# Education and Entrepreneurship in Industrialized Countries: A Meta-analysis

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Abstract

This paper provides a meta-analytical review of empirical studies into the impact of schooling on entrepreneurship selection and performance. We first describe the main effects found in the current entrepreneurship literature. We then explain the variance in results across the hundreds of empirical studies by means of an analysis of variance. Five main conclusions result from this meta-analysis. First, we find that the impact of education on selection into entrepreneurship is neither positive nor negative. Second, the effect of education on performance is positive and significant. Third, the return to a marginal year of schooling in terms of the income it generates is 6.1 percent in the U.S.A. Fourth, the effect of education on earnings is smaller for entrepreneurs than for employees in Europe, but equal or larger in the U.S.A.. The fifth conclusion from the meta-analysis is the most striking and pertains to the estimated effect of education on performance: all results obtained so far are potentially biased. Estimation and identification strategies used to identify the effect of education on performance have merely measured the (conditional) correlation between education and performance rather than the causal effect, which is the estimate of interest. We finally conclude that the entrepreneurship literature on education can greatly benefit from the technical sophistication used to estimate the returns to schooling for employees by means of twins studies, field experiment or instrumental variables approaches.

Keywords: Meta-analysis, schooling, entrepreneurship, performance, occupational choice

JEL-codes: J23, J24, J31, M13.

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## 1. Introduction

Researchers and practitioners alike are fully aware of the (potential) contributions of entrepreneurs to the economy. Entrepreneurs generate a substantial part of the national income and they generate jobs in most countries. Entrepreneurs contribute to R&D and innovations. Entrepreneurship serves as a good alternative to wage employment for people who need more flexibility in combining work and family obligations than an employer can often offer. In addition, entrepreneurship might also be a preferable alternative to minority groups that are discriminated by employers in the labor market. One important determinant and probably the most easily influenced determinant of entrepreneur performance is education. If education leads to a higher quality of entrepreneurial performance and to a greater number of entrepreneurs, this justifies appropriate investments in education. Therefore, there is an urgent need for research into whether and how this is achieved. The effect of education on entrepreneurship selection and performance is the topic of this paper.

A substantial and technically sophisticated economics literature has developed in the last decade about returns to schooling (e.g., Psacharopoulos, 1994; Card, 1998; and Ashenfelter et al., 1999). Returns to schooling have been measured for many countries and over a number of years in a way that allows both international comparisons and trend analyses. Innovative methods have been developed within this strand of research to assess whether the measured correlations between schooling and income reflect a causal effect of schooling on earnings (e.g., Ashenfelter et al., 1999). However, almost without exception, returns to schooling refer to the returns employees generate from their years at school.

The objective of the current paper is to compile, analyze and describe all empirical studies that measure the effect of schooling on entry and performance for entrepreneurs in industrial countries[1]. This allows us to see whether there is an overall effect of education on entrepreneur performance and selection into entrepreneurship. In addition, such a compilation of studies allows us to measure the extent to which characteristics like "percentage of ethnic minorities in the sample", "size of the sample" and "country" influence the results found till now. We thus develop insights into the outcomes, practices and methodologies used, and we gain a deeper understanding of the problems encountered in this type of entrepreneurship research. We aim to compare these practices to the studies pertaining to employees' returns to schooling.

Our main instrument to study the relationship between schooling and entrepreneurship entry and performance is a meta-analysis, which we split up in two parts. The first part is descriptive and describes the main effects found in the entrepreneurship literature. The second part is an analysis of variance in

[1] Van Der Sluis, Van Praag and Vijverberg (2003) cover developing countries and countries in transition.

which we use various characteristics of the studies to explain the variance in their measurements of the effect of schooling on entrepreneurship outcomes.

To be able to perform these analyses we have first gathered all relevant studies from the large number of published and unpublished academic studies[2]. Each of the 94 resulting studies measures, among others, the impact of schooling on entrepreneurship entry, performance, or both for a specific sample, i.e., for a given country, time period, gender, occupation, and so on. This results in 299 observations in our database. The descriptive part of the meta-analysis is based on this dataset. We take stock of several characteristics of each of these studies, such as sample size, the type of sample, ability controls used, whether the study is published or not, and, if it is published, the type and level of journal. These factors constitute the potential determinants of cross-study variation in the effect of education.

Several conclusions can be drawn from our results. First, the effect of education on entry is neither positive nor negative. Second, we find that entrepreneurship performance, independent of the measure used, is significantly and positively affected by schooling. The return to education in the U.S. is estimated at 6.1%. Third, the returns to education for entrepreneurs seem to be lower for entrepreneurs than for employees. However, a compilation of those studies that estimate the return to education for both entrepreneurs and employees in a comparable fashion show that entrepreneurs in the U.S. have a slightly higher return to their education than employees, whereas the reverse is true in Europe. Fourth, the returns to schooling in entrepreneurship are strongly positively correlated with location of the venture in the United States or in another country with superior business conditions. We also find that minorities benefit less from their education as entrepreneurs than others.

The fifth conclusion from the meta-analysis is the most striking: all results obtained so far are potentially biased. Estimation and identification strategies used to identify the effect of education on performance have merely measured the (conditional) correlation between education and performance rather than the causal effect, which is the estimate of interest. The methodological approaches in the schooling-entrepreneurship literature lag far behind the quality standards in the comparable but neatly defined schooling-employees literature. The schooling-entrepreneurship literature could take a leap forward by addressing similar endogenous choices of entrepreneurs with similar techniques. Moreover, our database demonstrates a need for greater uniformity in the definition and measurement of entrepreneurship, schooling, and performance, such that results can be compared numerically. These yet unsolved problems of measurement and definition have prevented the development of a quantified knowledge base of the (potential) returns to schooling in entrepreneurship. It is certainly not for lack of relevance and interest.

[2]We used various databases and the Internet to find all relevant studies published after 1980 and all unpublished studies after 1997.

The paper proceeds as follows. Section 2 briefly summarizes economic theory about the (supposed) relationship between entrepreneurship entry, performance and educational attainment. Section 3 describes the data gathering process. Section 4 illustrates the lack of standards in the literature that hampers the development of a quantified knowledge base. Section 5 summarizes the evidence concerning the relationship between schooling on the one hand and entrepreneurship entry and performance on the other hand. Substantial cross-study variation comes to light, which is precisely the motivation for doing the meta-analysis of variance that is the subject of Section 6. Section 7 concludes.

## 2. Economic Theory[3]

There are several theoretical determinants of entrepreneurship selection and performance that have been empirically tested (see the overview article by Le, 1999). Among them are risk attitude, access to capital, various types of labor market experience, economic conditions, business acumen, family background, psychological traits, and last but not least education: "One of the major theoretical determinants of self-employment choice is educational attainment" (Le, 1999:386). The same holds for the relationship between educational attainment and performance, though the two relationships have different theoretical roots.

*Education as determinant of entrepreneurship selection*

Le (1999) argues that there are two different channels (managerial ability and outside options) through which the level of education might influence the propensity to become self-employed. Calvo and Wellisz (1980), inspired by Lucas' general equilibrium model (1978), explain the impact of educational attainment on the probability of selection into an entrepreneurial position through managerial ability. Education would enhance managerial ability, which in turn increases the probability of entrepreneurship.

The other channel of influence as indicated by Le causes an opposite, negative effect of education on entrepreneurship selection. It points to the possibility that higher levels of education might generate better outside options (i.e., more lucrative paid wage employment under better working conditions) and thus decrease the likelihood of entrepreneurship as the preferred choice. It is yet unclear what the theoretical predicted effect of these offsetting forces on the effect of schooling on entrepreneurship selection might be.

[3] Our meta-analysis includes several empirical studies from other disciplines than economics. However, we do not aim to put forth an overview of theories developed outside the economics discipline. The particular empirical studies reviewed from these broader disciplines including labor relations, sociology and psychology are not rooted in any theoretical framework other than various (sometimes valuable, but quite ad hoc) theoretical conceptualizations.

*Education as determinant of entrepreneurship performance*

According to the Mincerian specification of the determinants of individual earnings, the main factors affecting earnings are schooling and experience. Schooling is acknowledged not only for its productive effect on the quality or quantity of labor supplied, as assumed by Mincer, it also has value as a signal of productive ability in labor markets without complete information (Spence, 1973; Riley, 2002).

In signaling, the party with private information – i.e., the employee in the selection and hiring process by employers, and the business owner in the selection process by clients, stakeholders, or business relations – takes the lead in adopting behavior that, upon appropriate interpretation, reveals his information about his own type or productivity. Educational attainment has signaling value as long as two self-selection constraints are met: (1) completing education is either impossible or prohibitively costly for low productivity types, and (2) all high productivity workers indeed self-select into higher education. For these two conditions to hold, it is obviously required that the completion of education be more expensive for low productivity types than for high. With costs aligned in this way, a separating equilibrium exists that renders schooling a credible signal since the high productivity group prefers to complete higher levels of schooling, whereas it will not be in the interest of low productivity workers to feign that they are of the high productivity type, even if high productivity types are remunerated accordingly. These conditions might very well be met in the entrepreneurial market as long as entrepreneurial ability and learning ability are positively correlated, and stakeholders are less informed about these levels than are prospective entrepreneurs themselves.

*Basic integrated models of choice and performance*

Another type of models, known as structural models, simultaneously explains the occupational choice and performance of labor market participants. In these models, the actual division between entrepreneurs and wage labor turns on the distribution of individual characteristics among the utility maximizing population. In Lucas (1978) and Van Praag and Cramer (2001), this characteristic is individual entrepreneurial ability as determined by, for instance, education[4]. Van Praag and Cramer (2001) extend Lucas' model by allowing risk averse individuals to be uncertain of their entrepreneurial talents when choosing occupations: they choose the occupation that renders the highest expected utility[5].

In such models, education generates higher levels of (expected) entrepreneurial ability that, in turn, causes higher levels of entrepreneurial performance (in terms of profit and firm size). This higher level of expected performance and thereby (psychological) income, increases the expected utility attached to

[4] Estimation of the structural model (Van Praag and Cramer, 2001) indeed shows that education plays a significant role in the determination of entrepreneurship choice and performance.
[5] The model in this respect resembles Kanbur's (1979) model.

entrepreneurship and thereby favors this occupational choice. Education now has a positive effect on both the choice of and the performance in entrepreneurship[6].

## 3. Constructing a Database for Meta Analysis

We perform a meta-analysis in order to assess whether there are any consistent findings from the vast empirical entrepreneurship literature with respect to the impact of educational attainment on performance in and choice of entrepreneurship. Meta-analysis is a quantitative tool that is applied to synthesize previous research findings that share common aspects that can be addressed in a statistical sense. The set of meta-analytical techniques have largely been developed and applied outside the academic field of economics in the medical and natural sciences. Rare examples of the application of these techniques amongst economists are Phillips (1994), Card and Krueger (1995), Ashenfelter et al. (1999), and Nijkamp and Poot (2002).

The objective of this study is to assess the mean estimates and the variation across studies in the effect of schooling on (i) entry into entrepreneurship, (ii) whether an individual currently is an entrepreneur, and (iii) the various entrepreneurial performance measures. Let us assume that each observation in the database we are going to construct describes a study of the effect of schooling ($S$) on entrepreneurship selection or performance ($Y$). To be more precise, let us define such a relationship as $Y = g\,X + b\,S + u$, where $X$ is a set of controls. Let $b$ be the estimate of $b$, and let $Z$ be various features of the way this relationship has been estimated, such as a characterization of the sample used, the type of controls entered, the precise form of the dependent variable, etc. With meta-analysis, one describes $b$ across studies in the database, either with simple descriptive statistics (the descriptive approach) or by means of regression analysis (the analysis of variance approach). We define this regression model as $b = Za + e$.

In order to meet the data requirements for such an analysis, the available empirical literature needs to be categorized and selected according to systematic rules. As Nijkamp and Poot (2002:7) note, these rules prescribe that the database must have sufficient coverage (i.e., is representative of the population of published and unpublished studies) and precision (i.e., provides high quality information on the issues at hand). In Appendix A, we offer a detailed account of the rules we employ, and we describe features of the resulting database.

In essence, the database contains journal articles, book chapters, and working papers published after 1980, pertaining to entrepreneurship selection and performance in industrial countries. Studies that focused on developing countries or transition economies are omitted in order to preserve homogeneity. In

[6] If education is allowed to also raise the productivity of the individual as an employee, the effect of education on the choice becomes ambiguous.

all, 94 studies are represented in the database, yielding 299 observations describing a quantified relationship between education on the one hand and an entrepreneurship selection or performance variable on the other.[7] Among these, 144 (48 percent) examine performance, 69 (23 percent) investigate entry into entrepreneurship, and 86 (29 percent) specify the dependent variable as "being self-employed." The latter is a stock (rather than flow) variable that is a hybrid of entry (everyone who *is* self-employed has entered this occupational status) and performance (it generates an overrepresentation of survivors). We therefore keep "stock studies" as a separate category.[8] Furthermore, we distinguish structural (entry, performance and stock) studies from reduced form studies into the same relationship. Several authors have acknowledged that the selection into self-employment is an endogenous choice, dependent on the expected performance or on the utility from income. Failing to account for such selectivity effects may well bias the estimated return to education (or any other variable). Those studies that we label as "structural" attempt to incorporate at least some kind of a deliberate occupational choice of labor force participants, and it is worthwhile to compile such studies under a separate heading in order to examine the direction of the selectivity bias.[9] Eleven percent of the observations are structural, constituting 19 percent of the performance observations, 10 percent of the entry observations, and a negligible proportion of stock observations.

## 4. A literature in search of standards

In constructing this database, we were struck by the great variation among the studies in facets like the definition of the primary variables of interest, such as entrepreneurial outcomes and education, as well as the type of data that were used, the analytical techniques that researchers employed, and so forth. Variation in research may represent innovative thinking, or it may reflect a field that is adrift without a rudder. Anyway, the lack of uniform definitions of the key variables of our study, i.e. education, entrepreneurship and performance, represents the challenge of performing a meta-analysis.

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[7] Many studies actually estimate several specifications of the same relationship. In such cases, we selected the set of estimates that best represent the objective of the author; other specifications are omitted to create a sample of independent observations, which is a requirement of meta-analytical research.

[8] See Van Praag (2002) for a theoretical analysis of the interrelations between entry, survival and stock of self-employment.

[9] There are actually many choices that could fall under this heading. For example, it is often assumed that the individual is working anyway and that the only choice to be modeled is whether to be self-employed as opposed to working for a wage. However, this choice model could be augmented with the choice whether to work, a choice between working in the public sector or the private sector, a choice to work for a large corporate organization as opposed to a smaller business that offers a similar environment as one's own enterprise, a choice to find employment in an urban area as opposed to a more rural setting, a choice to quit schooling in favor of employment, etc. Obviously, there is no study that includes all of these features. The point is that structural studies attempt to remove the bias caused by ignoring one or perhaps several of these choices but that one could easily think of other omitted selectivity factors that still may bias the estimated returns to schooling. Any comparison between reduced form and structural model estimates therefore has obvious limitations.

In general, fortunately, apart from the stock versus entry distinction, empirical definitions of entrepreneurship are fairly well comparable to each other, though their meanings are much more prosaic than those in most (untestable) theories that refer to the innovative free mind of the resourceful spiritual entrepreneur. Most researchers empirically define entrepreneurs as self-employed. Some specifically define the entrepreneur to be the starter of a new firm. Other studies examine entrants into the occupation of entrepreneurship, defined as those labor force participants who switch during a specific period from wage employment (and sometimes unemployment) to self-employment.

Unfortunately, the literature has not yet converged upon standardized definitions of performance and educational achievement. Table 1 shows the various empirical definitions of self-employment performance that have been used: the majority (52 percent) of performance observations focus on self-employment earnings–annual, monthly, weekly, or hourly–which is then entered in linear or logarithmic form. Another 27 percent examine exit or survival (types of studies that can be easily translated into each other); 7 percent of the observations pertain to hazard models; and 8 percent estimate models of mixed categories of growth (employment growth, asset growth, profit growth). Other categories each comprise less than 5 percent of the 117 performance observations.

Table 2 shows that a lack of uniformity in the measurement of schooling might generate additional problems for a quantified meta-analysis of the relationship between schooling and entrepreneurship. Years of education, the only continuous measure of schooling available, is quite frequently used (18, 30 and 41 observations of entry, stock and performance respectively). The dummy "college graduate," though, is the most frequently used measure of education: it appears in 42 entry, 51 stock and 64 performance studies.[10]

-Insert Table 1 about here-

-Insert Table 2 about here-

The fact that there is no agreement on the exact definition of entrepreneurship and on the measurement of entrepreneurial performance and education points to the need to be very careful in the design of the conceptual framework that synthesizes the available evidence in this field of research.

[10]Schooling levels in British studies diverge somewhat from others: O-levels, since 1991 called General Certificate of Secondary Education (GSCE), is an exam that all pupils take at age 16. It used to have a rather academic character, but has become slightly broader based in 1991. A-level exams are taken by pupils at age 18 who have continued their education after the O-level exam. This exam is traditionally academic and qualifies pupils for a university education.

## 5. The effect of schooling on entrepreneurial outcomes: descriptive analysis

The lack of standardization creates variability in the results among the studies that examine the relationship between entrepreneurial outcomes and education. In this section we examine the general direction of the relationship and expose the degree of variation in the estimates in a descriptive way; in the next section, we turn to an analysis of variance of the studies in the database, which examines causes of the variability in the estimates.

*Effect of schooling*

The centerpiece of our analyses is the relationship between schooling and entrepreneurship entry/performance as is reflected by the various estimated coefficients (i.e., *b*).[11] Table 3 shows the percentages of the estimated effects of schooling on entry, stock and performance respectively, that are significantly positive, insignificantly positive, insignificantly negative, and significantly negative. We distinguish eight schooling measures: years of education and seven dummy variables of which the first five and the last (British) two are frequently used in combination.

The table shows that the effect of schooling on entry is mostly insignificant. There are two exceptions: the effect of college dropout shows a significantly positive coefficient in 42 percent of the cases. This confirms the "Bill Gates" effect that (a) dropping out of the regular schooling system might be a common thing to do for a nascent entrepreneur, or (b) due to screening in the wage sector, college dropouts are pushed into the alternative route of entrepreneurship. The other exception is the significant positive effect on entry of postgraduate training that appears in as many as 52 percent of studies.

Performance in the entrepreneurial sector has a clear significantly positive relationship with schooling: the higher the type of schooling (i.e., college graduate and postgraduate) and the more years of education, the higher the chances of better performance. This positive relationship between performance and schooling is not found with regard to the British school system that works with A-levels and O-levels, perhaps as a consequence of the curriculum offered.

-Insert Table 3 about here-

While Table 3 summarizes evidence *whether* education matters, an equally important question is *how large* the impact of education really was estimated to be. To achieve this kind of quantitative assessment of the available estimates, we assemble subsets of studies from the database, which use the same combination of entrepreneurial outcome (entry, stock, or performance measure) and educational attainment. To ensure a degree of reliability, we also require these subsets to contain at least 30 studies.

[11] The estimated effects of the dummy variables for schooling are calculated in more than 95 percent of the cases relative to a reference category of no or primary schooling.

At this point, the lack of uniformity in measurement and definition becomes critical and, as should already be clear from the discussion above, forces us to discard more than a few studies from further analysis. For example, there are not enough studies that examine entry on the basis of years of schooling to warrant the computation of an average effect[12].

Table 4 shows the assembled subsets of studies. The second column, labeled N(1), lists the number of studies includes in the relevant subset. Columns three and four indicate the education and outcome variables that form the basis of the subset. The subsets are divided into two groups. The first group allows a numerical comparison of estimation results[13]. The second group, shown in Panel B, only permits an ordinal analysis of the estimation results, as will be explained in the next section.

Table 4 complements Table 3: it shows the percentages of positive, negative and, insignificant effects for the defined subsets. For the subsets I to IV that allow quantitative analyses, the averages and standard deviations of the estimated effect of schooling are given as well. The effect of education on entry is ambiguous. In contrast, the effect of schooling on earnings is unambiguously positive: between 84 and 89 percent of the studies find a positive significant relationship, whereas none of them reveal a negative significant relationship. The average return to schooling in subset IV, which, as it happens, only includes US studies, is 6.1 percent. This is a somewhat lower percentage than the 7 to 9 percent commonly found in the wage sector (see Ashenfelter et al., 1999).

-Insert Table 4 about here-

*Returns to schooling for entrepreneurs in comparison to employees*

A more direct comparison of the returns to education for entrepreneurs and employees can be obtained from a separate analysis of some studies in our meta-analysis database. Approximately twenty studies have measured the returns to education for entrepreneurs and employees in a comparable fashion (Table B1 in appendix B).

Less than half of these twenty studies focuses on the screening function of education. One of the ways in which the (strong or weak version of the) screening hypothesis is tested empirically is to compare the

[12] A further requirement is that the estimates must indeed be comparable. Estimates of logit, probit, and linear probability models are readily transformed to comparable magnitudes. Performance studies are not straightforwardly comparable. For example, some studies examine earnings in logarithmic form whereas other studies specify a linear variable. Earnings may refer to hourly, weekly, monthly, or annual values. They may reflect before or after tax values, and they are expressed in the local currency. Even so, all of these estimation results might be made comparable by expressing the education effect in elasticity form or by standardizing the parameter estimates with the standard deviation of earnings, but that requires descriptive statistics on earnings and education values that are often not reported in the studies. In fact, no more than 30 studies in our entire database revealed the standard deviation of the performance measure.

[13] Subset IV only consists of 21 observations. Here, we make an exception on our 30-study rule because this subset offers the best comparison to the established returns-to-schooling of employees literature.

returns to education for employees to the returns for entrepreneurs, where the latter group is considered as an unscreened control group. Almost all screening studies reject the strong screening hypothesis: i.e. these studies find positive returns to education for entrepreneurs. However, the evidence related to the weak screening hypothesis (WSH) is mixed. Studies based on US data reject the WSH, (Fredland & Little 1981, Tucker 1985, Tucker 1987, Evans and Leighton 1990, Robinson and Sexton 1994), implying that the returns to education are not higher for employees than they are for entrepreneurs in the United States. Studies using European data (UK, Italy, and The Netherlands) support the WSH (Rees & Shah 1986, De Wit & Van Winden 1989, Brown & Sessions 1998, Brown & Sessions 1999). The latter result implies that the returns to education are (slightly) lower for entrepreneurs than for employees in Europe.

The majority of the twenty papers that compare returns to education for entrepreneurs with those returns for employees use the comparison to highlight differences in labor market participation and success factors between minorities and non-minorities and/or between females and males (e.g. Moore 1982, Gill 1988, Macpherson 1988, Borjas & Bronars 1989, Fairlie & Meyer 1996, Lombard 2001, Lofstrom 2002). The results from these (exclusively US) studies are consistent with the results obtained in the screening literature: the estimated returns to education for entrepreneurs are at least as high, and usually (slightly) higher, than for employees.

From these studies we fail to conclude that the returns to education are higher for employees than they are for entrepreneurs, as one would gather from comparing the descriptive statistics of Table 4 with the meta analysis of Ashenfelter et al. (1999). More specifically, all studies pertaining to Europe indicate that the returns to education are slightly lower for entrepreneurs than for employees. However, the opposite result is found for the studies that pertain to the United States.

## 6. The effect of schooling on entrepreneurial outcomes: Analysis of variance

*The analysis of variance approach*

The descriptive statistics in the previous section provided meaningful insights into the impact of education on entrepreneurship selection and performance. However, equally important is to find out which characteristics of the studies influence the descriptive results found. To this end we apply the analysis of variance approach described in Section 3 (estimating the model $b = Za + e$ ).

Several notes are in order to ensure that the estimation results from this model are meaningful. First, the models must be estimated across a subset of comparable studies: the less variation there is across studies in the measurement of schooling attainment and entrepreneurial outcome (including the specific methodologies used), the more meaningful will be the result of the meta analysis. However, the advantage of homogeneous definitions has to be traded off with the size of the resulting sample for each of the

regressions. Table 4, excluding subset IV, shows the subsets larger than 30 studies that can be used for (separate) regression analyses.

Second, in building suitable subsets, we need to address one statistical requirement that is to be met in any regression analysis: independence of observations. In the meta-analytical regression, the study is the "observation," and the subset is the "sample." Thus, at issue is whether studies present us with independent measurements of the impact of education. A detailed examination of the studies reveals the potential for a violation of the independence assumption across observations that use comparable samples from the same (publicly available) dataset[14]. It does occur that several studies use the same data source and (roughly) the same subsample to examine the same entrepreneurial outcome variable. There are 16 of such combinations[15], involving a total of 37 studies. We have randomly kept one study of each of the 16 problematic combinations and deleted the other 21 studies. This deletion disqualifies sub-sample VII in Table 4 for a separate analysis since its size has become smaller than 30. Moreover, we will not utilize subset IV due to its small size. Nine subsets remain: three allowing a numerical analysis of the schooling coefficients found, and six requiring an ordinal analysis of the direction of effects of schooling on entry or performance. The last column in Table 4, labeled N(2), shows the number of independent studies in each subset that will be used in the meta-analytical regression models. Subsets I to III each consist of studies that use the exact same methodology for establishing the effect of the exactly identical educational measure on the uniquely defined phenomena studied (entry in subset I and stock in subsets II and III). Since the coefficients for education established in these narrowly defined samples are numerically comparable to each other and vary over a whole range of values, we can estimate the effects of the potential determinants of variation by OLS.

Third, note that the remaining six subsets (V - XI, omitting VII) are not sufficiently homogeneous and therefore need to be processed differently. Thus, the estimates of $b$ cannot be made comparable and estimation of a regression model $b = Z'' + ,$ is meaningless. However, there is a way to pool such small subsets in meaningful ways. Namely, $t$-statistics of $b$ reflect the sign and significance of the estimated relationship, where it does not matter so much whether the dependent variable is measured in linear or logarithmic form. Better yet, one may pool across all forms of performance measures, as long as the parameter estimates and t-statistics are recorded in such a way that the hypothesized effect of education

[14] In many cases, multiple observations of the same type (for instance, performance) come from one publication that uses a single dataset. As we indicated in footnote 7, to preserve independence, we have therefore selected only one of the estimated models, in particular the one that best shows the estimated relationship. But if one publication presents separate estimates for, e.g., men and women, we include both in our database, since independence is not in danger. We do acknowledge that two estimates drawn for different sub samples from one study (or from two studies by the same author) inherit a scientific approach from a single source and might therefore still be correlated, statistically speaking, from the perspective of a meta analysis. Our use of the term "independence of observations" pertains to the statistical independence of the samples that generate the estimated education effects.

[15] Available from the authors upon request.

points in the same direction. To this end we proceed in two steps: we first recode all the effects of schooling for performance measures for which "the more, the better" does not hold, i.e., exit from self-employment and the hazard out of self-employment. We then define a recoded variable $t^*$ that takes on the value 0 for observations that have established a significantly negative effect, 1 for all studies that find an insignificantly negative effect, 2 for studies that show an insignificantly positive effect, and 3 for significantly positive effects. This ordered variable is then regressed on characteristics of the studies by means of an ordered probit model: $t^* = Z'' + ,$. The advantage of this approach is that it allows us to merge different entrepreneurial performance indicators into a single analysis.

*What may cause variation among studies in the literature?*

What variables should be included in $Z$? Since our subset sizes are not particularly large, to use an understatement, we must be careful to formulate parsimonious meta-analytical models. Subset sizes between 30 and 71 do not permit rich models (and the estimated effects require a cautious interpretation). Actually, theory provides little guidance in generating hypotheses about the determinants of the returns to schooling for entrepreneurs, nor about the determinants of the relationship between entry and schooling. This analysis therefore has an explorative character and provides some first answers to the following kinds of questions. Is the return to schooling or the effect of schooling on entry, for example, higher in the US than elsewhere, higher for men than for women, or higher for whites than for non-whites? Is the return to schooling diminishing or increasing over time? Does the performance measure selected affect the return to schooling result? Does it relate to sample size? Moreover, is there any distinction in the effect of education across the various schooling levels? And does the relationship vary by the scientific level or by the strand of the journal in which the study is published? Is there something like a publication or reporting bias in the sense that there is an over-representation of significant results? Does the elimination of self-selection bias by estimating a structural model instead of a reduced form model affect the relationship between schooling and performance or schooling and entry? With this in mind, we now turn to the description of the explanatory variables of the meta-analytical models, i.e. the components of the $Z$ vector.

SAMPLE CHARACTERISTICS OF OBSERVATIONS The first group of control dummy variables is meant to control for three sample characteristics: whether the sample is taken from the US or from some other country,[16] the percentage of females in the sample, and the percentage of "non-white" (including

[16] Multi-country studies that are shown in Table 1 always split their samples into various single country observations. These are the observations that we use.

immigrants) individuals.[17] These explanatory variables have been dropped from our analyses whenever the cross-sectional variation within a subset was too small, for instance when all but one study were from the US.

TIME A variable is included that indicates the (earliest) year from which the observations in the sample have been drawn. In specifications not included here, we also tested whether there is any relationship between the dependent variables of the analyses and the year of publication of each of the studies. This was not the case.

CHARACTERISTICS OF JOURNALS There is an insufficient number of unpublished observations in each of the subsets to warrant the inclusion of a separate "publication" dummy. In preliminary work, we found no effect of the branch of journal in which a study is published. These dummies were omitted. The impact factor of the journal is included in the equations because if the impact factor stands for journal quality, then the study that is included in the better quality journal should itself be of a better quality. If all better quality studies report higher (or lower) schooling effects, then we have reason to believe that the "true" effect is indeed higher (or lower) than what a simple average (such as Table 4) suggests.

CONTROL VARIABLES IN THE GATHERED STUDIES Table C1 in appendix C shows the most commonly used control variables within the gathered studies and their effects. We investigated whether the inclusion of these variables in the observed studies affected the effect of schooling on entry, stock, and performance: quod non. We also verified whether the effect of specific schooling dummies (for instance college graduate) is affected by the inclusion of other schooling dummies such as college dropout or postgraduate schooling. This wasn't the case either.

PUBLICATION/REPORTING BIAS As expressed in Ashenfelter et al. (1999), we are concerned that the observed universe of published results has emerged solely because they were statistically significant. It might be the case that studies remain unpublished because they failed to provide a statistically significant rejection of the null-hypothesis of no effect. It is also quite possible that authors drop insignificant determinants from their models, and that therefore a statistically insignificant education effect leads to the omission of all education variables. If so, those studies would not appear in the database.

In order to test for this so called publication or reporting bias of the schooling measures, we include

[17] Sometimes, when the sample consisted of a mix of males and females and/or of a mix of original inhabitants and immigrants, and when the study didn't supply the relevant statistics, we inserted the general ratios applying to the working population in the relevant country as taken from OECD statistics. We assessed whether the effects of this inserted variable is different from the effects of the individual study-specific numbers, by including a dummy into each of the equations that was 0 for "actual sample numbers" and 1 for "inserted OECD country number". The dummy was not significant and is further left out from the tables.

the standard error of the parameter estimate for education in the observed studies. Without publication bias, standard errors shouldn't have any significant relationship with the coefficients. In the presence of publication bias however, we would expect a positive relationship between the standard error and the coefficient of the schooling measure.

Unlike in our first three subsets in which the dependent variable is the schooling coefficient itself, the standard error cannot be used as a control variable in the latter six subsets: the dependent variables in these subsets are based on the t-values, which are partly determined by these standard errors themselves. Therefore, in these models, we include the square root of the sample size $N$, since the standard error of the parameter estimate declines with the sample size at a rate of $N^{0.5}$. Consider the effect of $N^{0.5}$: (*i*) if the true effect of the education variable is positive (negative), it becomes more likely that its t-statistic become significantly positive (negative), and therefore the parameter on $N^{0.5}$ should be positive (negative); (*ii*) if the true effect of the education variable is 0, its t-statistic continues to hover around 0, no matter what the sample size is, so that the parameter on $N^{0.5}$ should be near 0; (*iii*) if publication bias exists, studies with small data samples are also reporting statistically significant education effects, so that, regardless of whether the true education effect is positive or negative, the parameter on $N^{0.5}$ should be near 0. The latter situation is therefore indicative of publication bias. Yet, it behooves to be cautious: if the true effect of education is positive under some conditions and negative (or zero) under others and if the subset of studies utilizes data samples that describe both of these situations, the parameter on $N^{0.5}$ could be near zero even in the absence of publication bias.

PERFORMANCE MEASURES USED Our last four subsets include all types of performance measures. In these equations, we control for the types of performance measures used to assess whether the impact of schooling differs between these measures. After some preliminary attempts, we include a dummy for earnings-related performance measures in these equations.

ESTIMATION METHODS AND TYPES OF DATA Finally, we include a dummy variable for whether a structural probit has been estimated (in subset I) or whether a structural earnings model has been used (in subsets V and VI). Since the practice of structural model estimation is almost uniquely present in entry and earnings studies, this control variable is omitted in our remaining subsets. A control dummy for whether a panel data set has been used or not appeared to have no effect in any of the subsets, not even the subset referring to entry-studies where the absence of panel data must imply the (often thought to be inferior) use of cross-sectional data retrieved from questionnaires that ask ex-post about individuals' labor market histories.

*Results from the meta-analysis of the effect of education on entrepreneurial outcomes*

Table 5 reports the estimates resulting from the meta-analytical models that examine the determinants of the variation in the estimated impact of educational attainment on the entrepreneurial selection and performance outcomes.

META ANALYSIS OF EFFECT OF SCHOOLING ON ENTRY (SUBSET I) The effect of being a college graduate on the probability of selection into an entrepreneurial position has several observable significant determinants. The effect is higher in the United States than elsewhere, implying an educational environment that is more conducive for entrepreneurship development. An alternative explanation, that we will test below, might be that the US offers better business conditions for entrepreneurs than elsewhere, which attracts more highly educated individuals. The effect is the same for males and females, and there are no racial differences either. The effect of education on entry increases over time indicating that the stimulus generated by schooling has increased over time.

The first equation in Table 5, panel A, furthermore shows evidence of a "publication" or "reporting" bias: a larger effect of being a college graduate on entry is associated with a higher standard deviation. The effect of the last control variable shown in the table is significantly negative: estimating a structural probit model gives rise to a lower estimate of the effect of education on entry. Thus, part of the overall education effect on entry works through income differentials (typically measured as wage earnings minus entrepreneur earnings). When discussing the policy implications of the effect of education on entrepreneurship, it is important to realize that it is the net effect, not the overall effect, that is the most important. This net effect is estimated with bias when one does not account for expected income differences.

-Insert Table 5 about here-

META ANALYSIS OF THE SCHOOLING EFFECT ON BEING AN ENTREPRENEUR (SUBSETS II AND III) We find few consistently significant determinants of the effect of schooling (college graduate and years of schooling in our second and third subset respectively) on the probability of *being* an entrepreneur, which we already labeled as kind of a hybrid measure. Only the impact factor shows up significantly positive in both columns, suggesting that more rigorous publication outlets report somewhat more positive schooling effects. We find no evidence of publication bias.

META ANALYSIS OF THE EFFECT OF SCHOOLING ON PERFORMANCE MEASURES (SUBSETS V-IX) Table 5 shows that the return to education in terms of performance is generally higher in the United States than elsewhere. This might be due to a schooling system that is more oriented towards entrepreneurship skills

and knowledge, or to better business conditions that predominantly benefit the more highly educated.

The link between education and performance seems to be comparable for men and women, and is, if anything, higher for females than for males. Non-whites or minorities benefit less from their education given the selection into an entrepreneurial position: the higher the percentage minorities in the sample, the lower the effect of education on business performance. This latter effect might be caused by the fact that the group of non-whites includes all immigrants who have pursued (part of) their education abroad with a probably smaller directly productive effect in the country of immigration.

There is evidence of an increasing trend in the return to schooling over time. Apparently, education has become more worthwhile over the years to achieve superior performance as an entrepreneur. This is in line with the dramatic shifts in industry and occupation compositions and technological advances over the last two decades, which obviously favor aspirants for entrepreneurship.

When the performance measure is earnings, rather than survival, duration, or growth, the effect of education is substantially stronger: the effect measured in subsets VIII and IX is statistically significant, and subsets X and XI show a positive effect as well, though not significant. Apparently, education is more influential with respect to earnings. In none of these subsets, the parameter estimate on $N^{0.5}$ is statistically significant. Is this evidence of publication/reporting bias? Since the effect of education on earnings appears to be positive, the statistical insignificance of $N^{0.5}$ in subsets V and VI strongly hints at publication bias: authors, referees and journal editors are less likely to publish estimates of entrepreneurial earnings equations when the effect of education is not statistically significant, regardless of the size of the sample that the author uses. The impact factor shows up with small positive parameter estimates in the performance equations (subsets IX-XI), though not significantly so.

META ANALYSIS: UNITED STATES OR COMPETITION? Finally, since we wish to understand the U.S. effect a bit better, we have replaced the U.S. dummy with a variable "WCS" which denotes the World Competitiveness Scoreboard outcome per country as found in the IMD Yearbook 2002. This country-specific number rises with improvements in infrastructure, capital market access, and business start up opportunities. The result is shown in Panel B of Table 5. It is clear from this part of Table 5 that the U.S. effect can be completely attributed to the superior competitiveness and accessibility of the U.S. market: the higher the WCS score, the greater the effect of education is on both entry and performance. Indeed, whereas the WCS score of the United States is indexed at 100, all the other countries show lower scores: the WCS score of Canada for instance is 79, Western Europe ranges from 62 (France) to 84 (Luxembourg), and Australia's value is 74.

## 7 Conclusion, evaluation and suggestions for further research

This paper's objective has been to give an overview of the literature on the relationship between entrepreneurship selection and performance on the one hand and schooling on the other hand. We quantify and summarize the existing studies by the application of meta-analysis. In this manner we examine on the basis of the available heterogeneous evidence whether and to what extent schooling is related to entrepreneurship selection and performance and what factors determine the variation of this relationship across all the studies that have been performed.

Our conclusions are the following. First, there is no evidence of a systematic relationship between an individual's schooling level and the probability of selection into entrepreneurship. This does not contradict economic theory, which points out that there are two opposing effects that education might have on entrepreneurship entry. Second, the relationship between schooling and performance is significant and positive, in line with economic theory. To formulate more precisely, the higher the schooling level or the more years of education have been pursued, the higher are the chances that performance is good. For the specific relationship between years of schooling and (log annual dollar) earnings as an entrepreneur in the United States, the average return to a year of schooling pursued is 6.1 percent. This return seems to be smaller than the usual comparable estimates for employees that are between seven and nine percent.

However, there are 21 studies in our database that permit us to examine the difference in the returns to education for entrepreneurs and for employees more closely, because they estimated the returns for both entrepreneurs and employees in comparable ways. This leads us to our third conclusion: it is not clear from these studies that the returns to education are uniformly higher for employees than they are for entrepreneurs. More specifically, all studies pertaining to Europe indicate that the returns to education are slightly lower for entrepreneurs than for employees. However, the opposite result is found for the studies that pertain to the United States.[18]

Fourth, with meta-analytical variance analysis, we assess whether the return to education is affected by certain characteristics of the studies' sample characteristics, estimation methods, publication outlets, and usage of control variables. We find evidence that the effect on both entry and earnings is higher in the

[18] By design, our database is restricted to studies pertaining to industrial countries. In developing countries, education levels are substantially lower, and entrepreneurship is a choice relative to not only wage employment and non-employment but also farming. As reported in a meta analysis by Van der Sluis, Van Praag and Vijverberg (2003), the typical rate of return to education in non-farm enterprises is about 5 percent, which is just a shade below the rate we find in this paper. As well, again similar to industrial countries, this rate is somewhat lower than the rates of return to education in wage employment in developing countries, where averages range from 7.2 percent in upper-middle-income countries to more than 11 percent in low- and lower-middle-income countries (Psacharopoulos, 1994). Unlike the situation in industrial countries, education is instrumental in selecting non-farm self-employment: the most educated workers select wage jobs; the least educated workers work on the farm; and those in between operate their own non-agricultural businesses.

United States than elsewhere, and that this effect is associated with the superior business climate that exists in the U.S. compared to other countries. The effects are no different for males than for females, and the effect of education on performance is lower for non-whites including immigrants. Furthermore, in line with expectations, the effect of schooling on entry and performance has increased over the past decades. Moreover, earnings-related performance measures are significantly more positively affected by educational attainment than are other entrepreneurial performance measures such as survival, duration or growth. Estimation methods used do matter in the instance of entrepreneurship selection: structural probit estimation that account for potential earnings differences between entrepreneurship and employment decreases the estimated effect of education on entrepreneurship entry. These conclusions must be tempered with the caution that we do find some indications that publication/reporting bias exists in studies of both entry and earnings, and that therefore the literature may be overstating the effect of education.

*Evaluation of the "State of the Art" and suggestions for further research*

The fifth and most surprising conclusion from this study is the weak state of the art of research into the effect of education on selection into entrepreneurship and performance as an entrepreneur. Though much research effort has been directed towards the issue, we have found many "white spots," issues that either have not been addressed at all or were not addressed in a satisfactory manner. We benchmark against the common practice in the returns to schooling in employment literature.

A first drawback is the lack of homogeneity in definitions used of both schooling and performance. Most researchers utilize a haphazardly designed set of dummies for specific levels of schooling in their performance and entry equations: only 35 percent of the studies uses "years of schooling" as the measure of educational attainment. The same holds true for performance: various (by themselves useful) definitions of performance are in fashion.

A second issue that should receive more attention in the literature is the role that ability and other often unobserved factors might play in determining entrepreneurial selection and performance. It is quite plausible that the "effect" of schooling that is typically estimated as being a (conditional) correlation is not completely causal: ability and other factors might increase performance and also lead to more schooling, thus potentially leading to a spurious positive effect of schooling on performance. A deeper theoretical concern is that schooling itself is endogenous to one's performance in the labor market. Although future earnings are not the only reason to pursue an education, the prospect of earning higher incomes entices many students to stay in school longer. In the established returns-to-schooling literature that focuses on wage employment, this issue is well recognized, and whenever the data permit,

researchers attempt to correct for the ability bias and the endogeneity of schooling by including measures of innate ability into the specifications, by using instrumental variables of one type or another, or by running controlled experiments (e.g., in "twins" studies). This is not at all the case in the entrepreneurship counterpart of this literature. Ability controls are hardly used, and none of the studies made reference to the endogeneity of schooling. A major challenge in entrepreneurship research will be to perform these types of analyses and to find appropriate ways to endogenize the decision to pursue schooling. Two very recent studies suggest that correcting for the endogeneity of schooling substantially increases the estimated rate of return (Parker and Van Praag 2004; Van der Sluis, Van Praag, and Van Witteloostuijn 2004).

A third observed issue is that only 12 percent of the studies that we surveyed corrected for selection biases; the vast majority paid no attention to selectivity issues. Omission of such a correction should at least be acknowledged in the type of recommendations these studies put forth.[19]

There are other lacunae in our understanding of the role of education in entrepreneurship as well. For employees, the distinction between (the effects of) general education and specific education is quite well known. In the entrepreneurship counterpart of the literature, little is known about the occurrence and effect of specific training. Related, while we found evidence from a limited number of studies that prior entrepreneurship experience of the person him-/herself or of the father of the respondent enhances the likelihood that the person pursues entrepreneurial interest, it is not clear whether the prior experience measures a particular skill set or rather preferences towards risk or working conditions.

Furthermore, we note the lack of attention that has been paid to the effect of various *types* of schooling on entrepreneurship entry and performance. It may well be true that the type of curriculum is more important than the level of schooling pursued, but this issue is considered in only a small number of studies pertaining to different countries. It is quite conceivable that both curriculum and level of schooling impact entrepreneurial outcomes through productivity (human capital theory) and sorting (screening or signaling theory; see Wolpin, 1977, and Riley, 2002). To disentangle this represents another challenge not yet addressed. Moreover, little is known about the (trends in) differences across industries of these (productive and screening) effects of education on performance. Does success as an entrepreneur nowadays require more education than in the past due to the evolution of new more advanced technologies? Did both the emergence of high tech industries and the downsizing in the traditional corporate sector open up new opportunities for highly educated individuals who formerly used to be absorbed into the large-scale industrial corporate sector? We don't know yet.

[19] A related issue that has not yet been discussed is the potential bias resulting from non-representative participation in samples. It might well be the case that more successful entrepreneurs do not take the time to fill out questionnaires, or, conversely, that poorly performing entrepreneurs are unwilling to reveal their bad state of affairs in a questionnaire. This would be an interesting issue to address.

Finally, entrepreneurship might be described as the process of bringing inputs, technologies, and output markets together. The role of education in this process is insufficiently addressed. For example, there is some agreement about the fact that entrepreneurs face a capital constraint that either hinders them to select into an entrepreneurial position at all, or that negatively affects their investment opportunities during the start-up phase of their venture (Bosma, Van Praag and De Wit, 2003). It is quite conceivable that banks and other capital suppliers use education as a means to screen prospective entrepreneurs for whom little information is observed. In these ways, education will also have an indirect effect on performance and selection into entrepreneurship. This indirect effect has only recently been modeled and estimated (Parker and Van Praag, 2004). The estimates render strong support for such an indirect effect.

To summarize, if this meta-analysis demonstrates anything, it is that, in industrial countries, the selection of entrepreneurs seems to be unaffected by the levels of formal education, whereas performance has a positive relationship with education pursued. If schooling is so positively related "even" to entrepreneurship performance, this makes a stronger case for investment in human capital through schooling (perhaps including lifelong learning) at all levels. Yet, there are many challenges left in the study of the relationship between entrepreneurship and education: in this field of research, bright days are still ahead.

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**Table 1 Definitions of Performance Used**

| | *ReducedForm* | | *Structural Model* | |
|---|---|---|---|---|
| *Performance category* | *Number* | *Percentage* | *Number* | *Percentage* |
| Earnings | 61 | 52.1 | 22 | 81.5 |
| Exit | 15 | 12.8 | 2 | 7.4 |
| Duration | 8 | 6.8 | 0 | 0.0 |
| Survival | 17 | 14.5 | 0 | 0.0 |
| Growth | 9 | 7.7 | 2 | 7.4 |
| Profit | 4 | 3.4 | 0 | 0.0 |
| Subjective | 1 | 0.9 | 0 | 0.0 |
| Employment | 2 | 1.7 | 1 | 3.7 |
| Total | 117 | 100 | 27 | 100 |

**Table 2 Definitions of Education Used**

| | *Reduced Form* | | | *StructuralModel* | | |
|---|---|---|---|---|---|---|
| | *Entry* | *Stock* | *Performance* | *Entry* | *Stock* | *Performance* |
| Years of education | 18 | 30 | 41 | 2 | 1 | 14 |
| Dummy: high school dropout | 20 | 11 | 28 | 0 | 0 | 3 |
| Dummy: high school graduate | 26 | 38 | 21 | 2 | 0 | 10 |
| Dummy: college dropout | 30 | 7 | 40 | 1 | 0 | 7 |
| Dummy: college graduate | 42 | 51 | 64 | 5 | 0 | 7 |
| Dummy: postgraduate | 19 | 6 | 27 | 2 | 0 | 1 |
| Dummy: O -levels (UK) | 3 | 1 | 8 | 1 | 0 | 3 |
| Dummy: A -levels (UK) | 3 | 14 | 8 | 1 | 0 | 3 |

**Table 3 Effects of Education on Entrepreneurship Entry and Performance**

| **Years of education** | **Entry** | **Stock** | **Performance** |
|---|---|---|---|
| % negative coefficients (t<-1.96) | 5.0% | 19.4% | 1.8% |
| % insignificant negative coefficients | 30.0% | 12.9% | 10.9% |
| % insignificant positive coefficients | 45.0% | 16.1% | 20.0% |
| % positive coefficients (t>1.96) | 20.0% | 51.6% | 67.3% |
| Total # observations (>5) | 20 | 31 | 55 |
| **High school dropout** | **Entry** | **Stock** | **Performance** |
| % negative coefficients (t<-1.96) | 10.0% | 18.2% | 25.8% |
| % insignificant negative coefficients | 60.0% | 54.6% | 51.6% |
| % insignificant positive coefficients | 10.0% | 18.2% | 12.9% |
| % positive coefficients (t>1.96) | 20.0% | 9.1% | 9.7% |
| Total # observations (>5) | 20 | 11 | 31 |
| **High school graduate** | **Entry** | **Stock** | **Performance** |
| % negative coefficients (t<-1.96) | 14.3% | 13.2% | 9.7% |
| % insignificant negative coefficients | 46.4% | 34.2% | 32.3% |
| % insignificant positive coefficients | 14.3% | 13.2% | 25.8% |
| % positive coefficients (t>1.96) | 25.0% | 39.5% | 32.3% |
| Total # observations (>5) | 28 | 38 | 31 |
| **College dropout** | **Entry** | **Stock** | **Performance** |
| % negative coefficients (t<-1.96) | 6.5% | 42.9% | 4.3% |
| % insignificant negative coefficients | 32.3% | 0.0% | 55.3% |
| % insignificant positive coefficients | 19.4% | 28.6% | 12.8% |
| % positive coefficients (t>1.96) | 41.9% | 28.6% | 27.7% |
| Total # observations (>5) | 31 | 7 | 47 |
| **College graduate** | **Entry** | **Stock** | **Performance** |
| % negative coefficients (t<-1.96) | 14.9% | 9.8% | 0.0% |
| % insignificant negative coefficients | 23.4% | 25.5% | 16.9% |
| % insignificant positive coefficients | 34.0% | 25.5% | 11.3% |
| % positive coefficients (t>1.96) | 27.7% | 39.2% | 71.8% |
| Total # observations (>5) | 47 | 51 | 71 |
| **Postgraduate** | **Entry** | **Stock** | **Performance** |
| % negative coefficients (t<-1.96) | 4.8% | 66.7% | 0.0% |
| % insignificant negative coefficients | 23.8% | 0.0% | 10.7% |
| % insignificant positive coefficients | 19.1% | 33.3% | 3.6% |
| % positive coefficients (t>1.96) | 52.4% | 0.0% | 85.7% |
| Total # observations (>5) | 21 | 6 | 28 |
| **O-level** | **Entry** | **Stock** | **Performance** |
| % negative coefficients (t<-1.96) | | | 0.0% |
| % insignificant negative coefficients | | | 36.4% |
| % insignificant positive coefficients | | | 36.4% |
| % positive coefficients (t>1.96) | | | 27.3% |
| Total # observations (>5) | 4 | 1 | 11 |
| **A-level** | **Entry** | **Stock** | **Performance** |
| % negative coefficients (t<-1.96) | | 7.1% | 0.0% |
| % insignificant negative coefficients | | 28.6% | 9.1% |
| % insignificant positive coefficients | | 57.1% | 63.6% |
| % positive coefficients (t>1.96) | | 7.1% | 27.3% |
| Total # observations (>5) | 4 | 14 | 11 |

**Table 4 Subsets of Studies Suitable for Meta Analysis**

| | | | | Size of effect | | | | |
|---|---|---|---|---|---|---|---|---|
| Subset | N(1) | Education | Entrepreneurial outcome | Average (s.d.) | %negative | %insig | %positive | N(2) |
| **A. Suitable for numerical analysis** | | | | | | | | |
| I | 40 | College grad | Entry | 0.026 (.035) | 18 | 60 | 22 | 33 |
| II | 37 | High school grad | Stock | 0.024 (.012) | 13 | 49 | 38 | 31 |
| III | 50 | College grad | Stock | 0.018 (.013) | 10 | 52 | 38 | 43 |
| IV | 21 | Years | Performance: log earnings | 0.061 (.013) | 0 | 14 | 86 | .. |
| **B. Suitable for ordinal analysis** | | | | | | | | |
| V | 37 | Years | Performance: earnings | n.a. | 0 | 11 | 89 | 34 |
| VI | 43 | College grad | Performance: earnings | n.a. | 0 | 16 | 84 | 43 |
| VII | 31 | Years | Stock | n.a. | | | | .. |
| VIII | 55 | Years | Performance: all combined | n.a. | | | | 52 |
| IX | 31 | High school grad | Performance: all combined | n.a. | | | | 31 |
| X | 47 | College dropout | Performance: all combined | n.a. | | | | 47 |
| XI | 71 | College grad | Performance: all combined | n.a. | | | | 69 |

N(1) indicates the number of studies before duplicate sources are dropped.
N(2) indicates the number of studies after duplicate sources are dropped.

**Table 5 Determinants of Effects of Schooling on Entrepreneurship**

*Panel A: country control (dummies)*

| *Subsample:* | *I* | *II* | *III* | *V* | *VI* | *VIII* | *IX* | *X* | *XI* |
|---|---|---|---|---|---|---|---|---|---|
| Effect of Dep var | College Grad. | Highs Grad. | College Grad. | Years | College Grad. | Years | Highs Grad | College Dropout | College Grad |
| Effect on | Entry | Stock | Stock | Earnings | Earnings | Perf. | Perf. | Perf. | Perf. |
| US | 0.22** | -0.18** | -0.09 | drop | 0.35 | 0.55 | 1.74* | 1.35** | 1.58** |
| | (3.4) | (2.2) | (1.2) | | (0.3) | (1.0) | (1.8) | (2.1) | (3.4) |
| % Female | 0.11 | 0.14** | 0.03 | drop | -0.34 | 4.71** | -0.23 | 0.71 | -0.56 |
| | (1.6) | (2.3) | (0.4) | | (0.2) | (2.4) | (0.3) | (0.7) | (0.9) |
| % Non-white | -0.01 | 0.00 | 0.01 | drop | -0.29** | -0.16** | -0.19** | -0.04 | -0.09** |
| | (1.1) | (0.6) | (0.4) | | (3.1) | (2.4) | (2.4) | (0.5) | (2.1) |
| Year earliest observation | 0.01** | -0.01** | 0.00 | 0.08* | -0.09 | -0.03 | 0.14** | 0.03 | 0.03 |
| | (2.7) | (3.9) | (0.8) | (1.9) | (1.3) | (1.3) | (2.7) | (0.9) | (1.0) |
| Standard deviation | 0.21** | 0.09 | -0.94 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| | (8.2) | (0.2) | (1.2) | | | | | | |
| $N^{0.5}$ | n.a. | n.a. | n.a. | drop | drop | drop | -0.01 | 0.01 | -0.01 |
| | | | | | | | (0.8) | (0.9) | (1.4) |
| Impact | 0.11 | 0.13** | 0.13** | -0.45 | drop | drop | 0.36 | 0.59 | 0.28 |
| | (1.4) | (2.9) | (2.6) | (1.3) | | | (1.2) | (0.9)) | (0.72) |
| Earnings | n.a. | n.a. | n.a. | n.a. | n.a. | 2.28** | 1.60** | 0.13 | 0.62 |
| | | | | | | (3.8) | (2.8) | (0.2) | (1.5) |
| Structural | -0.20** | n.a. | n.a. | -0.15 | -0.17 | n.a. | n.a. | n.a. | n.a. |
| | (2.3) | | | (0.2) | (0.1) | | | | |
| Sample size | 33 | 31 | 43 | 34 | 43 | 52 | 31 | 47 | 69 |
| Adj(Pseudo)$R^2$ | 0.75 | 0.46 | 0.05 | 0.21 | 0.45 | 0.38 | 0.24 | 0.09 | 0.30 |
| Method | OLS | OLS | OLS | OrdProb | OrdProb | OrdProb | OrdProb | OrdProb | OrdProb |

*Panel B: Controlled for country-specific World Competitive Scoreboard**

| *Subsample:* | *I* | *II* | *III* | *V* | *VI* | *VIII* | *IX* | *X* | *XI* |
|---|---|---|---|---|---|---|---|---|---|
| Effect of Dep var | College Grad. | Highs Grad. | College Grad. | Years | College Grad. | Years | Highs Grad. | College Dropout | College Grad |
| Effect on | Entry | Stock | Stock | Earnings | Earnings | Perf. | Perf. | Perf. | Perf. |
| WCS* | 0.01** | -0.00** | -0.00 | 0.11 | -0.00 | 0.02 | 0.00 | 0.03* | 0.04** |
| | (3.1) | (2.6) | (1.1) | (1.0) | (0.1) | (0.9) | (0.2) | (1.7) | (2.9) |
| % Female | 0.10 | 0.16** | 0.04 | drop | -0.44 | 4.43** | -0.65 | 0.54 | -0.61 |
| | (1.4) | (2.7) | (0.5) | | (0.3) | (2.4) | (0.8) | (0.6) | (1.0) |
| % Non-white | -0.01 | 0.00 | 0.00 | drop | -0.29** | -0.15** | -0.23** | -0.01 | -0.07* |
| | (1.3) | (1.4) | (0.6) | | (3.1) | (2.4) | (3.0) | (0.1) | (1.7) |
| Year earliest observation | 0.01** | -0.01** | 0.00 | 0.12 | -0.09 | -0.02 | 0.11** | 0.02 | 0.01 |
| | (2.3) | (2.7) | (0.6) | (1.6) | (1.3) | (1.1) | (2.2) | (0.6) | (0.5) |
| Standard deviation | 0.22** | 0.05 | -1.15 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| | (8.2) | (0.1) | (1.5) | | | | | | |
| $N^{0.5}$ | n.a. | n.i. | n.i. | drop | drop | drop | 0.00 | 0.01 | -0.01 |
| | | | | | | | (0.3) | (0.6) | (1.3) |
| Impact | 0.09 | 0.11** | 0.14** | -0.86 | drop | drop | -0.41 | 0.73 | 0.41 |
| | (1.2) | (3.4) | (3.5) | (1.5) | | | (0.7) | (1.2) | (1.1) |
| Earnings | n.a. | n.a. | n.a. | n.a. | n.a. | 2.28** | 1.48** | 0.50 | 0.87** |
| | | | | | | (3.8) | (2.6) | (0.8) | (2.2) |
| Structural | -0.24** | n.a. | n.a. | 2.12 | -0.50 | n.a. | n.a. | n.a. | n.a. |
| | (2.7) | | | (0.7) | (0.4) | | | | |
| Sample size | 33 | 31 | 43 | 34 | 43 | 52 | 31 | 47 | 69 |
| Adj(Pseudo)$R^2$ | 0.74 | 0.50 | 0.13 | 0.33 | 0.45 | 0.38 | 0.20 | 0.06 | 0.27 |
| Method | OLS | OLS | OLS | OrdProb | OrdProb | OrdProb | OrdProb | OrdProb | OrdProb |

* World Competiveness Scoreboard (IMD 2002)

## Appendix A: Construction of the Database

This Appendix provides detailed information on the construction of the database used for the meta analysis in this study and describes some of the features of the data.

*Database: precision, coverage, rules, and sources*

We aim at a fairly complete coverage of empirical studies that estimate a quantified relationship between entrepreneurship (entry and/or performance) and education. We impose several restrictions on studies for inclusion in the database. We only include English language primary studies that are written for an academic audience. We include studies pertaining to all industrialized countries, but we exclude studies pertaining to countries in a transition. Studies that pertain to limited parts of the population of entrepreneurs, as defined by for instance gender, age or race, are included in the sample and are marked as such.

Our first avenue of search is the Internet. We therefore consider journal articles and book chapters published as of 1980, due to the lack of studies in several key virtual databases prior to that year. We use ECONLIT and Web of Science as our primary sources for published journal articles. Web of Science includes journals with an impact factor only, a constraint that leads to the exclusion of most journals that focus on small business and entrepreneurship.

Since we want to establish the relationship between the scientific weight of a journal (as measured by its impact factor) on the one hand and the schooling-entrepreneurship relationship on the other hand, we wish to include journals of all scientific weights. We shall also examine whether the schooling-entrepreneurship relationship varies between journals belonging to different academic fields. The field of entrepreneurship research is well known for its multidisciplinary character. We therefore try to cover (and distinguish) various academic fields: economics, management, small business and entrepreneurship, human resources and labor relations, and other fields such as sociology and psychology.

Besides journal articles, we also include unpublished papers in the database. The motivation for this is twofold: it is the only way of including the most recent research output and it enlarges our sample. We consider working papers from 1997 to December 2002, the date at which we completed the construction of the database. In order to prevent double counts and to preserve independence of observations, we always check whether working papers have more recently appeared as publications (sometimes with a different title or authorship). Our primary (virtual) search engines for working papers are the SSRN (Social Science Research Network), WOPEC (WOrking Papers in EConomics), Nep-ent (an e-mail alerting services on entrepreneurship research), and working papers series of well-known research institutes such as NBER, CEPR and IZA, as well as Frontiers of Entrepreneurship Research (a published selection of papers presented at the annual Babson-Kaufmann conference on entrepreneurship that is cited

frequently).

Our second avenue of search for both published and unpublished papers is a scan through the references of each sampled paper. Furthermore, the Web of Science allows one to do a search of citations. Thus, after an article is published, it is straightforward to find all other articles (in the journals covered) that refer to the studies that were already captured in our sample. Together, these two citation search methods yield a substantial number of additional literature sources that must be inserted into the database.

Table A1 shows the resulting selection of studies. We gathered 94 studies that included at least one valid observation on either the quantified relationship between schooling and entry/selection (a transition to entrepreneurship) or the quantified relationship between schooling and performance (earnings, duration, etc.). As shown in the first summary row of the table, altogether, the 94 studies yielded 299 observations. Among these, 144 (48 percent) examine performance, 69 (23 percent) investigate entry into entrepreneurship, and 86 (29 percent) specify the dependent variable as "being self-employed." The latter is a stock (rather than flow) variable that is a hybrid of entry (everyone who is currently self-employed has entered this occupational status) and performance (it generates an overrepresentation of survivors). We therefore keep "stock studies" as a separate category (Van Praag 2002).

--Insert Table A1 about here --

Furthermore, for reasons indicated in Section 3, we distinguish structural (entry, performance and stock) studies from reduced form studies into the same relationship. Those studies labeled as "structural" attempt to incorporate at least some kind of a deliberate occupational choice of labor force participants, and it is worthwhile to compile such studies under a separate heading in order to examine the direction of the selectivity bias. Eleven percent of the observations is structural: 19% (27/(27+117)) of the performance observations, 10% (7/(7+62)) of the entry observations and a negligible proportion of stock observations.

*Characteristics of the data*

Underneath the first summary row, Table A1 shows the number of valid observations per study per research relationship of interest (either entry or performance). The table also shows to which country or country group each study pertains. The geographical distribution of studies into entrepreneurship entry and performance is summarized in Table A2. The U.S. dominates by far, contributing 56 percent of all observations. The U.K. is the country of study for 10 percent of the observations, continental Europe for 23 percent, and Australia and Canada for nine percent. Some studies pertain to various countries.

--Insert Table A2 about here --

Most studies (92 percent) include the entire working population (age group 20-65) in their samples

(not tabulated). Six percent of the studies are limited to young labor force participants/entrants and two percent to older workers. As for race, 80 percent of the studies use no clause and pertain to all races (with or without control variables to allow for different intercepts). Twelve percent of the observations are confined to white labor force participants. Eight percent of observations reflect the determinants of entrepreneurship entry and success of ethnic and minority groups, as well as of immigrants from certain geographical areas, as ethnicity is believed to affect these determinants at large (see section 5). The same holds true for gender. Ten percent of the studies are limited to females, 40 percent pertain to males, and half of the studies use both while allowing for differences through an intercept shifter.

Figure A1 shows the distribution of sample sizes across studies by type of study. The median sample size for entry studies is 9540, for stock studies 13900, for performance studies 610, and for structural studies 4760 for entry and 1545 for performance. Obviously, the median sample sizes in performance studies are small relative to the same type of studies of employees. The distribution differs somewhat over performance measures, though. The median sample size for earnings studies is 350 only, for exit studies 2615, for duration 455, and for survival (defined as the opposite of exit) 1055.

--Insert Figure A1 about here—

Table A3 characterizes the origin of the studies in the sample. 93.6 percent of the studies found have been published by today. Panel A distinguishes several types of journals in which these studies have been published: general economics journals (44.1%), labor economics and education journals (22.7%), small business and entrepreneurship journals (14.1%), management journals (2.3%) and other journals (10.0%). Structural studies are over-represented in the category of economics journals, whereas stock studies are over-represented in labor economics journals.

Besides type we also categorize journals in terms of their (2001) SSCI impact factor that we use as a measure of scientific weight or quality. Panel B shows that the majority of studies has been published in journals of rather low impact. Somewhat less than twenty percent of studies have been published in journals with an impact factor higher than 1.0. Contrary to expectations, structural studies are underrepresented in journals of higher impact and somewhat overrepresented in journals without an impact factor.

Panel C finally shows the distribution over publication years of each type of study: half of the studies have been published in 1998 or later. The table clearly shows a revived interest in the topic. No clear distinct trends pop up for particular types of studies, except that structural studies were relatively very popular in the mid 1990s.

--Insert Table A3 about here--

*Methodologies and types of data used*

There is also a substantial variation in terms of the estimation methods used (OLS, duration, or probit), the type of data used (panel or cross-section), and the processes that are treated as endogenous in the structural models. Since probit, logit and linear probability models can be easily translated into each other, we treat these methods as a single method, translate the relevant coefficients accordingly, and refer to them as 'probit'; variation in this regard is not troublesome.

Almost half of the entry studies use panel data and 'probit.' Models in the other half are mainly estimated by the same methodology on cross-sectional data (37 percent) or by multinomial logit models using panel data (10 percent). The percentage of entry studies that are based on cross-sectional data is rather high: these data must include some information on the career histories of the individuals included in the sample such that the researchers can assess who has ever started as an entrepreneur and when that was the case, so that time-varying variables can be recoded to that moment. The multinomial logit models examine the flows between various labor market states such as self-employment, wage employment, unemployment, and in some studies also, non-employment. These models are used to study, for example, the decision by unemployed workers to become self-employed or to find a new wage job.

The estimation methods used for stock-studies are not very surprising: 95 percent use probit models or variants, where the division between cross-sectional and panel data usage is two thirds to one third. Estimation methods for performance models vary across the performance measures in an expected way.

Structural models usually combine entry and performance (earnings) equations; commonly, such studies use a structural probit and an OLS-equation. The latter includes an inverse Mill's ratio, derived from the reduced form probit equation of entry, such that consistent estimates of the wage-employment and self-employment income equations result. The expected income difference for these labor market states is then finally included in the structural probit models. Most studies find significant coefficients for both the inverse Mill's ratios and the expected income difference, pointing at (positive) selection effects and incentives generated by expected income differences for occupational choices.

As mentioned earlier, only 19 percent of the performance observations and even fewer of the entry and stock observations estimate structural models. Structural models were relatively popular in the 1990s; it seems surprising that, with the threats of endogeneity bias in standard OLS analysis, the structural model has not become a standard approach.

**Table A1: Sources of the Sample**

| | *Number of observations* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Reduced Form* | | | *Structural Model* | | | | |
| *Study* | *Entry* | *Stock* | *Performance* | *Entry* | *Stock* | *Performance* | *Total* | *Country* |
| *Summary* | | | | | | | | |
| All Studies | 62 | 85 | 117 | 7 | 1 | 27 | 299 | All countries |
| *Individual Studies* | | | | | | | | |
| 1. Alba-Ramirez, 1994 | 4 | 0 | 1 | 0 | 0 | 0 | 5 | Spain, US |
| 2. Bates, 1985 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | US |
| 3. Bates, 1990 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | US |
| 4. Bates, 1995 | 6 | 0 | 0 | 0 | 0 | 0 | 6 | US |
| 5. Bates, 1999 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | US |
| 6. Bates; Dunham, 1993 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | US |
| 7. Bernhardt, 1994 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | Canada |
| 8. Blanchflower, 2000 | 0 | 16 | 0 | 0 | 0 | 0 | 16 | * |
| 9. Blanchflower; Meyer, 1994 | 2 | 0 | 2 | 0 | 0 | 0 | 4 | US,Australia |
| 10.Blanchflower; Oswald; Stutzer,01 | 0 | 3 | 0 | 0 | 0 | 0 | 3 | ** |
| 11. Blumberg; Pfann, 1999 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Netherlands |
| 12. Boden, 1996 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | US |
| 13. Boden, 1999 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | US |
| 14. Boden, 1999 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | US |
| 15. Boden; Nucci, 2000 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | US |
| 16. Borjas, 1986 | 0 | 6 | 0 | 0 | 0 | 0 | 6 | US |
| 17. Borjas; Bronars, 1989 | 0 | 4 | 4 | 0 | 0 | 0 | 8 | US |
| 18. Bosma et al, 2002 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | Netherlands |
| 19. Boyd, 1991 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | US |
| 20. Brown; Sessions, 1998 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | UK |
| 21. Brown; Sessions, 1999 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | Italy |
| 22. Bruce, 1999 | 0 | 0 | 13 | 0 | 0 | 0 | 13 | US |
| 23. Bruce, 2000 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | US |
| 24. Bruce, 2002 | 2 | 0 | 12 | 1 | 0 | 0 | 15 | US |
| 25. Bruce; Holtz-Eakin; Quinn, 2000 | 2 | 0 | 2 | 0 | 0 | 0 | 4 | US |
| 26. Bruderl; Preisendorfer, 1992 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | Germany |
| 27. Bruderl; Preisendorfer, 1998 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | Germany |
| 28. Caputo; Dolinsky, 2001 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | US |
| 29. Carrasco, 1999 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Spain |
| 30. Carroll; Mosakowski, 1987 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | Germany |
| 31. Clark; Drinkwater; Leslie, 1998 | 0 | 2 | 0 | 0 | 0 | 2 | 4 | UK |
| 32. Clark; Drinkwater, 1998 | 3 | 0 | 0 | 0 | 0 | 3 | 6 | US |
| 33. Cooper et al, 1992 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | US |
| 34. Cooper; Gimeno; Woo, 1994 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | US |
| 35. Cooper; Woo; Dunkelberg, 1988 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | US |
| 36. Cowling, 2000 | 0 | 13 | 0 | 0 | 0 | 0 | 13 | *** |
| 37. Cramer; Hartog; Van Praag, 2002 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Netherlands |
| 38. De Wit; Van Winden, 1989 | 1 | 0 | 0 | 1 | 0 | 1 | 3 | Netherlands |
| 39. Dolton; Makepeace | 1 | 0 | 0 | 1 | 0 | 1 | 3 | UK |
| 40. Dunn; Hotz-Eakin | 1 | 0 | 0 | 0 | 0 | 0 | 1 | US |
| 41. Evans, 1989 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Australia |
| 42. Evans: Jovanovic, 1989 | 1 | 0 | 2 | 0 | 0 | 0 | 3 | US |
| 43. Evans; Leighton, 1989 | 4 | 1 | 1 | 0 | 0 | 0 | 6 | US |
| 44. Evans; Leighton, 1990 | 4 | 1 | 1 | 0 | 0 | 0 | 6 | US |
| 45. Fairlie, 1999 | 2 | 0 | 2 | 0 | 0 | 0 | 4 | US |
| 46. Fairlie, 2002 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | US |
| 47. Fairlie; Meyer, 1996 | 0 | 2 | 1 | 0 | 0 | 1 | 4 | US |
| 48. Flota; Mora, 2001 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | US |

| | *Number of observations* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Reduced Form* | | | *Structural Model* | | | | |
| *Study* | *Entry* | *Stock* | *Perform ance* | *Entry* | *Stock* | *Perform ance* | *Total* | *Country* |
| 49. Fredland; Little, 1981 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | US |
| 50. Fuchs, 1982 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | US |
| 51. Gentry; Hubbard, 2000 | 1 | 0 | 2 | 0 | 0 | 0 | 3 | US |
| 52. Gill, 1988 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | US |
| 53. Gimeno; Folta; Cooper; Woo, 1997 | 0 | 0 | 2 | 0 | 0 | 1 | 3 | US |
| 54. Guiso; Sapienza; Zingales, 2002 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Italy |
| 55. Hamilton, 2000 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | US |
| 56. Hammarstedt, 2001 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Sweden |
| 57. Honjo, 2000 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | Japan |
| 58. Hout; Rosen, 1999 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | US |
| 59. Hundley, 2001 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | US |
| 60. Johansson, 2000 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Finland |
| 61. Kangasharju; Pekkala, 2002 | 0 | 2 | 4 | 0 | 0 | 4 | 10 | Finland |
| 62. Kidd, 1993 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | Australia |
| 63. Kuhn; Scheutze, 2001 | 4 | 0 | 2 | 0 | 0 | 0 | 6 | Canada |
| 64. Laferrere, 2001 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | France |
| 65. Lentz; Laband, 1990 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | US |
| 66. Lin; Picot; Compton, 2000 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | Canada |
| 67. Lofstrom, 2000 | 0 | 1 | 1 | 0 | 0 | 1 | 3 | US |
| 68. Lofstrom, 2002 | 0 | 1 | 1 | 0 | 0 | 1 | 3 | US |
| 69. Lombard, 2001 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | US |
| 70. Long, 1982 | 0 | 2 | 2 | 0 | 0 | 0 | 4 | US |
| 71. Macpherson, 1988 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | US |
| 72. Maxim, 1992 | 0 | 1 | 0 | 0 | 0 | 2 | 3 | Canada |
| 73. Meager; Bates, 2001 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | UK |
| 74. Mehta; Cooper, 2000 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | US |
| 75. Moore, 1982 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | US |
| 76. Moore; Mueller, 2002 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | Canada |
| 77. Rees; Shah, 1986 | 1 | 0 | 0 | 1 | 0 | 1 | 3 | UK |
| 78. Robinson; Sexton, 1994 | 0 | 3 | 3 | 0 | 0 | 0 | 6 | US |
| 79. Sanders; Nee 1996 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | US |
| 80. Scheutze, 2000 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | US, Canada |
| 81. Simpson; Sproule, 1998 | 0 | 2 | 0 | 2 | 0 | 2 | 6 | Canada |
| 82. Storey; Wynarczyk, 1996 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | UK |
| 83. Taylor, 1996 | 1 | 0 | 0 | 1 | 0 | 1 | 3 | UK |
| 84. Taylor, 1999 | 0 | 0 | 6 | 0 | 0 | 0 | 6 | UK |
| 85. Taylor, 2001 | 1 | 0 | 1 | 0 | 0 | 1 | 3 | UK |
| 86. Tucker, 1985 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | US |
| 87. Tucker, 1987 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | US |
| 88. Tucker, 1988 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | US |
| 89. Tucker, 1990 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | US |
| 90. Uusitalo, 2001 | 1 | 2 | 0 | 0 | 0 | 0 | 3 | Finland |
| 91. Van Praag, 2002 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | Netherlands |
| 92. Van Praag; Cramer, 2001 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | Netherlands |
| 93. Van Praag; van Ophem, 1995 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | US |
| 94. Wagner; Sternberg, 2002 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Germany |

*US, France, Belgium, Netherlands, Germany, Italy, Luxembourg, Denmark, Ireland, UK, Greece, Spain, Portugal, Norway, Austria, Sweden, Finland, Canada

** Bulgaria, Canada, Czech Republic, Denmark, East Germany, France, United Kingdom, Hungary, Israel-Arabs, Israel-Jews, Italy, Japan, New Zealand, Norway, Poland, Portugal, Russia, Slovenia, Sweden, Switzerland, United States of America

*** Portugal, United Kingdom, Austria, Sweden, Finland, Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy

**Table A2: Countries Studied**

| Observation | US | UK | Australia/ Canada | Continental Europe | All / other |
|---|---|---|---|---|---|
| Entry | 36 | 5 | 9 | 12 | 0 |
| Stock | 37 | 5 | 7 | 32 | 4 |
| Performance | 83 | 11 | 6 | 16 | 1 |
| Structural | 11 | 10 | 6 | 8 | 0 |
| Total | 167 | 31 | 28 | 68 | 5 |

**Table A3: Characteristics of Studies**

**Panel A Journal Categories of Published Studies**

| # | Ec* | | Lab* | | SB/E* | | Mng* | | WP* | | Oth* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Entry | 29 | 46.8% | 6 | 9.7% | 15 | 24.2% | 2 | 3.2% | 5 | 8.1% | 5 | 8.1% |
| Stock | 35 | 41.2% | 31 | 36.5% | 6 | 7.1% | 0 | 0.0% | 2 | 2.4% | 11 | 12.9% |
| Performance | 49 | 41.9% | 24 | 20.5% | 21 | 17.9% | 5 | 4.3% | 10 | 8.5% | 8 | 6.8% |
| Structural | 19 | 54.3% | 7 | 20.0% | 2 | 5.7% | 0 | 0.0% | 1 | 2.9% | 6 | 17.1% |
| Total | 132 | 44.1% | 68 | 22.7% | 44 | 14.7% | 7 | 2.3% | 18 | 6.0% | 30 | 10.0% |

**Panel B Impact Factors of Published Studies**

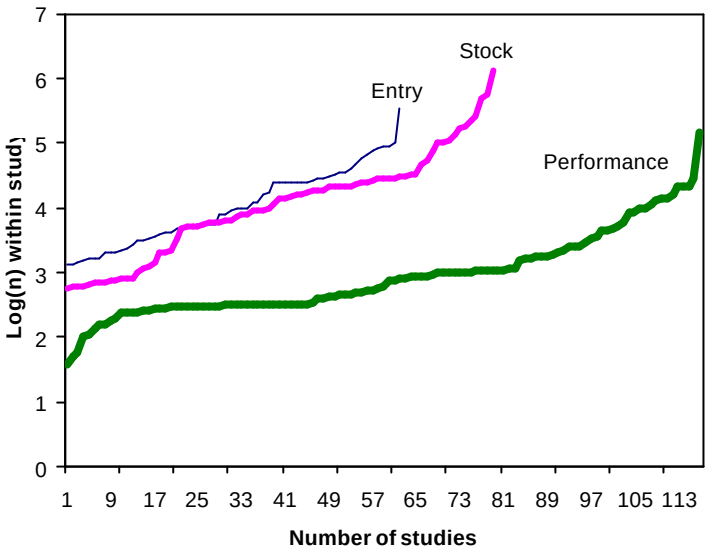
| # | >1.5 | | 1.0-1.5 | | 0.5-1.0 | | 0-0.5 | | No | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry | 7 | 12.3% | 1 | 1.8% | 19 | 33.3% | 23 | 40.4% | 7 | 12.3% |
| Stock | 8 | 9.8% | 10 | 12.2% | 10 | 12.2% | 32 | 39.0% | 22 | 26.8% |
| Performance | 13 | 12.1% | 13 | 12.1% | 33 | 30.8% | 32 | 29.9% | 16 | 15.0% |
| Structural | 1 | 3.3% | 1 | 3.3% | 9 | 30.0% | 12 | 40.0% | 7 | 23.3% |
| Total | 29 | 10.4% | 25 | 8.9% | 74 | 26.4% | 100 | 35.7% | 52 | 18.6% |

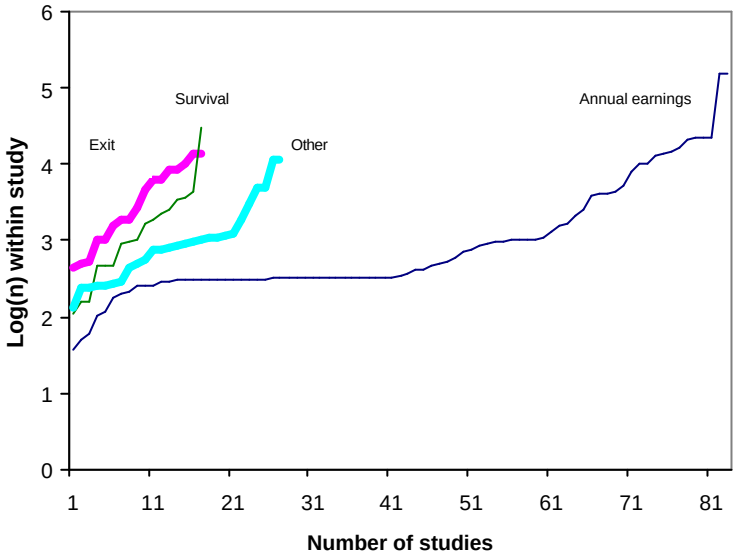
**Panel C Publication Year of Published Studies**

| # | 1980-1989 | | 1990-1993 | | 1994-1997 | | 1998-1999 | | 2000-2002 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry | 15 | 26.3% | 7 | 12.3% | 13 | 22.8% | 10 | 17.5% | 12 | 21.1% |
| Stock | 19 | 23.2% | 8 | 9.8% | 9 | 11.0% | 33 | 40.2% | 13 | 15.9% |
| Performance | 22 | 20.6% | 13 | 12.1% | 9 | 8.4% | 30 | 28.0% | 33 | 30.8% |
| Structural | 8 | 23.5% | 3 | 8.8% | 14 | 41.2% | 2 | 5.9% | 7 | 20.6% |
| Total | 64 | 22.9% | 31 | 11.1% | 45 | 16.1% | 75 | 26.8% | 65 | 23.2% |

*Ec=Economics; Lab= Labor economics; SB&E= Small Business and Entrepreneurship; Mng= Management; Wp=Working papers; Oth=Other studies.

**Figure A1: Distribution of Sample Sizes over Observations**



## Appendix B: Direct Comparisons of Entrepreneurs and Employees

**Table B1 Comparing the performance of employees and entrepreneurs**

| Author | Dependent Variable | Education | Sample | Country | Entr > Empl * | Screen** |
|---|---|---|---|---|---|---|
| Brown & Sessions 1998 | Log hourly earnings | Dummies | Male | Italy | No | No |
| De Wit & Van Winden 1989 | Log after tax earnings per hour | Years | Both | Netherlands | No | No |
| Alba-Ramirez 1994 | Log net monthly earnings | Dummies | Full time male | Spain | Equal | No |
| Brown 1998 | Log hourly earnings | Dummies | Male | UK | No | Yes |
| Rees & Shah 1986 | Log annual earnings | Years | Male | UK | No | No |
| Dolton & Makepeace 1990 | Log salary | Dummies | Both | UK | No | No |
| Taylor 1996 | Log gross hourly earnings | Dummies | Male | UK | No | No |
| Lombard 2001 | Log hourly wage | Dummies | Married women | USA | Yes | No |
| Tucker 1985 | Log annual labor income | Years | Both | USA | Yes | Yes |
| Tucker 1987 | Wage | Dummies | Male | USA | Equal | Yes |
| Evans & Leighton 1990 | Log earnings | Years | Male | USA | Yes | No |
| Fredland & Little 1981 | Earnings | Years | Male | USA | Yes/Equal | Yes |
| Lofstrom 2002 | Weekly wage | Years | High immigrant sample | USA | Yes | No |
| Fairly & Meyer 1996 | Log fulltime earnings | Dummies | High immigrant sample | USA | Yes | No |
| Robinson & Sexton 1994 | Annual earnings | Years | Both | USA | Yes | No |
| Macpherson 1988 | Hourly wage | Years | Married women | USA | Yes | No |
| Borjas & Bronars 1989 | Log weekly income | Dummies | High immigrant sample | USA | Yes | No |
| Gill 1988 | Log hourly wage | Years | Both | USA | Yes | No |
| Moore 1982 | Annual earnings | Years | Both | USA | Yes | No |
| Simpson & Sproule 1998 | Log of pre-tax annual earnings | Dummies | Both | Canada | Yes | No |

*This column denotes whether the education coefficient is larger for entrepreneurs than for employees or not
**This column denotes whether the screening hypothesis is tested explicitly

## Appendix C: The Impact of Control Variables

Appendix C shows the most commonly used control variables within the gathered studies and their effects. We investigated whether the inclusion of these variables in the observed studies affected the effect of schooling on entry, stock, and performance: quod non.

*Control variables*

To supplement the description of the education/entrepreneurship nexus in the literature, let us briefly turn to a summary of the impact of the control variables used in the various studies. Table C1 shows the most common control variables used (column 2) as well as the number of observations that uses them (column 3) and the signs of the resulting estimates (columns 4 to 7). Controls are tabulated whenever the estimated effect of the control is reported in more than 5 studies. However, we make an exception to this rule for ability, which is an important but rarely used control variable, in contrast with the comparable literature on wage employees where approximately 20 percent of studies use ability controls (Ashenfelter et al., 1999).

As in the regular returns-to-schooling literature, the Mincerian variables age and (self-employment) experience are very frequently used, as are marital status, gender, and race.[20] The distinction between general and self-employment experience, which is somewhat akin to specific human capital, is made in some studies but could clearly receive more attention. Note that prior self-employment experience is not used in entrepreneurship stock studies, since it is an improper determinant of stock. It has been used on occasion in entry studies. Health status appears in some studies. The use of parental background variables is usually limited to father's self-employment, if it is included at all.

The last four columns of the table summarize the impact of these control variables on entrepreneurial outcomes. The general picture is described as follows. Males are more likely to become self-employed and to succeed as such. Age is commonly modeled in a non-linear fashion, as "age squared" has frequently been included. Therefore, for those studies we have also calculated the marginal effect of age at age 30. The relationship of age with each outcome variable tends to have an inverted U-shape, but the marginal effect at age 30 is ambiguous with respect to performance and stock and positive only with respect to entry. People with a minority ethnic background are somewhat less inclined to start as entrepreneurs, but there is no significant evidence that they perform poorly relative to those not labeled as an ethnic minority. People with a handicap or who are in bad health do not have a significantly different probability to become self-employed, though success is clearly harder to achieve.

[20] As elaborated in the next section, Table C1 in fact understates the concerns in the literature with gender and race, since a number of the studies analyze the entrepreneurial outcomes among specific gender and race subsamples.

In line with common wisdom, people with a self-employed father are more likely to become an entrepreneur. However, they are not more likely to be successful, as is sometimes thought and seldom found: this informal type of experience is hardly productive. Parental self-employment may therefore be less an indicator of informal experience and more a measure of a certain preference for risk and working conditions such as, for instance, freedom of operation, decision making, working hours, and type of obligations. Prior self-employment experience appears to have no impact on performance. In the five studies on entry that used this variable (not tabulated), it always increases the probability to enter; in this way, it seems to measure the same kinds of underlying factors as parental self-employment. The lack of impact on entrepreneurship performance of "self-employed father" and "former self-employment" may raise the question if entrepreneurship, much like creativity, can be nurtured and developed through education. General work experience, on the contrary, increases both the probability of entry and success.

-Insert Table C1 about here-

**Table C1 Effect of Control Variables on Entrepreneurial Outcomes**

| entrepreneurial outcome | variable | number of studies | % negative coefficients (t<-1.96) | % insignif. negative coefficients | % insignif. positive coefficients | % positive coefficients (t<-1.96) |
|---|---|---|---|---|---|---|
| Entry | Male | 28 | 7.1% | 0.0% | 14.3% | 78.6% |
| Stock | Male | 42 | 2.4% | 7.1% | 16.7% | 73.8% |
| Performance | Male | 41 | 4.9% | 17.1% | 14.6% | 63.4% |
| Entry | Age | 44 | 4.5% | 13.6% | 11.4% | 70.5% |
| Stock | Age | 66 | 3.0% | 9.1% | 9.1% | 78.8% |
| Performance | Age | 76 | 7.9% | 46.1% | 15.8% | 30.3% |
| Entry | Age squared | 36 | 63.9% | 13.9% | 13.9% | 8.3% |
| Stock | Age squared | 41 | 58.5% | 17.1% | 17.1% | 7.3% |
| Performance | Age squared | 64 | 25.0% | 57.8% | 12.5% | 4.7% |
| Entry | Age effect at 30 | 36 | 27.8% | 12.1 | 10.1% | 50.0% |
| Stock | Age effect at 30 | 41 | 36.6% | 13.4 | 13.4% | 36.6% |
| Performance | Age effect at 30 | 63 | 17.5% | 50.9 | 17.3% | 14.3% |
| Entry | Married | 51 | 11.8% | 19.6% | 27.5% | 41.2% |
| Stock | Married | 49 | 8.2% | 22.4% | 20.4% | 49.0% |
| Performance | Married | 53 | 7.5% | 32.1% | 32.1% | 28.3% |
| Entry | Ethnic minority | 19 | 36.8% | 26.3% | 26.3% | 10.5% |
| Stock | Ethnic minority | 12 | 83.3% | 8.3% | 8.3% | 0.0% |
| Performance | Ethnic minority | 36 | 22.2% | 44.4% | 13.9% | 19.4% |
| Entry | Disabled | 12 | 16.7% | 50.0% | 25.0% | 8.3% |
| Stock | Disabled | 22 | 4.5% | 31.8% | 31.8% | 31.8% |
| Performance | Disabled | 25 | 52.0% | 16.0% | 28.0% | 4.0% |
| Entry | Self-employed father | 10 | 10.0% | 0.0% | 10.0% | 80.0% |
| Stock | Self-employed father | 4 | | | | |
| Performance | Self-employed father | 17 | 11.8% | 41.2% | 35.3% | 11.8% |
| Entry | Self-Employment experience | 5 | | | | |
| Stock | Self-Employment experience | 0 | | | | |
| Performance | Self-Employment experience | 25 | 16.0% | 36.0% | 36.0% | 12.0% |
| Entry | Employment experience | 18 | 11.1% | 5.6% | 38.9% | 44.4% |
| Stock | Employment experience | 14 | 0.0% | 0.0% | 7.1% | 92.9% |
| Performance | Employment experience | 48 | 8.3% | 10.4% | 35.4% | 45.8% |
| Entry | Ability | 4 | 0.0% | 50.0% | 50.0% | 0.0% |
| Stock | Ability | 0 | | | | |
| Performance | Ability | 4 | 0.0% | 0.0% | 50.0% | 50.0% |