneurial effort. Also in this setting we find that taxes impact both the quantity and the quality of entrepreneurship, so that the study of entry alone would again underestimate the distortion caused by taxation.

Taxes can lead to a larger share of self-employed but less entrepreneurial quality through other mechanisms as well. For example, the self-employed have an easier time evading taxes, so taxes can directly discourage the pursuit of entrepreneurial ideas, while encouraging self-employment motivated by tax evasion only. Clearly the later type of entrepreneur is hardly the same economic entity as a new firm based on innovative ideas. Studies that point to these opposing effects of taxes and argue that taxes have ambiguous impact on entrepreneurship miss an important point. Self-employment and entrepreneurship are not ends to themselves; they are sought after by policy makers because they are thought to increase economic growth and help create high paying jobs. Even if higher taxes lead to the swelling of the ranks of the self-employed encouraging the creation of many small stagnant firms, they are still detrimental to the economy because they stifle productive and fast growing entrepreneurial ventures.

Taxes can impact quality differently than quantity in more subtle ways. Monetary income is not the only reward from entrepreneurship; many individuals with have preferences conducive to entrepreneurship, such as a wish for independence. In a low taxes environment these individuals are strongly rewarded if they create successful firms and if they choose to grow. In countries with high taxes many of these individuals may nevertheless pursue the entrepreneurial lifestyle but because of dulled economic incentives choose "comfort" in their business rather than risk, competition and expansion. The latter countries might have the same quantity of entrepreneurs as the former but end up with lower quality entrepreneurship and disparate economic outcomes.

References

[1] Aghion, P. and P. Howitt. 1992. A model of growth through creative destruction. Econometrica, 60(2): 323–351.

[2] Acs, Z. and L. Szerb. 2009. The Global Entrepreneurship Index (GEINDEX). Foundations and Trends in Entrepreneurship 5(5): 341–435.

[3] Ardagna, S. and A. Lusardi. 2010. Explaining International Differences in Entrepreneurship: The Role of Individual Characteristics and Regulatory Constraints. In J. Lerner and A. Schoar (Eds) International Differences in Entrepreneurship.

[4] Autio, E. 2007. 2007 Global Report on High-Growth Entrepreneurship. Global Entrepreneurship Monitor.

[5] Bygrave, W., M. Hay, P. Lopez-Garcia and P. Reynolds. 2001. The Global Entrepreneurship Monitor (GEM) model for economic growth: A study of venture capital in 19 nations. In W. D. Bygrave et al. (eds.) Frontiers of Entrepreneurship Research 2001, Wellesley, MA: Babson College.

[6] Bitler, M., T. Moskowitz and A. Vissing-Jørgensen. 2005. Testing Agency Theory with Entrepreneur Effort and Wealth. Journal of Finance 60(2): 539-76.

[7] Bruce, D. 2000. Effects of the United States Tax System on Transitions Into Self-Employment. Labour Economics 7(5): 545-74.

[8] Bruce, D. and T. Gurley. 2004. Taxes and Entrepreneurial Entry: An Empirical Investigation Using Longitudinal Tax Return Data. Proceedings of the 97th Annual Conference on Taxation, National Tax Association, 336-343.

[9] Bruce, D. and H. Schuetze. 2004. Tax Policy and Entrepreneurship. Swedish Economic Policy Review, 11(2): 235-65.

[10] Cagetti, M.and M. De Nardi. 2006. Entrepreneurship, Frictions, and Wealth. Journal of Political Economy 114(5): 835-70.

[11] Carroll, R., D. Holtz-Eakin, M. Rider, and H. S. Rosen. 2001. Personal Income Taxes and the Growth of Small Firms. In James Poterba (ed.), Tax Policy and the Economy. Vol. 15, Cambridge, MA: MIT Press.

[12] Carroll, R., D. Holtz-Eakin, M. Rider, and H. S. Rosen. 2000a. Entrepreneurs, Income Taxes, and Investment. In Joel B. Slemrod (ed.), Does Atlas Shrug? The Economic Consequences of Taxing the Rich. New York: Russell Sage Foundation

[13] Carroll, R., D. Holtz-Eakin, M. Rider, and H. S. Rosen. 2000b. Income Taxes and Entrepreneurs' Use of Labor. Journal of Labor Economics 18(2): 324-51.

[14] Cullen, J. and R. Gordon. 2002. Taxes and Entrepreneurial Activity: Theory and Evidence for the U.S.. NBER Working Paper nr 9015.

[15] Dixit, A. and R. Pindyck 1994 Investment under Uncertainty. Princeton University Press.

[16] Domar, E. D. and R. A. Musgrave. 1944. Proportional income taxation and risk-taking. Quarterly Journal Eco-nomics, 58(3): 388–422.

[17] Gentry, W. M. and R. G. Hubbard. 2004. The effects of progressive income taxation on job turnover. Journal of Public Economics 88(11): 2301-22.

[18] Gentry, W. M. and R. G. Hubbard. 2000. Tax Policy and Entrepreneurial Entry. American Economic Review 90(2): 283-87.

[19] Gordon, R.H. 1998. Can High Personal Tax Rates Encourage Entrepreneurial Activity? IMF Staff Papers, International Monetary Fund, vol. 45(1): 49-80.

[20] Gordon, R. H. and J. MacKie-Mason 1994. Tax Distortions to the Choice of Organizational Form. Journal of Public Economics 55(2): 279–306.

[21] Gordon, R. H. and J. MacKie-Mason 1991. Taxes and the Choice of Organizational Form. NBER Working Paper No. 3781.

[22] Henrekson, M. and T. Sanandaji. 2011. Entrepreneurship and the Theory of Taxation. Small Business Economics, forthcoming

[23] Hurst E. and B. W. Pugsley. 2011. Understanding Small Business Heterogeneity. NBER Working Papers 17041

[24] Kanbur, S. M. 1982. Entrepreneurial Risk Taking, Inequality, and Public Policy: An Application of Inequality Decomposition Analysis to the General Equilibrium Effects of Progressive Taxation. Journal of Political Economy 90(1): 1–29.

[25] Kaplan, S. N., B. A. Sensoy and P. Stromberg. 2009. Should Investors Bet on the Jockey or the Horse? Evidence from the Evolution of Firms from Early Business Plans to Public Companies. Journal of Finance 64(1): 75-115.

[26] Kihlstrom, R. E. and J.-J. Laffont. 1979. A General Equilibrium Entrepreneurial Theory of Firm Formation Based on Risk Aversion. Journal of Political Economy 87(3): 719–48.

[27] Kirzner, I. M. 1973. Competition and Entrepreneurship. Chicago: University of Chicago Press.

[28] Kneller, R. and D. McGowan. 2011. Tax Policy and Firm Entry and Exit Dynamics: Evidence from OECD Countries. University of Nottingham working paper.

[29] Knight, F. H. 1921. Risk, uncertainty and profit. Boston: Houghton Mifflin Company.

[30] Lerner, J. 2009. The Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed—and What to Do About It. Princeton: Princeton University Press.

[31] Ljungqvist, L. and T. J. Sargent. 1995. Welfare States and Unemployment. Economic Theory, 6(1): 143-60.

[32] Lucas, R. E. 1978. On the Size Distribution of Business Firms. Bell Journal of Economics, 9(2): 508-23.

[33] Nordhaus, W. D. 2004. Schumpeterian Profits in the American Economy: Theory and Measurement. Cowles Foundation Discussion Papers 1457, Yale University

[34] Panteghini, P. 2007. Corporate Taxation in a Dynamic World. Berling: Springer.

[35] Pissarides, C. A. 1990. Equilibrium Unemployment Theory. Blackwell, Oxford.

[36] Schumpeter, J. A. 1934. The Theory of Economic Development. Cambridge, MA: Harvard University Press.

[37] Stenkula, M. 2009 Taxation and Entrepreneurship in a Welfare State IFN Working Paper No. 800

Appendix

A Existence and Uniqueness of Equilibrium

Given that both the RHS and the LHS of equation (6) are continuous functions of θ^*, sufficient conditions for existence of an equilibrium are:

$$\begin{aligned} w &> \frac{\theta_l(1+\beta p) - \beta E(\theta)}{1-\beta(1-p)} \\ w &< \theta^h \end{aligned}$$

These conditions describe a relationship between the market wage and the distribution of the quality of entrepreneurial projects. The second condition simply says that the best possible entrepreneurial idea must yield a return higher than the market wage. The first condition says that the wage rate should not be inferior to a quantity that depends on the distribution of entrepreneurial projects. It is positively related to the lowest entrepreneurial project and negatively related to the average entrepreneurial project. Intuitively if the lowest entrepreneurial project increases, then market wage should generally be higher. However if the lowest bound on the distribution increases the average value of entrepreneurial ideas also increases, counteracting the first effect. Generally the effect depends on the particular form of the distribution. To get a sense of how strict this requirement is consider the following. Since the thetas are defined over a positive intervale we can normalize , without loss of generality $\theta_l = 0$. In this case the first condition simply says that the wage has to be greater than some negative number. Since the wage is non-negative by definition this is not a strict requirement.

Nothing in the structure of the problem ensures a unique solution to equation (6). Since

the LHS of the equation is decreasing in θ^*, a sufficient condition for uniqueness is:

$$F(\theta^*)\left[1+\frac{\theta^* f(\theta^*)}{F(\theta^*)}\right] \leq \frac{1+\beta p}{\beta}$$

This condition clearly imposes some restrictions on the shape of the distribution function of thetas that depend on the value of the parameters β and p.

In our problem multiplicity of equilibria arises from the fact that agents can follow several internally consistent decision rules. Having a decision rule over decision rules will eliminate the multiplicity problem. One such decision rule is the following:

$$\theta^* = \max\{\theta \in [\theta_l, \theta_h] : V^s(\theta) = V^e(\theta)\}$$

This decision rule generates the highest utillity (discounted profit). Suppose there is more than one solution to equation (6), so that different decision rules are available to the agent. Call these solutions θ_1^*, θ_2^* ... θ_n^* and let's assume, without loss of generality, that $\theta_1^* < \theta_2^* < ... < \theta_n^*$.

Notice that $V^e(\theta^*)$ is an increasing function of θ^*; it follows that $V^e(\theta_1^*) < V^e(\theta_2^*) < ... < V^e(\theta_n^*)$. Morever since θ_i^* for $i = 1, ..., n$ are defined as those points that equate the value of search and the value of entrepreneurship, it has to be the case that $V^S(\theta_1^*) < V^S(\theta_2^*) < ... < V^S(\theta_n^*)$.

Let's define $V^e(\theta|\theta_i^*)$ and $V^s(\theta|\theta_i^*)$ as the value functions for the entrepreneur and the worker when the agent chooses the θ_i^* as his decision rule. Then $V_i(\theta_i^*) = \max\{V^e(\theta|\theta_i^*), V^s(\theta|\theta_i^*)\}$ is the value function for the agent when using decision rule θ_i^*.

Equation (4) implies that if $\theta_i^* > \theta_j^*$ then $V^s(\theta|\theta_i^*) > V^s(\theta|\theta_j^*)$; hence from equation (3) we see that $V^e(\theta|\theta_i^*) > V^e(\theta|\theta_j^*)$ for every θ. It follows that for every θ, $V_i(\theta_i^*) \geq V_j(\theta_j^*)$ when $\theta_i^* > \theta_j^*$. We conclude that the agent will choose the decision rule that will give him at least as much utility as the others. Notice however that different θ^* imply that the agent will

choose to become an entrepreneur with different probabilities each period. In particular, the higher is θ^* the longer the wait to become an entrepreneur (and enjoy the higher income guaranteed by it). It is possible that an impatient agent will choose to choose a lower θ^* in order to enjoy sooner the income guaranteed by entrepreneurship. We do not address this issue.

B Proofs of Propositions

B.1 Proof of Proposition 2

Proof. We can write (9) using the known result:

$$E(x) = \int_a^b x dF(x) = \int_a^b (1 - F(x))dx - [(1 - F(b))b - (1 - F(a))a]$$

which in our case implies:

$$\int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) = \theta_h - \int_{\theta_\tau^*}^{\theta_h} F(\theta)d\theta - F(\theta_\tau^*)\theta_\tau^*$$

Using this result, writing $\theta_\tau^* = \theta_\tau^*(\tau_w)$ and differentiating (9) with respect to τ_w we get

$$\frac{d\theta_\tau^*}{d\tau_w} = \frac{-w(1 - \beta(1 - p))}{(1 - \tau_\pi)\left(1 + \beta p - \beta F(\theta_\tau^*)\right)} < 0$$

Analogously we can show that:

$$\begin{aligned} \frac{d\theta_\tau^*}{d\tau_\pi} &= \frac{-\beta \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) + \theta_\tau^* \left[1 + \beta p - \beta F(\theta_\tau^*)\right]}{(1 - \tau_\pi)\left[1 + \beta p - \beta F(\theta_\tau^*)\right]} = \qquad \text{using (9)} \\ &= \frac{\left[1 - \beta(1 - p)\right](1 - \tau_w)\, w}{(1 - \tau_\pi)^2 \left[1 + \beta p - \beta F(\theta_\tau^*)\right]} > 0 \end{aligned}$$

■

B.2 Proof of Proposition 3

Proof. As before, using the following expressions for the expected values

$$\begin{aligned} \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) &= \theta_h - \int_{\theta_\tau^*}^{\theta_h} F(\theta)d\theta - F(\theta_\tau^*)\theta_\tau^* \\ \int_{\hat{\theta}}^{\theta_h} \theta dF(\theta) &= \theta_h - \int_{\hat{\theta}}^{\theta_h} F(\theta)d\theta - F(\hat{\theta})\hat{\theta} \end{aligned}$$

writing $\theta_\tau^* = \theta_\tau^*(\tau)$ and differentiating (14) with respect to τ we get:

$$\frac{d\theta_\tau^*}{d\tau} = \frac{\beta\left[1 - F(\hat{\theta})\right]}{\left[1 + \beta p - \beta F(\theta_\tau^*)\right]} \left[\hat{\theta} - E(\theta | \theta > \hat{\theta})\right] \leq 0$$

■

B.3 Proof of proposition 4

Proof. As before we can calculate the total derivative of (15) with respect to the tax rate

$$\begin{aligned}\frac{d\theta_\tau^*}{d\tau} &= \frac{\beta\left[1-F(\theta_\tau^*)\right]}{\left[1+\beta p-\beta F(\theta_\tau^*)\right](1-\tau)}\cdot \\ &\quad\cdot\left[\hat{\theta}-E(\theta|\theta>\theta_\tau^*)+\frac{\left[1+\beta p-\beta F(\theta_\tau^*)\right]}{\beta\left[1-F(\theta_\tau^*)\right]}(\hat{\theta}-\theta_\tau^*)\right]\end{aligned}$$

the sign of this derivative is not certain and depends on the relative position of $\hat{\theta}$ and θ_τ^*. We cannot determine the relative positions of θ_τ^* and θ^* either. ■

B.4 Proof of proposition 5

Proof. Once again we can calculate the derivative of θ_τ^* with respect to τ from (17):

$$\begin{aligned}\frac{d\theta_\tau^*}{d\tau} &= \frac{\beta\left[1-F(\theta_\tau^*)\right]}{\left[1+\beta p-\beta F(\theta_\tau^*)\right](1-\tau)}\cdot \\ &\quad\cdot\left[\hat{\theta}-E(\theta|\theta>\theta_\tau^*)+\frac{\left[1-\beta F(\theta_\tau^*)\right]}{\beta\left[1-F(\theta_\tau^*)\right]}(\hat{\theta}-\theta_\tau^*)-\frac{(w-\hat{w})}{\gamma\left[1-F(\theta_\tau^*)\right]}\right]\end{aligned}$$

the sign of this derivative is not certain. ■

C Searching for New Ideas Each Period

Here we modify the assumption that the decision to become an entrepreneur precludes search for new ideas. Some of the results from the previous section depend on the assumption of irreversible investment. In order to illustrate the importance of this assumption we consider the other extreme, that each period the old idea has run its course and there is a search for a new idea. We should emphasize we do consider this case because we believe it to be realistic rather it is done to illustrate a property of the previous model. There is no longer an alternative cost in terms of searching for new ideas when choosing self-employment. We maintain all the other assumptions, including the important assumption that the θ are not correlated over time.

We keep, when possibile, the same notation. The problem can be rewritten as

$$V(\theta) = \max\{V^e(\theta), V^s(\theta)\}$$

where

$$V^s(\theta) = w + \beta \int_\theta V(\theta) dF(\theta) \tag{32}$$

$$V^e(\theta) = \theta + \beta \int_\theta V(\theta) dF(\theta) \tag{33}$$

It is straightforward from this formulation to conclude that $\theta^* = w$ and that for all $\theta < \theta^*$, $V^e(\theta) < V^s(\theta)$ and for all $\theta > \theta^*$, $V^e(\theta) > V^s(\theta)$.

C.1 Proportional Taxes

As before we consider taxation on business and labor income and we distinguish between proportional and progressive taxes. Again, proportional taxes do not have any effect if the tax rate on labor and business income are the same. If they are different the equilibrium reservation entrepreneurial idea is given by:

$$\theta_{\tau}^{*} = \frac{1-\tau_{w}}{1-\tau_{\pi}} w \tag{34}$$

From expression (34) it is possible to see that if $\tau_w > \tau_\pi$ then $\theta_\tau^* > \theta^*$ and vice versa and that θ_τ^* is decreasing in τ_w and increasing in τ_π. These results are identical to those obtained with persistent entrepreneurial ideas.

C.2 Progressive Taxes

Consider the tax schedules described in (10) and (11) and consider two cases. The case with $\theta^* > \hat{\theta} > w$ is no longer available since in this case $\theta^* = w$.

C.2.1 Case A: $\hat{\theta} > \theta^* = w$

The income level at which the tax rate increases from zero is higher than the equilibrium entrepreneurial entry level. As shown in the previous section, in this case the only effect of a change in the top marginal tax rate will be a change in the option value of waiting for a better entrepreneurial. However now both workers and the entrepreneurs have the same option: both of them will receive a new entrepreneurial idea unlike the previous case when only workers could receive another entrepreneurial idea while entrepreneurs were tied to their current project.

Clearly the change in the option value will be the same for both types and a change in the top marginal tax rates will not have any impact on the entry threshold into entrepreneurship. More precisely, the value function for the worker and the entrepreneur can be re-written as:

$$V_\tau^s(\theta) = w + \beta \int_\theta V(\theta) dF(\theta) \tag{35}$$

$$\begin{aligned} V_\tau^e(\theta) &= \theta + \beta \int_\theta V(\theta) dF(\theta) && \text{for } \theta < \hat{\theta} \\ &= \theta - \tau(\theta - \hat{\theta}) + \beta \int_\theta V(\theta) dF(\theta) && \text{for } \theta \geq \hat{\theta} \end{aligned} \tag{36}$$

and is clear that θ_τ^* in this case is:

$$\theta_\tau^* = w$$

so that taxes do not affect the optimal level of entry. The option value is the same for the entrepreneur and the worker; the mechanism that previously caused θ_τ^* to decrease with taxes is absent now.

C.2.2 Case B: $\hat{\theta} < \theta^* = w$

The value function for the entrepreneur stays as in (36), while the one for the worker can be re-written as:

$$V^s(\theta) = w - \tau(w - \hat{\theta}) + \beta \int_\theta V(\theta) dF(\theta) \tag{37}$$

and also in this case θ_τ^* is:

$$\theta_\tau^* = w$$

This result should not be surprising. As seen in previous section there are two mechanisms at work when $\hat{\theta} < \theta^*$. The first mechanism is the change in the option value described above. We now know that since the option value is the same for both the entrepreneur and the worker there should be no change coming through that channel. Moreover since wage and entrepreneurial income are taxed now at the same rate (the top marginal rate), any change will affect both sources of income in the same way; this changes the value of being an entrepreneur and the value of being a worker in the same way resulting in no change in the optimal threshold/decision rule.

C.3 Interpretation

The previous section demonstrates the importance of our assumption about the level of commitment associated with the entrepreneurial project.

When the entrepreneurial ideas that agents discover each period are not correlated over time neither proportional nor progressive taxes will affect optimal entrepreneurial entry through the mechanisms proposed in this model[5]. Our assumption about the possibility of changing one's project once the firm is created is simply a particular case where entrepreneurial ideas (the value of the innovation or firm) are perfectly correlated over time. This suggests that in the case of positive but imperfect correlation over time the effect of taxation on the option value will be different for the worker and for those that are already self-employed.

[5]There are of course other mechanisms through which taxes can be important, such as distorting the choice between leisure and work or smoothing risks.

In particular since entrepreneurs tend to be those agents with high $\theta's$ and workers generally those with lower $\theta's$ the direction of the effect of taxation on the option value of searching for new ideas will be the one illustrated in previous section, albeit if not as strong in intensity. In practice the choice to enter with one idea is not irreversible, but involves some alternative value in terms of other perhaps better innovations or business ideas.

D Figures

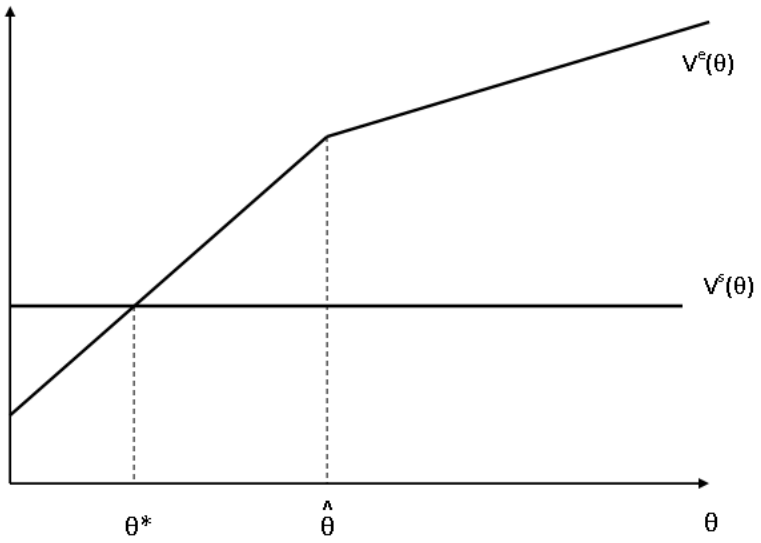

Figure 1: Graphical representation of a decision rule, θ^*. All individuals with an unobservable entrepreneurial idea, θ, above the threshold, θ^*, will choose to become entrepreneurs. The others will decide to be workers and wait for next period entrepreneurial draw. Entrepreneurial income has a kink because of the progressive nature of taxation. The graph illustrates the case where $\hat{\theta} > \theta^*$.

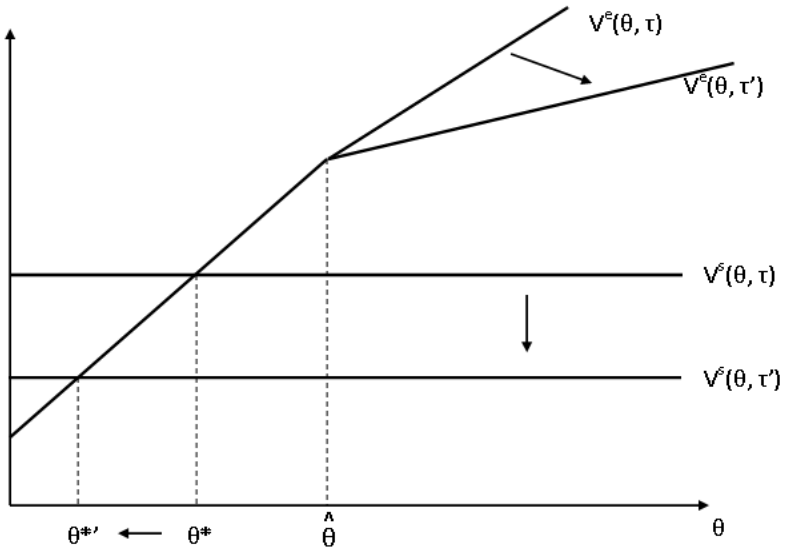

Figure 2: This figure shows the effect of an increase in the top marginal tax rate on the quality of entrepreneurial firms through a change in the option value of searching for better ideas. The threshold decreases as the value of waiting for a good entrepreneurial idea decreases. An increase in the top marginal tax rate decreases the workers' option value as the best ideas will be taxed more heavily; this will prompt more individuals to join the ranks of the entrepreneurs with lower quality firms. This happens irrespective of the relative position of $\hat{\theta}$ and θ^*. Here we draw the case when $\hat{\theta} > \theta^*$.

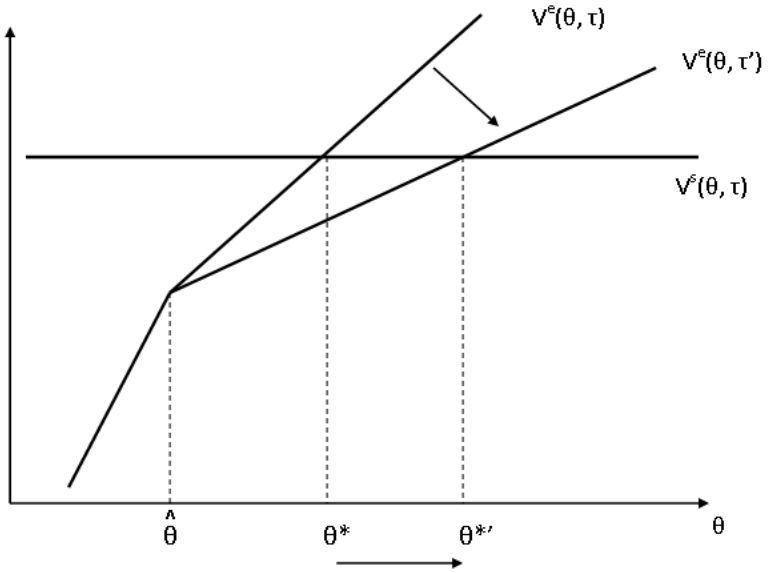

Figure 3: This figure shows the direct effect of an increase in the top marginal tax rate on the threshold for entrepreneurial activity. The threshold increases as the value of each entrepreneurial idea decreases vis-a-vis market wage. This only happens when $\hat{\theta} > \theta^*$. However there is a counterbalancing effect (not shown in this picture) resulting from the decrease in the value of being a worker and waiting for a good entrepreneurial idea, as illustrated in previous picture. In this case the total effect is indeterminate.

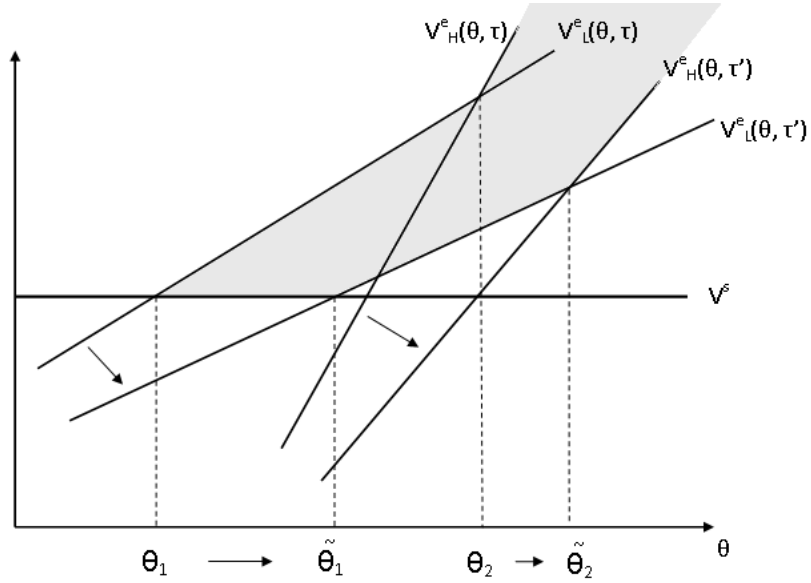

Figure 4: This figure shows the effect of an increase in proportional taxes on the value of entrepreneurial firms. The shaded area represents the welfare loss for the entrepreneurs.

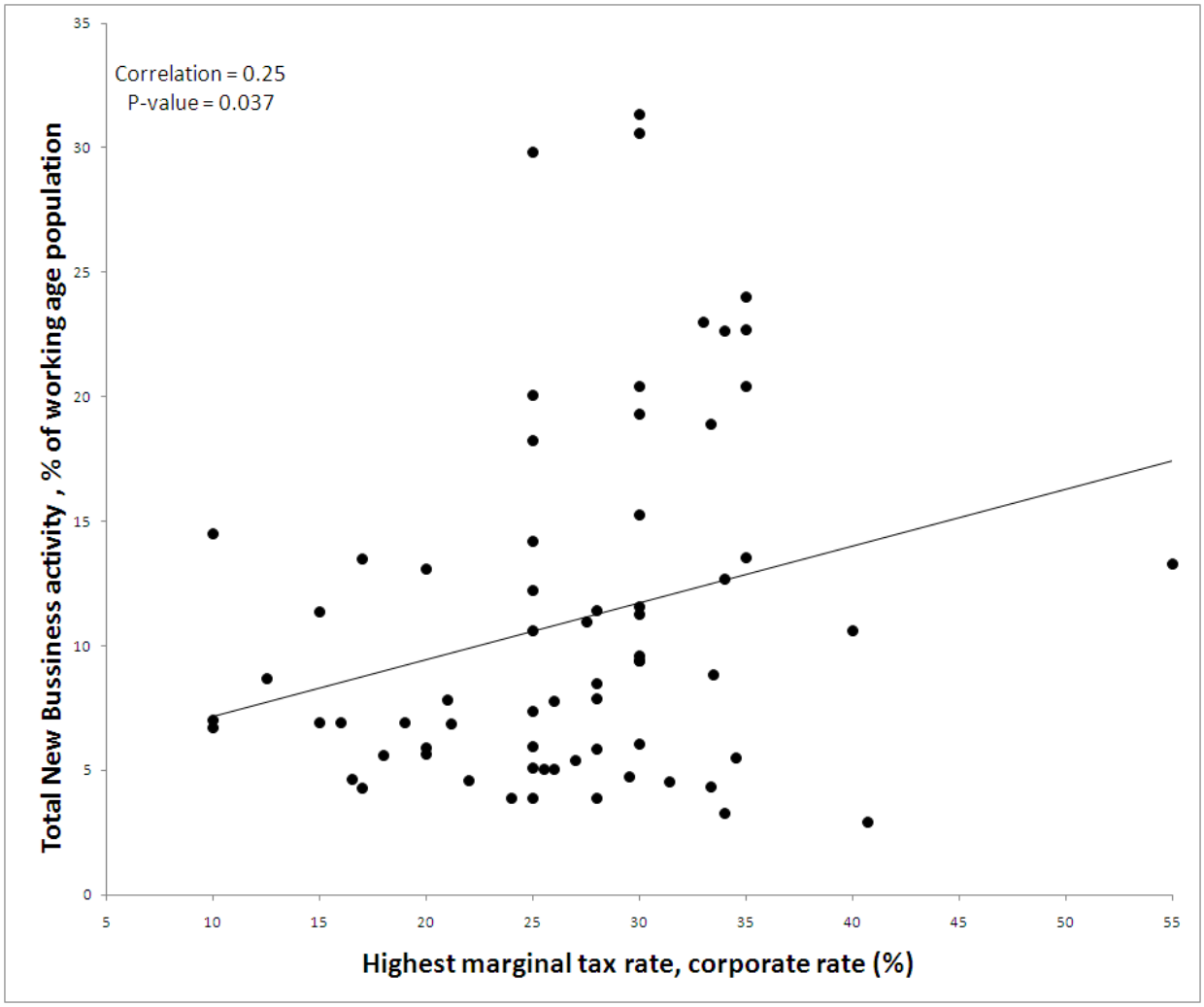

Figure 5: The Highest marginal tax rate, corporate rate (%) refers to "the highest rate shown on the schedule of tax rates applied to the taxable income of corporations". It is calculated by the authors using the World Bank data. The year 2009 or the latest available year is used. Total new business activity refers to the standard Global Entrepreneurship Monitor measure, Total Early State Entrepreneurial Activity (TEA), which is "the Percentage of 18-64 population who are either a nascent entrepreneur or owner-manager of a new business". Nascent entrepreneurs are in turn those actively involved in setting up a business they will own or co-own. The figure refers to the average of years 2001-2009, as calculated by authors using the Global Entrepreneurship Monitor Database.

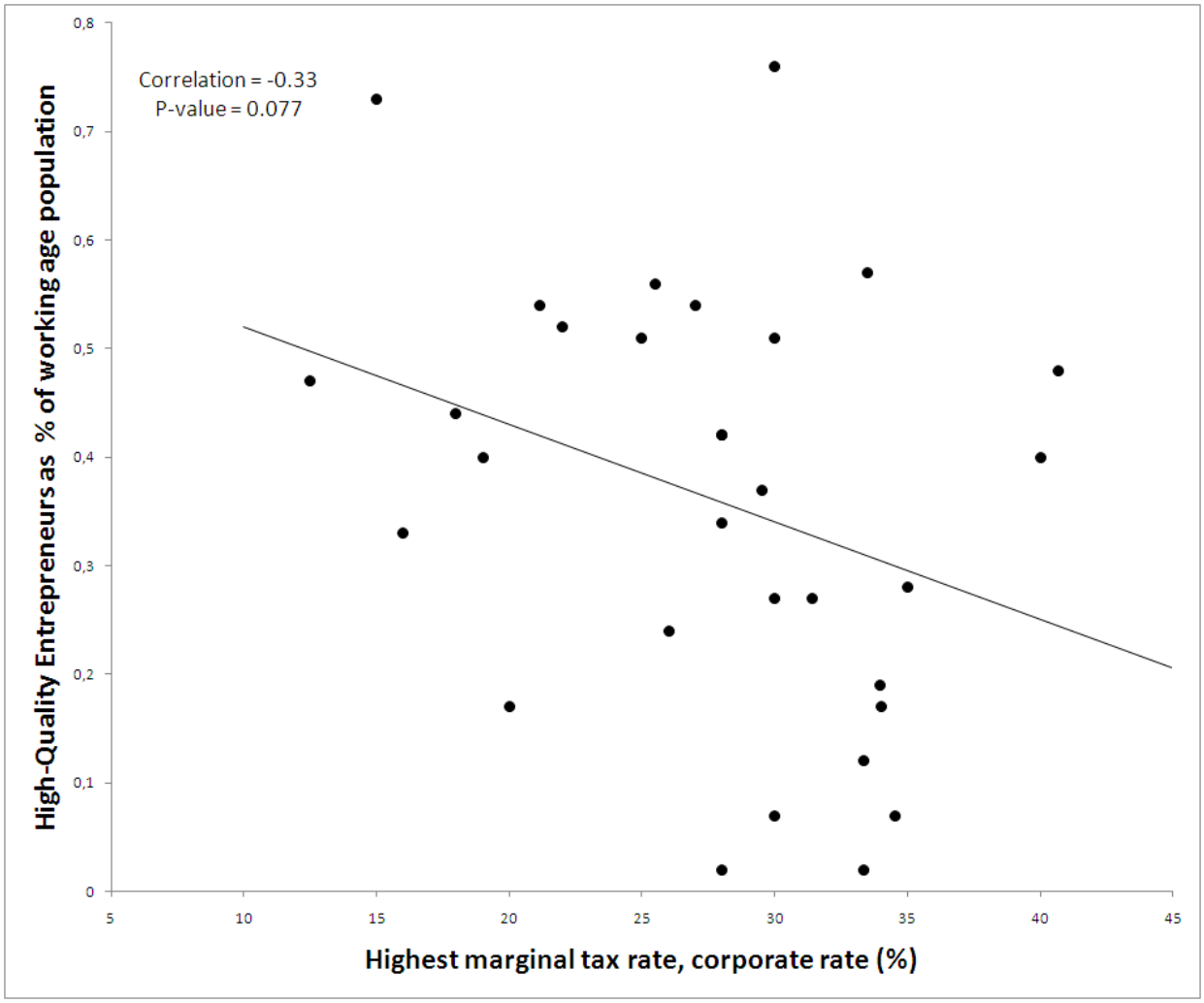

Figure 6: The Highest marginal tax rate, corporate rate (%) refers to "the highest rate shown on the schedule of tax rates applied to the taxable income of corporations". It is calculated by the authors using the World Bank data. The World Bank in turn based the measure on KPMG's Corporate and Indirect Tax Rate Survey 2009, and PricewaterhouseCoopers's Worldwide Tax Summaries Online. The year 2009 or the latest available year is used. High-Quality Entrepreneurs refers to the share of working age population that are business owners and have at least 20 employees. The figure refers to the average of the years 2000-2006.

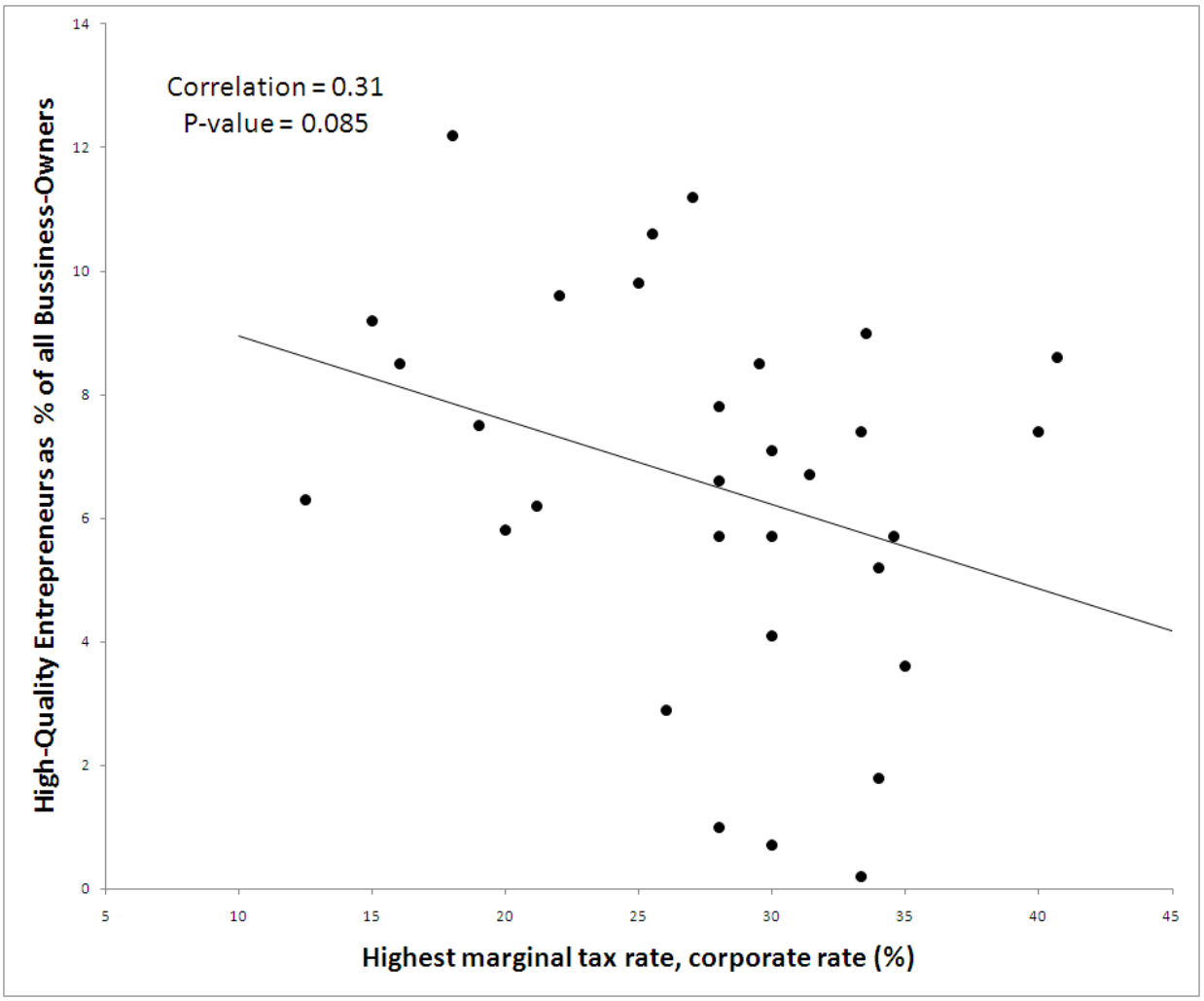

Figure 7: The Highest marginal tax rate, corporate rate (%) refers to "the highest rate shown on the schedule of tax rates applied to the taxable income of corporations". It is calculated by the authors using the World Bank data. The World Bank in turn based the measure on KPMG's Corporate and Indirect Tax Rate Survey 2009, and PricewaterhouseCoopers's Worldwide Tax Summaries Online. The year 2009 or the latest available year is used. High-Quality Entrepreneurs refers to the percent of firms that have at least 20 employees. The figure refers to the average of the years 2000-2006.

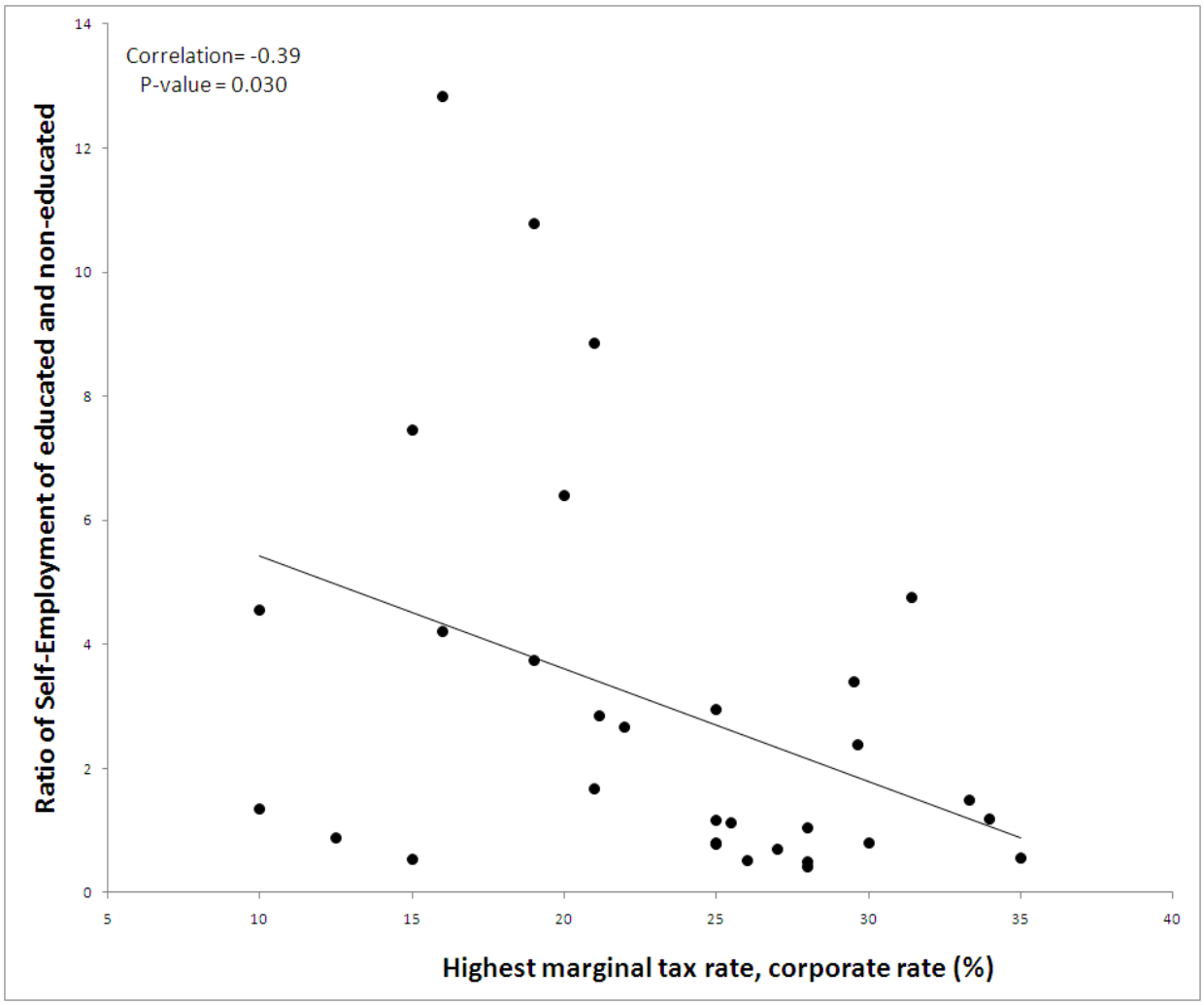

Figure 8: The Highest marginal tax rate, corporate rate (%) refers to "the highest rate shown on the schedule of tax rates applied to the taxable income of corporations". It is calculated by the authors using the World Bank data. The World Bank in turn based the measure on KPMG's Corporate and Indirect Tax Rate Survey 2009, and PricewaterhouseCoopers's Worldwide Tax Summaries Online. The year 2009 or the latest available year is used. "The Ratio of Self-employment of educated and non-educated" refers to the share of individuals with tertiary degrees who are self-employed with employees divided by the share of individuals with less than upper-secondary education who are self-employed with employees. Data is from Eurostat 2010 for 31 European countries, age group 20-64.