IFN Working Paper No. 805, 2009

Entrepreneurship, Wage Employment and Control in an Occupational Choice Framework

Robin Douhan and Mirjam van Praag

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

Entrepreneurship, Wage Employment and Control in an Occupational Choice Framework*

Robin Douhan

Research Institute of Industrial Economics (IFN) and Uppsala University

Mirjam van Praag†

University of Amsterdam, Amsterdam Center for Entrepreneurship

Max Planck Institute of Economics, Tinbergen Institute and IZA

March 31, 2009

Abstract

We combine two empirical observations in a general equilibrium occupational choice model. The first is that entrepreneurs have more control than employees over the employment of and accruals from assets, such as human capital. The second observation is that entrepreneurs enjoy higher returns to human capital than employees. We present an intuitive model showing that more control (observation 1) may be an explanation for higher returns (observation 2); its main outcome is that returns to ability are higher in higher control environments. This provides a theoretical underpinning for the control-based explanation for higher returns to human capital for entrepreneurs.

JEL codes: L26; I20; J24; J31
Keywords: Entrepreneurship; Ability; Occupational Choice; Human Capital; Wage Structure

*Robin Douhan is employed in the Gustaf Douglas Research Program on Entrepreneurship at the Research Institute of Industrial Economics. He also gratefully acknowledges the financial support from the Hedelius Foundation during his visit at Columbia University.
†Corresponding author. Email: C.M.vanPraag@uva.nl, phone: +31 20 525 4096.

1 Introduction

Entrepreneurs are more satisfied with their work than employees, even though they work longer hours and obtain lower and more variable rewards (Blanchflower and Oswald, 1998; Hamilton, 2000; Van Praag and Versloot, 2007). This remarkable difference is explained empirically by more autonomy and control over (the accruals from) one's own work as an entrepreneur compared to positions in wage employment (Benz and Frey, 2008). Control over one's work thus seems like an important distinguishing feature of entrepreneurship.

The aspect of control that we study in this article is control over the employment of and accruals from assets in the form of human capital. We do not consider the control-satisfaction relationship, but, instead, the relationship between control and the pecuniary returns to human capital. Empirical evidence indeed support the contention that entrepreneurs enjoy a higher return to their human capital (Van der Sluis *et al.*, 2005; Parker and Van Praag; 2006; Hartog *et al.*, 2008). Is more control over the employment of and accruals from human capital a likely explanation for this empirical observation?

The control explanation has a clear intuition. Entrepreneurs, defined as the business owning managers of their firms can better form and control the environment in which they operate than wage employees. They can adapt their production processes in a way that yields the highest return to their assets. One of these assets is their own human capital. Moreover, as a residual claimant of the firm, the benefits of the profitable use of their human capital accrue fully to the entrepreneur. Employees, on the other hand, are constrained by the organizational and wage structure surrounding them. Organizations cannot adapt their organizational and wage structure to every individual, i.e. both the jobs and the wages that individuals are matched to are not uniquely tailored. As a consequence, the proceeds from their human capital are not mapped on a one-to-one basis to the employees' earnings.

In this article we incorporate the notion of control in a general equilibrium occupational choice model. The main robust equilibrium property is that workers' returns to ability are higher when they work in an environment where they have more control. Therefore, our model provides a theoretical underpinning for the control-based explanation of the empirical observation that the returns to ability and education are higher for entrepreneurs than for employees. Moreover, some implications are derived in terms of the social allocation of human capital and the distribution of income in general equilibrium.

The notion of control is explicitly incorporated in the model as follows. Workers are employed by firms that utilize an exogenously determined number of wage brackets. Individual employees are assigned to particular functional levels based on their actual ability levels. Each functional level is attached to a wage bracket which is based on the average ability level of the workers in that functional level. Differential levels of control are modelled by varying the number of wage brackets. With just one wage bracket, an employee's remuneration level (and more implicitly, her tasks) does not depend on her ability and there is no control as how to employ or create value from human capital (ability in this case). When the number of brackets is increased, the sorting of employees over wage brackets is more accurately tied to their ability level. Hence, the correspondence between individual ability and remuneration increases in the number of brackets.

Another property of our model is that individuals with a high skill level as compared to their peers within their functional level are most likely to become entrepreneurs. In each bracket individuals are paid a wage corresponding to the mean skill level. Individuals with an ability level above the mean are consequently undercompensated. The opportunity cost of becoming an entrepreneur is hence determined in relation to the relevant wage bracket.[1] Thus, we will find entrepreneurs not only among the highest skilled, which would be the case with one wage bracket, but among those who are highly skilled relative to the mean ability within their bracket. This is consistent with the empirical observation that the division of the workforce over employees and entrepreneurs is not determined by ability levels (that are possibly generated by schooling).[2] Exactly this observation is what Lazear (2005) sought to explain with his jacks-of-all-trades hypothesis. Our model, which assumes that the entrepreneur can better command his abilities, yields the same prediction.

The main question that the model answers is how control, i.e., the number of wage brackets, affects the returns to ability. Given that more brackets increase the correspondence between ability and remuneration, the answer to this question might seem obvious. However, as *Figures*

[1] In support of this, Andersson and Wadensjö (2006) establish evidence that people whose expected earnings – based on their observed characteristics including education and experience – in wage employment are higher than their actual earnings in wage employment are more inclined to become entrepreneurs.

[2] See for instance Van der Sluis *et al.* (2008), Hartog *et al.* (2008) and Van der Sluis *et al.* (2005).

1a,b in Section 3 will demonstrate, the relationship between control (as indicated by the number of wage brackets) and returns to ability may be positive, negative or zero.

General equilibrium occupational choice models in the tradition of Lucas, (1978) and Kanbur (1979) have implicitly assumed a higher degree of control for entrepreneurs than for employees by assuming a uniform wage level for employees and entrepreneurial profits dependent on the entrepreneur's ability. General equilibriums where the difference in control between entrepreneurs and employees is extremely high are hence well-explored; although the interpretation in terms of control has not yet been made. Much less is known about general equilibrium properties when the level of control varies. This article creates a better understanding of the general equilibrium effect of a differential level of control. Another contribution of this article is to show the possibility of finding an equilibrium in a general equilibrium setting which incorporates a control mechanism. The equilibrium is consistent with the robust empirical finding that ability plays an important role in shaping occupational choice decisions (between entrepreneurship and wage employment), in combination with higher returns to ability for entrepreneurs than for employees.

The remainder of the article is organized as follows. The next section provides an overview of the empirical results so far on the returns to human capital for entrepreneurs relative to employees. In Section 3 we discuss the model and in Section 4 its equilibrium properties. Section 5 concludes.

2 Returns to human capital for entrepreneurs versus employees

We shall now review the evidence with regard to returns to ability according to three indicators of ability: education, intelligence and balanced skills sets. Recent studies that measure the returns to education for entrepreneurs and compare them to those of employees – and acknowledges the endogenous nature of education to income – include Van Der Sluis *et al.* (2005) and Van Der Sluis and Van Praag (2007). The first study estimates income equations for a combined representative panel sample of entrepreneurs and employees from the U.S. population (NLSY). An instrumental variable approach is used to take into account that education is endogenous. Family background variables are used as instruments. Returns to education are found to be significantly higher for entrepreneurs than for employees. The result is robust to a specification with individual fixed effects and identification on switchers between employment and entrepreneurship.

Van der Sluis and van Praag (2007) use the variation over time and geographical regions (states) in compulsory schooling laws in the US as the identifying instrument for education, similar to Oreopoulos (2006). They extend the application by Oreopoulos by distinguishing entrepreneurs from employees. The dataset is taken from the US Census for each decade from 1950 until 2000. Again, the results show that the returns to education are substantially higher for entrepreneurs than for employees and that the result is robust to several possible measurement problems.

The two studies discussed pertain to the United States. Comparable studies for Europe have not yet been performed. However, Parker and Van Praag (2006) show, using a method similar to Van Der Sluis *et al.* (2005), but based on a Dutch sample of entrepreneurs only, that the return to education for entrepreneurs in the Netherlands is high, and, actually, higher than the returns to education for Dutch wage employees as measured using a similar method by Plug and Levin (1999). Moreover, a recent descriptive study of the education backgrounds of the 200 top entrepreneurs in the Netherlands shows that more than 60 percent of them have an academic background. This proportion is five times as high as it is for the general working population in the Netherlands in 2005 (CBS, 2007) and may therefore be indicative of substantial returns to education for entrepreneurs.

A second indicator of ability is intelligence. Hartog *et al.* (2008) is the only study to our knowledge which estimates income equations for entrepreneurs and employees in order to quantify the returns to (various kinds of) intelligence and ability for entrepreneurs relative to employees. Based on a representative panel of individuals in the United States (NLSY), Hartog *et al.* (2008) find that the returns to general intelligence (using the ASVAB [Armed Service Vocational Aptitude Battery] scores measured at a young age) are higher for entrepreneurs than for employees. The returns to general ability are estimated to be higher for entrepreneurs than for employees in both random-effects and fixed-effects frameworks, where the latter controls for unobserved time-invariant individual characteristics. This suggests that it is really occupational returns rather than personal characteristics which underpin the findings.

The third measure of ability that has been studied in the literature is the balance between various dimensions of abilities. A recent series of articles, initiated by Lazear (2005) and further built on by Wagner (2003), Silva (2007) and Hartog *et al.* (2008) pays attention to the combination of different competencies instead of merely their level. People with balanced scores on various measures of skill are so-called Jacks-of-all-Trades (JAT) (Lazear, 2005). These studies find unambiguous evidence for higher marginal returns to a balanced set of skills for entrepreneurs than for employees.

Another relevant finding in Van der Sluis *et al.* (2005) is that people who have a high perceived control over the environment, measured by locus of control (Rotter, 1966), also have higher return to education. If locus of control is used as a proxy for actual control, those entrepreneurs and employees who have the perception that they are in control of their environment should experience, on average, higher returns to education .[3] Besides the control explanation, two alternative theoretical mechanisms that are consistent with this empirical evidence can be identified.[4] First, higher educated individuals have better outside opportunities. Hence, they are likely to venture into projects with a higher expected return. If such projects are at the same time more risky they may require an additional profit margin as a risk premium, which could cause the observed effect of differential returns to education. Van Der Sluis *et al.* (2005) test and reject this hypothesis. Their findings indicate that entrepreneurs are indeed exposed to more income risk than employees, but that the difference is a decreasing rather than an increasing function of education. Thus, they conclude that the higher returns to education or ability for entrepreneurs are not a kind of risk premium.

The second explanation is related to signalling theory. The classic notion has long been that education can only be used as a signal of superior productivity by employees, not by entrepreneurs, as the only stakeholders towards whom signals can be valuable are (prospective) employers (Weiss, 1995). However, as recent works indicate and support empirically, entrepreneurs may use their education as a signal towards suppliers of capital (Parker and Van Praag, 2006), or towards customers and highly qualified employees (Backes-Gellner and Werner, 2007). This may

[3] Individuals with an external locus-of-control personality tend to perceive an event as beyond their control, and attribute the outcomes of the event to chance, luck, as under control of powerful others, or as unpredictable.

[4] Various alternative explanations related to measurement issues have been put forth, tested and rejected by Van Der Sluis *et al.* (2005).

provide an explanation for higher returns to education for entrepreneurs than for employees, but not why the return to cognitive abilities as such is higher.

3 The Model

Preliminaries

We consider a standard occupational choice model. Individuals who are only heterogeneous with respect to general ability make a choice whether to become an entrepreneur or a wage employee.[5] An individual's ability level affects the relative return to entrepreneurship and employment, and thereby determines the entry decision. Human capital, i.e., general ability enters into the entrepreneur's production function as the only input.

The model is amended in a simple way by assuming that firms use multiple discrete wage levels. The common assumption in this class of models has been that either there is only one wage level (e.g. Kanbur (1979) and Lucas (1978)) or individual wages are a continuous function of individual characteristics such as ability, experience and education, as in the classic Mincerian approach (1974). Both of these assumptions are arguably at odds with reality. There are numerous circumstances that prevent the employer from perfectly tailor jobs to each individual's unique characteristics. At the firm level, such tailor made procedures would arguably be prohibitively costly and also clash with other organizational goals. Other obstacles pertain to labor market rigidities such as collective wage bargaining and employment protection which increases the cost of flexibility in job assignment.

By imposing discrete wage levels we position ourselves somewhere in between these two extremes and add to the realism of the model. The implicit assumption is that employers are unable to perfectly discriminate between the ability levels of wage workers. Moreover we assume a situation where all brackets are of equal size. The distribution of ability used is generated from an underlying distribution of talent and a production function. This allows us to make some interpretations in terms of educational institutions represented as features of the production function.

[5] This is in contrast to Lucas (1978) and Kanbur (1979) who both assumed that agents were heterogeneous in managerial ability – used as an entrepreneur – but homogeneous in abilities relevant for wage employment.

We use the model developed below along these lines to analyze the control theory by answering the question how the number of wage brackets, i.e., control, affects the return to ability for employees (vis-à-vis entrepreneurs).

It should be emphasized that in our model the indicator for control is the strength of the association between input (in our case ability) and the employee's proceeds from output (i.e., in terms of wages in our case). Alternatively, one could think of how control affects the firm's output. Our model does not address this question. Neither do we address control in terms of the employee's freedom to allocate effort and ability over various tasks. The decision in our model is a binary occupational choice between employment and entrepreneurship. This choice thus assigns individuals to a particular degree of control in terms of association between ability and proceeds – not in terms of freedom to allocate time.

The equilibrium wage rate in each bracket is determined based on the mean productivity within this bracket. This implies that an individual within the bracket may be under- or over-compensated depending on whether his ability is below or above the mean. This is the essence of the lack of control of return to ability, and hence to education, as a wage worker. Control increases in the number of brackets, but for any finite number of brackets it will always be lower than for the entrepreneur who is assumed to get a one-to-one return on his human capital. Therefore, the entrepreneur will by construction always have a higher return to education than the employee. Our primary interest is to investigate the effect of increasing the number of brackets, implying an increase in the control of wage employees, on the returns to ability for employees. If more control leads to higher returns in wage employment we can induce that the control-explanation may be a valid explanation for the higher returns to ability in entrepreneurship vis-à-vis wage employment.

Figure 1a shows intuitively what happens when one wage bracket (L) is subdivided into two at the point A. The wage will tend increase for those with ability above A and decrease for those below. It follows that the correspondence between ability and compensation increases. However, in a general equilibrium framework there are counteracting mechanisms. A stronger correlation between ability and wage tends to increase profits, shifting the profit curve upwards, see *Figure 1b*. This increases the number of entrepreneurs in M and H, thereby increasing labor demand. The net effect on the wage in the lowest of the subdivided brackets is inconclusive.

———————[FIGURE 1a & 1b]———————-

Production

Individuals can choose to become either entrepreneurs or workers. Entrepreneurs hire workers, and their own contribution is purely managerial, i.e. entrepreneurs do not enter as labor input. Wages and profits are expressed in relation to the price of the good produced, which is normalized to 1.

Although entrepreneurs are perfectly informed about workers' ability, they have a limited capability of discriminating them into different wage brackets. More specifically, they are able to sort workers into n distinct ability brackets, where n is exogenously given. It is worth emphasizing that n is no choice variable. Hence, it would not add anything to the analysis to assign a cost dependent on n (which might seem natural). Moreover, n is a unique number, i.e., all firms in the economy employ exactly the same number of wage brackets in their firms.

Throughout, we use j to denote brackets and the set of brackets is $B = \{j\}_{j=1}^{n}$. For simplicity, we assume that these brackets all contain the same number of individuals, i.e., $1/n$ of a total population of N belongs to each bracket j.[6] Each individual i is endowed with an ability θ_i which is drawn from a distribution $H(\theta)$. Depending on the distribution $H(\theta)$, $n-1$ ability levels will constitute breakpoints between different brackets. We assume that $H(\theta)$ is continuous, strictly increasing and everywhere differentiable. The wage is uniform within each bracket and is in equilibrium determined by the average productivity within the bracket. Hence wages do not perfectly reflect the ability of each individual worker.

Entrepreneurs, on the other hand, earn a profit that reflects their actual ability. We assume that the contribution of labor from each bracket is scaled by the average productivity in that bracket. Hence, implicitly we are abstracting from individuals' work-effort decisions and the possibility of shirking. Workers within a firm are assigned to one out of n different wage brackets. Each task is subject to decreasing returns to scale, determined by a parameter $\gamma \in [0.5, 1)$. Without a scale effect, all workers would be hired by the entrepreneur with the highest ability.[7]

[6] We assume $n < N$. As n grows large, the level of control in employment approaches the level of control in entrepreneurship and our model breaks down.

[7] An alternative to the production function here is one where the total amount of labor employed is subject to decreasing returns to scale (rather than labor in each bracket). The disadvantage of such a functional form is that the general equilibrium properties are much less stable.

These assumptions yield the following production function:

$$f(\theta_i, \{L_k\}_{k=1}^n, \{\bar{\theta}_k\}_{k=1}^n) = \theta_i^\alpha \left[\sum_{k=1}^n \left(\bar{\theta}_k L_k\right)^\gamma \right]. \tag{1}$$

Labor input from each bracket k is denoted by L_k. Note that given (1), we will find entrepreneurs among the high ability individuals within each bracket. These are the individuals who lose the most by becoming an employee and conforming to the wage rate in their bracket, and these are also the ones with the highest profit as entrepreneurs. Finally, we add a parameter $\alpha \in (0, 1)$ which shifts the role of the entrepreneur's own ability.[8]

Firm's decision and labor demand

The entrepreneur *qua* firm makes a decision on how much labor to hire from each wage bracket. The price of the good produced is normalized to 1, and the entrepreneur's earnings can therefore by described as in equation (1). Moreover, the firm pays w_k for each unit of labor hired from bracket k. Put together, each entrepreneur i solves the following standard maximization problem,

$$\max_{\{L_k\}_{k=1}^n} \theta_i^\alpha \left[\sum_{k=1}^n \left(\bar{\theta}_k L_k\right)^\gamma \right] - \sum_{h=1}^n w_k L_k. \tag{2}$$

Note that because $\gamma < 1$, all entrepreneurs will hire a mix of labor from all brackets in order to minimize negative scale effects. Solving the maximization problem yields n first order conditions, one for each bracket k:

$$L_{ik} = \left(\bar{\theta}_k\right)^{\gamma/(1-\gamma)} \left(w_k\right)^{1/(\gamma-1)} \left(\gamma \theta_i^\alpha\right)^{1/(1-\gamma)}, \forall k \in B. \tag{3}$$

The higher an entrepreneur's ability level, the more workers they will hire. Because $\frac{1}{1-\gamma} > 1$, the number of workers hired is a convex function of the entrepreneur's ability level. Furthermore, the ratio of entrepreneur i's labor demand from bracket k and h is as follows:

$$\frac{L_{ik}}{L_{ih}} = \left(\frac{\bar{\theta}_k}{\bar{\theta}_h}\right)^{\gamma/(1-\gamma)} \left(\frac{w_h}{w_k}\right)^{1/(1-\gamma)}. \tag{4}$$

[8] α is only included for the technical purpose of facilitating the numerical solution, and plays no role for the results.

This ratio tells us how the hiring decision from different wage brackets is determined by the trade-off between the benefits of higher ability levels and the costs of higher wage levels in increasing wage brackets. To see how this depends on γ, assume that h represents the higher wage bracket and k the lower wage bracket, such that $\frac{\bar{\theta}_k}{\bar{\theta}_h} < 1$ and $\frac{w_h}{w_k} > 1$. As long as $\gamma > 0.5$ we have $1 < \frac{\gamma}{1-\gamma} < \frac{1}{1-\gamma}$. The higher is γ, the more important will the ratio of productivity relative to wages be in determining labor demand. This will tend to channel demand toward the high end of the ability distribution, i.e., where ability and wages are high. Conversely, if γ decreases, demand will grow stronger in the lower end of the distribution where ability, but also wages, are lower. As we will see, through this mechanism, the level of γ will have important consequences for the wage spread between different wage bracket and thus for returns to ability in wage employment. We will refer to the deviation from the situation that would result from $\gamma = 1$ as a "demand shift" effect of γ, shifting demand towards the lower end of the ability distribution.

Substituting the n conditions in equation (3) back into equation (2) and collecting terms yields the indirect profit function,

$$\pi_i = \theta_i^{\frac{\alpha}{1-\gamma}} \left[\sum_{k=1}^{n} \left(\frac{\bar{\theta}_k}{w_k} \right)^{\frac{\gamma}{1-\gamma}} \left(\gamma^{\frac{\gamma}{1-\gamma}} - \gamma^{\frac{1}{1-\gamma}} \right) \right]. \tag{5}$$

In circumstances where the discussion does not involve $\bar{\theta}_k$ and w_k we will let $\pi(\theta_i)$ denote the profit of individual i. The first term inside the square bracket captures the importance of productivity relative to wages, already discussed in relation to equation (4). The second term inside the square bracket increases in γ and captures the fact that as γ grows, entrepreneurial earnings from each unit of labor increase. The entrepreneur's own ability enters multiplicatively to this sum, which implies that the ratio of profit for two individuals $i \neq j$ is:

$$\frac{\pi(\theta_i)}{\pi(\theta_j)} = \left(\frac{\theta_i}{\theta_j} \right)^{\frac{1}{1-\gamma}}. \tag{6}$$

This ratio shows the role of the parameter γ in determining the impact of the entrepreneur's own ability in profits. Assuming that $\theta_i > \theta_j$ individual i will have a higher profit as an entrepreneur relative to individual j the higher is γ. Prospective profit as an entrepreneur in effect determines the opportunity cost of wage employment. Hence, the higher is γ, the higher is the wage of high ability individuals. We will refer to this as a "supply shift" effect of γ, where the effect refers again to the deviation from a situation with parameter value $\gamma = 1$. An equilibrium in this model involves a set of n ability levels that divide each bracket into workers and entrepreneurs, and a set of n wage levels.

Equilibrium I - Occupational choice

Individuals make an occupational choice between wage employment and entrepreneurship. As a wage employee the individual is assigned to a wage bracket depending on her ability level. Naturally, individuals become entrepreneurs whenever the resulting profit is higher than the wage they can earn as an employee.[9] Within each ability bracket, individuals with the highest ability levels become entrepreneurs. Thus in general, entrepreneurs may have higher or lower ability levels than wage workers.

Following standard procedure we identify a marginal individual for whom profit equals wage. In our setting we must perforce do that for each of the n brackets. The ability of this marginal worker/entrepreneur in bracket j will be denoted by θ_*^j. Individuals from the same bracket with lower ability levels will become workers and those with higher ability levels entrepreneurs. To keep track of the ability levels that divide the workforce into wage brackets, let θ_H^j be the highest and θ_L^j the lowest ability level in bracket j. Note that $\theta_H^j = \theta_L^{j+1}$, $\theta_H^n = \theta_H$ and $\theta_L^1 = \theta_L$. Also note that $\theta_L^j \leq \theta_*^j \leq \theta_H^j$, where an equality in the first case means that effectively everyone who would be attributed to wage bracket j as an employee will become an entrepreneur, and an equality in the latter case that no one within this bracket will opt for entrepreneurship. The average productivity in bracket j follows as:

$$\bar{\theta}_j = \frac{\int_{\theta_L^j}^{\theta_*^j} \theta_i dH(\theta)}{\left(H(\theta_*^j) - H(\theta_L^j)\right)}, \forall j \in B. \tag{7}$$

If a bracket contains both entrepreneurs and wage workers, we can use the equality between equation (5) and wage to identify the ability of the marginal worker/entrepreneur θ_*^j. However, some brackets may contain only workers ($\theta_*^j = \theta_H^j$) and some only entrepreneurs ($\theta_*^j = \theta_L^j$).[10]

[9] This implies that individuals are assumed to be risk neutral and that their utility is driven by financial rewards only.

[10] In practice, it will never happen that a bracket contains only entrepreneurs, since in that case, the wage would be pushed up to extreme levels due to a lack of supply.

To sum up, we have:

$$\begin{cases} (i) & \theta_*^j = \pi^{-1}(w_j) & \text{if } \pi(\theta_L^j) < w_j < \pi(\theta_H^j) \\ \\ (ii) & \theta_*^j = \theta_L^j & \text{if } \pi(\theta_L^j) \geq w_j \\ \\ (iii) & \theta_*^j = \theta_H^j & \text{if } \pi(\theta_H^j) \leq w_j \end{cases} \tag{8}$$

for all $j \in B$. Substituting equation (7) in (5) and applying the conditions in equation (8) will identify n equilibrium cut off points $\left\{\theta_*^j\right\}_{j=1}^n$ that divide the $1/n$ individuals per wage bracket into groups of wage earners and entrepreneurs. Note that even if wages are exogenous, this is a problem that involves a system of n non-linear equations which is intractable to an analytical solution.[11]

Equilibrium II - Labor market

The division into wage brackets means that we will in effect have n labor markets. Labor supply in market j is defined as the number of individuals in this bracket net of entrepreneurs. Formally, we write labor supply as

$$L_j^S = \frac{N}{n} - N\left[H(\theta_H^j) - H(\theta_*^j)\right]. \tag{9}$$

Labor demand from bracket j may come from all n brackets which makes this part a bit more involved. Using equation (3) we can write demand for bracket j workers from bracket k entrepreneurs as the following integral

$$L_{kj}^D = N \int_{\theta_*^k}^{\theta_H^k} L_{kj}(\theta_k, w_j) dH(\theta).$$

The sum over entrepreneurs from all k brackets defines the total demand from bracket j:

$$L_j^D = \sum_{k=1}^n L_{kj}^D.$$

[11] This would still hold with another assumption about the distribution of talents (e.g. a uniform distribution instead of the normal distribution used).

Given this we can determine the n wages that clear the market in each bracket.[12] If $\theta_*^j = \theta_L^j$ we set $w_j = \pi(\theta_L^j)$, and otherwise we set w_j to be the wage that solves

$$L_j^S = L_j^D, \tag{10}$$

for all $j \in B$. This gives us n conditions to identify the set of equilibrium wages $\{w_j\}_{j=1}^n$. Altogether we have a system of $2n$ equations where the $2n$ unknowns enter each equation. This system is solved numerically. We refer to Appendix A for a description of the iterative procedure used to solve the model.

4 Equilibrium properties

The ability distribution

The distribution we analyze is generated from a normal distribution. Individuals are assigned a potential ability level $\hat{\theta}_i$ drawn from a distribution $N(\mu, \sigma)$. The actual ability level is then determined by the following equation:

$$\theta_i = \hat{\theta}_i \left(1 - \exp(-t + \lambda t \left(\hat{\theta}_i - \kappa\mu\right))\right). \tag{11}$$

This simple transformation allows for an intuitive interpretation in terms of educational institutions. We can think of t as the (quality adjusted) time in school. The parameter $\lambda \in \{-1, 0, 1\}$ can be interpreted as the degree of elitism in the system. $\lambda = -1$, implies that individuals who have a high potential ($\hat{\theta}_i$) benefit more from education. If $\lambda = 0$ the system will be called neutral and with $\lambda = 1$ egalitarian (implying that low potential individuals gain the most from education). An egalitarian system skews the distribution to the left whereas the elitist system skews it to the right. The parameter κ is used to scale the distribution so that average productivity is constant irrespective of the value of λ.

[12] Since there exists no way to determine the market clearing wage in the hypothetical case that all individuals belonging to a certain bracket become entrepreneurs, we will simply assume that the wage in the bracket equals the profit of the lowest ability entrepreneur within the bracket.

Throughout we use a normal distribution of potential talents where $\mu = 1.25$ and $\sigma = 0.5$, together with $t = 2$ and $\lambda = 0$ in equation (11) if nothing else is indicated. Moments for the transformed distribution are indicated with the results. Moreover, we bound the range of potential abilities to $\hat{\theta}_i \in [0.5, 2]$, and choose $\gamma = 0.75$ and $\alpha = 0.75$ as the benchmark case.[13] The population size N is normalized to 1.

Results

Table 1 shows the effect of increasing the number of wage bracket on some equilibrium properties for $\gamma = 0.75$ and $\gamma = 0.9$. Both entrepreneurial and wage income tends to increase. As the number of brackets increases, each bracket will contain less workers and thus be affected less by decreasing returns to scale. Comparing $\gamma = 0.75$ with $\gamma = 0.9$ we see that the increase in income is less for the higher parameter value where decreasing returns are less pronounced.

——-[TABLE 1]——–

Another main feature is that the share of entrepreneurs decreases as the number of brackets increases. This is due to several effects. First, on average, the ability of highly skilled wage employees will be less undervalued, and the average wage level increases. This will have the effect of increasing the opportunity cost of entrepreneurship. At the same time, the entrepreneurial profits increases due to more efficient use of labor as ability and wages become more aligned. As *Table 1* reveals, the first two effects dominates the latter, resulting in a net outflow of entrepreneurs. Moreover, we note from *Table 1* that a larger number of brackets increases the general equilibrium income inequalities between wage workers and entrepreneurs. Entrepreneurs have a higher income in part because they have a higher average ability level, so that even as workers they would have a higher average income (i.e. a selection effect), and in part by virtue of being entrepreneur.

The increased average wage level is the net effect of three drivers. The first is a demand effect; more brackets reduce the negative effect from diminishing returns, allowing entrepreneurs to increase their labor demand. Counteracting this effect is the above mentioned tendency of

[13] The parameter α is added for technical purposes. By setting $\alpha < 1$, we will get an equilibrium with more entrepreneurs which has more stable properties for the purposes of a numberical solution.

a declining share of entrepreneurs. A third effect is a relatively strongly reduced supply in the higher brackets, where wages must be pushed upwards in order for labor markets to be in equilibrium.

Table 2 shows the main results. Using the general equilibrium outcomes we calculate the comparative static of increasing each individual's ability level (by a specific number of standard deviations of its distribution). We compute the resulting average increase in wages for several cases that differ from each other only in the presumed number of wage brackets. In our computations we include all individuals, i.e. also the ones that will enter into entrepreneurship. The main result that we want to emphasize is that a higher level of control (i.e. more wage brackets) tends to yield a higher increase in wages. This result is consistent with the control hypothesis: more control leads to higher returns to ability.

——[TABLE 2]——

Figure 2 plots the wage brackets and the profit lines for five brackets (dotted lines) and ten brackets (solid lines). It shows that the increased return to ability when increasing the number of wage brackets is explained by an increase in the top wages. The lowest brackets remain unaffected by increasing the number of different tasks.

Two more results can be seen from *Table 2*. First, we can conjecture that the effect of control on returns to ability is concave. Consider the case where we add 1/4 standard deviations to ability. Going from 3 to 5 brackets (i.e. less than double) increases the returns to education with some 20 percent, whereas the increase is about 15 percent when we go from 5 to 10 brackets (i.e. double). We can also see that control has a larger effect when the returns to scale parameter is low. Low returns to scale decreases the ratio of profit for a high and a low skilled entrepreneur, thus yielding more entry also in lower brackets. Entry of entrepreneurs tends to decrease supply of labor and drive up wages. This difference can be seen from the general equilibrium for $\gamma = 0.75$ and $\gamma = 0.5$ shown in *Figure 3*.

———[FIGURE 2]———

———[FIGURE 3]———

In *Table 3* and *Table 4* we change the underlying distribution, by increasing the (mean preserved) spread (σ) and then by giving it a right or left skew (λ). This is done to assess to what extent the main result is dependent on or affected by distributional assumptions.

As the spread of the distribution increases, the aggregate income becomes higher, as well as the difference in average returns for employees and entrepreneurs.[14] For our purposes it is important to note that the returns to ability is increasing in the number of brackets, for whatever size of the variance of the underlying distribution. Moreover, from *Table 3* we can also see that the returns to ability is higher when the variation is large. This is intuitive because wage differentials can be larger in a distribution with larger spread. *Table 3* also shows that the positive effects on returns to ability of the variance and the number of wage brackets interact: with larger variance the effect of increasing the number of wage brackets on the returns to ability becomes larger.

Next we give the distribution a right or a left skew. Given an invariant underlying distribution we may interpret this as giving the population a more egalitarian or elitist treatment. We can think of this as a school system where either the most talented or the ones with the weakest talents are furthered the most. A more elitist system (right skew) increases aggregate income and income inequalities in T*able 4*. Again, this is an effect of making the upper tail thicker and thereby increasing the ability levels of entrepreneurs. Moreover, we see that our result that more brackets increase the return to ability holds irrespective of the skewness. This result is stronger in the distribution with a right skew. This is again a reflection of an increased inequality in wages as the wage structure becomes more convex.

———[TABLE 3]———

———-[TABLE 4]———

[14]The latter effect is explained by the fact that entrepreneurs are overrepresented in the upper tail of the distribution. More highly skilled entrepreneurs also explains why a larger spread increases aggregate income.

5 Conclusions

When asked for reasons why becoming an entrepreneur, control is frequently mentioned. Is this more than a matter of preferences? Empirical evidence suggests that this is indeed the case: entrepreneurs tend to have a higher return to their human capital assets than employees. A highly intuitive explanation for this fact is that as an entrepreneur individuals are better able to control their human capital assets and put it to use. Wage workers are constrained by assigned tasks and work descriptions. Together with labor market rigidities this lowers the correlation between ability and remuneration.

In this article we have explored one way of integrating the idea of different levels of control in a general equilibrium framework. In this model workers who are heterogenous in ability may be assigned to the same wage bracket. In a given structure of brackets some ability levels will be over and some undercompensated relative to their productivity. We can vary the degree of control by varying the number of of exogenously given wage brackets.

With this model we can show that the returns to ability are higher for wage workers when the number of brackets increase. This is consistent with the idea of limited control as the basis for a distinction between wage workers and entrepreneurs in terms of their returns to ability. We thus show a way of integrating the concept of control in a widely used occupational choice model. By doing so we provide a theoretical underpinning for the control-based explanation of the empirical observation that the returns to ability and education are higher for entrepreneurs than for employees.

References

Andersson, P., and Wadensjö, E. "Wage-Earners who become self-employed: The impact of income and wages." In *Four Essays on Self-Employment* (PhD diss). Stockholm University, 2006.

Backes-Gellner, U., and Werner, A. "Entrepreneurial signaling via education: A success factor in innovative start-ups." *Small Business Economics*, Vol. 29 (2007), pp. 173–190.

Benz, M., and Frey, B. "Being independent is a great thing: subjective evaluations of self-employment and hierarchy." *Economica*, Vol. 75 (2008), pp. 362–383.

Blanchflower, D., and Oswald, A. "What makes an entrepreneur?" *Journal of Labor Economics*, Vol. 16 (1998), pp. 26–60.

Fairlie, R. "Self-employment, entrepreneurship, and the NLSY79." *Monthly Labor Review*, Vol. 128 (2005), pp. 40–47.

Hamilton, B. "Does entrepreneurship pay? An empirical analysis of the returns of self-employment." *Journal of Political Economy*, Vol. 108 (2000), pp. 604–631.

Hartog, J., van Praag, M., and van der Sluis, J. "If you are so smart, why aren't you an entrepreneur?" Working Paper, Max Planck Institute, 2008.

Kanbur, R. "Of risk taking and the personal distribution of income." *Journal of Political Economy*, Vol. 87 (1979), pp. 769–797.

Lazear, E. "Entrepreneurship." *Journal of Labor Economics*, Vol. 23 (2005), pp. 649–680.

Levin, J., and Plug, E. "Instrumenting education and the returns to schooling in the Netherlands." *Labour Economics*, Vol. 6 (1999), pp. 521–534.

Lucas, R. "On the mechanics of economic development." *Journal of Monetary Economics*, Vol. 22 (1988), pp. 3–42.

Mincer, J. *Schooling, earnings and experience.* NY: Columbia University Press, 1974.

Oreopoulos, P. "Estimating average and local average treatment effects of education when compulsory schooling laws really matter." *American Economic Review*, Vol. 96 (2006), pp. 152–175.

Parker, S., and Van Praag, M. "Schooling, capital constraints and entrepreneurial performance: The endogenous triangle." *Journal of Business and Economic Statistics*, Vol. 24 (2006), pp. 416–431.

Rotter, J. "Generalized expectancies for internal versus external control of reinforcement." *Psychological Monographs*, Vol. 80 (1966), pp. 1–28.

Silva, O. "The jack-of-all-trades entrepreneur: Innate talent or acquired skill?" *Economics Letters*, Vol. 97 (2007), pp. 118–123.

Van der Sluis, J., and Van Praag, M. "Measuring returns to education based on changes in compulsory schooling laws." Mimeo, University of Amsterdam, 2007.

Van der Sluis, J., van Praag, M., and Vijverberg, W. "Education and entrepreneurship selection and performance: A review of the empirical literature." *Journal of Economic Surveys*, Vol. 22 (2008), pp. 795–841.

Van der Sluis, J., van Praag, M., and van Witteloostuijn, A. "Why are the returns to education higher for entrepreneurs than for employees." Working Paper, University of Amsterdam, 2005.

Van Praag, M., and Versloot, P. "What is the Value of Entrepreneurship? A Review of Recent Research." *Small Business Economics*, Vol. 29 (2007), pp. 351–382.

Wagner, J. "Testing Lazear's jack-of-all-trades view of entrepreneurship with German data." *Applied Economics Letters*, Vol 10 (2003), pp. 687–689.

Weiss, A. "Human capital vs. signalling theories of wages." *Journal of Economic Perspectives*, Vol. 9 (1995), pp. 133–154.

Appendix A

Iterative Procedure to find the equilibrium

1. Guess a wage level for each bracket.
2. Trace out breakpoints using the occupational choice condition. If no entry into entrepreneurship occurs in any bracket, renew guess.
3. Iterate step 4 and 5 over all brackets, beginning with the first.
4. Find new wage that equilibrates bracket j, using labor market clearing condition (leaving out occupational choice condition). Since changing this wage will affect other brackets because the market clearing condition does not take into account the movement in breakpoints that will occur due to the change in wages. Hence wages must be changed marginally. If the equilibrium wage is higher than the previous wage, increase w_j by some small $\varepsilon > 0$. If it is lower, decrease it with the same amount.
5. Trace out new breakpoints for all brackets using the occupational choice condition.
6. Test if labor markets clear with new breakpoints. Repeat until convergence.

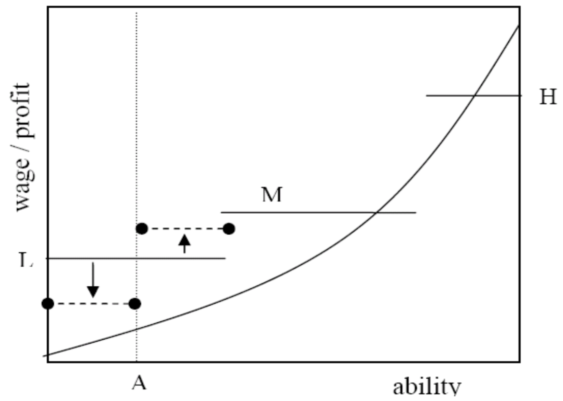

Figure 1a. Direct effects of subdividing a wage bracket.

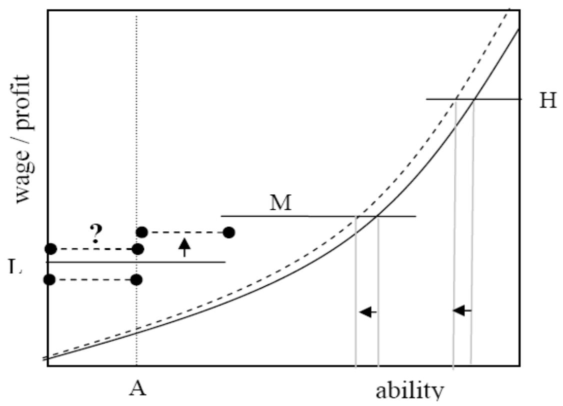

Figure 1b. Indirect effect on labor demand from subdividing a wage bracket.

Figure 1: General equilibrium effects of dividing wage brackets.

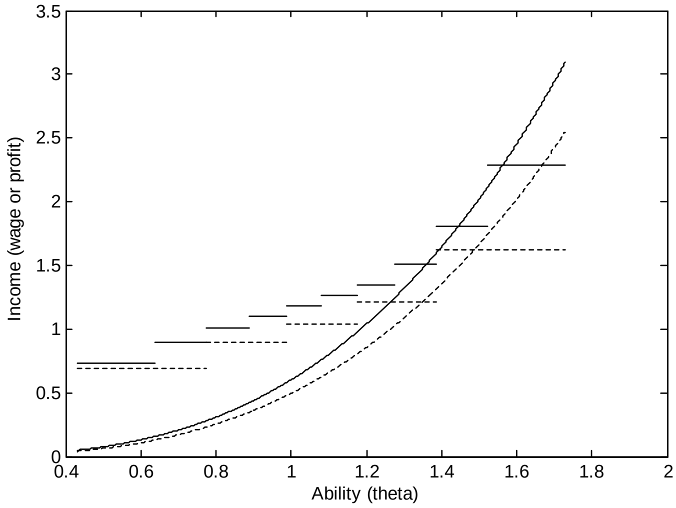

Figure 2: Wage levels and profit function for n=5 (dotted lines) and n=10 (solid lines).

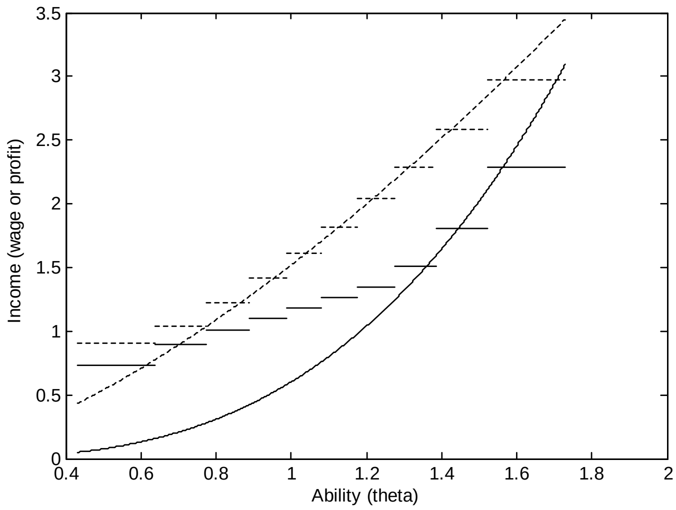

Figure 3: Wage levels and profit function for n=10 comparing γ=0.75 (solid lines) with γ=0.5 (dotted lines).

Table 1: General equilibrium properties

	$\gamma = 0.75$				$\gamma = 0.9$			
	2	3	5	10	2	3	5	10
Agg. wage	0.687	0.759	0.855	1.012	1.045	1.088	1.145	1.226
Agg. profit	0.229	0.253	0.285	0.337	0.116	0.121	0.127	0.136
Agg. income	0.916	1.012	1.140	1.349	1.161	1.209	1.272	1.362
Share entrepreneurs	0.168	0.155	0.153	0.150	0.062	0.059	0.056	0.052
Avg. wage	0.826	0.898	1.010	1.191	1.113	1.156	1.213	1.293
Avg. profit	1.368	1.634	1.861	2.245	1.887	2.067	2.286	2.617

Mean 1.08, std.dev 0.32.

Table 2: Returns to ability

	$\gamma = 0.75$				$\gamma = 0.9$			
	2	3	5	10	2	3	5	10
Increase in wage								
+1/4 std.dev. ability	4.47	5.82	6.98	8.05	4.72	5.78	6.52	7.14
+1/2 std.dev. ability	8.79	11.47	13.84	16.55	9.28	11.31	12.72	14.33
+1 std.dev ability	16.46	21.69	28.02	34.15	17.38	21.08	25.04	27.78

Mean 1.08, std.dev 0.32.

Table 3: Change (mean preserving) spread of distribution

	$\sigma = 0.25$		$\sigma = 0.5$		$\sigma = 1$	
	3	10	3	10	3	10
Agg. income	0.955	1.276	1.012	1.349	1.026	1.368
Avg.wage/Avg.profit	0.588	0.590	0.549	0.531	0.552	0.532
Increase in wage						
+1/4 std.dev. ability	4.56	6.06	5.82	8.05	6.29	9.05
+1/2 std.dev. ability	8.98	12.59	11.47	16.55	12.51	18.28
+1 std.dev ability	16.91	26.84	21.69	34.15	24.51	36.23

Mean1.08, std.dev0.21(σ=0.25),0.32(σ=0.5),0.36(σ=1).

Table 4: Change skewness of distribution

	$\lambda = -1$		$\lambda = 0$		$\lambda = 1$	
	3	10	3	10	3	10
Agg. income	1.024	1.365	1.012	1.349	1.002	1.340
Avg.wage/Avg.profit	0.552	0.538	0.549	0.531	0.594	0.629
Increase in wage						
+1/4 std.dev. ability	6.24	8.59	5.82	8.05	5.47	7.63
+1/2 std.dev. ability	12.35	17.67	11.47	16.55	10.72	24.09
+1 std.dev ability	23.48	36.37	21.69	34.15	20.11	32.02

Mean 1.07, std.dev 0.35 skew 0.08 ($\lambda = -1$)
Mean 1.09, std.dev 0.30 skew -0.14 ($\lambda = 1$)