If You Are So Smart, Why Aren't You an Entrepreneur? Returns to Cognitive and Social Ability: Entrepreneurs Versus Employees

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How valuable are cognitive and social abilities for entrepreneurs' relative to employees' earnings? We answer three questions: (1) To what extent does a composite measure of ability affect an entrepreneur's earnings relative to wages earned by employees? (2) Do different cognitive abilities (e.g., math ability,

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language, or verbal ability) and social ability affect earnings of entrepreneurs and employees differently?, and (3) Does the balance in these measured ability levels affect an individual's earnings? Our (difference-of-difference) estimates of the returns to ability for spells in entrepreneurship versus wage employment account for selectivity into entrepreneurial positions insofar as they are determined by fixed individual characteristics. Our robust results provide the following answers to the three questions: General ability has a stronger impact on entrepreneurial incomes than on wages. Moreover, entrepreneurs and employees benefit from different sets of specific abilities: verbal and clerical abilities have a stronger impact on wages, whereas mathematical, social, and technical ability are more valuable for entrepreneurs. The balance in the various kinds of ability also generates a higher income, but only for entrepreneurs: This finding supports Lazear's Jack-of-all-Trades theory.

1. Introduction

Starting up and running a business, as any labor market activity, allows an individual to exploit his or her personal characteristics in a particular way. Education, general ability, and specific types of ability may all have their value in the complex operations involved in entrepreneurial activities. Many (classic) economists, most notably Marshall, have stressed the relevance of general and specific abilities for succeeding as an entrepreneur.[1]

Recently, a literature has revived that measures the effects of cognitive and noncognitive abilities of individuals on their labor market performance (and other outcome variables).[2] Both cognitive and noncognitive abilities have a marked effect on labor market performance. However, the evidence is mostly limited to employees. There is a separate but less developed literature for entrepreneurs, and seldom the twain have met. Bringing them together is interesting for its own sake and for highlighting any differences between distinct but related markets: A combined analysis of entrepreneurs and employees enables a comparison of the *relative* value of abilities for the performance of entrepreneurs and employees. The only performance measure available

1. A discussion of the measurement of the returns to education is beyond the scope of this paper, we only focus on abilities. However, as we shall argue, measuring the effect of abilities on incomes requires acknowledging education as a channel for the effect of abilities, and we will do so. Van der Sluis, Van Praag, and Van Witteloostuijn (2005) and Van der Sluis and Van Praag (2007) focus on education and show that the returns to education are consistently higher for entrepreneurs than for employees. Our results will turn out consistent with these findings.

2. See Section 2. Borghans et al. (2008) note that the contrast between cognitive and noncognitive ability may have intuitive appeal but "creates the potential for much confusion because few aspects of human behavior are devoid of cognition." Nevertheless, the "contrasting" terminology is widely used.

for both groups and thereby allowing such a comparison, albeit with some limitations (Hamilton, 2000), is the individual's income.[3] This paper, therefore, aims at comparing the effects of measured cognitive and noncognitive abilities on incomes for entrepreneurs versus wage employees.

In particular, we analyze three questions: (1) To what extent does a composite measure of ability affect incomes for entrepreneurs and salaried employees? (2) Do distinct measures of cognitive abilities (e.g., verbal ability, mathematical ability, technical ability, and administrative ability) and noncognitive (social) ability affect incomes of entrepreneurs and employees differently?, and (3), inspired by Lazear's Jack-of-all-Trades theory (2005) of entrepreneurship, to what extent does the balance in these measured ability levels affect entrepreneurs' and employees' incomes differently?

To address these novel questions, we incorporate measures of ability into Mincerian income equations using panel data from the National Longitudinal Survey of Youth 1979–2000. This data set is particularly apt for the task at hand. It includes a number of distinct measures of specific abilities administered at early ages (15–23 years old), when respondents have probably not yet been affected by labor market activities. Moreover, the panel character of the data set allows us to estimate the differential returns to abilities in entrepreneurship versus wage employment spells by means of a differences-of-differences regression approach where we control for individual fixed effects. Thus, we can account for self-selection based on unobserved individual characteristics that are time-invariant (see Section 3.2). Finally, survivorship bias is limited thanks to the (bi)annual (panel) data collections about labor market activities and sources of income in the past period (see Section 3.1).

Our results indicate markedly different returns to ability for entrepreneurs and employees. General ability has a higher payoff in entrepreneurship. The same individual has a 30% higher return to general ability when active as an entrepreneur than when working as an employee. As the measure of general ability is a weighted average of measured specific abilities, it is interesting to assess which specific abilities render the returns to general ability in an entrepreneurial spell higher than in a spell in wage employment. As it turns out, it is, in particular, the science-oriented part of the set of abilities that generates higher returns. Especially technical and, to a lesser extent, mathematical ability are more lucrative in entrepreneurship than in

3. Income is a commonly used performance measure for entrepreneurs, see the meta-analysis by Van der Sluis et al. (2008). The meta-analysis further shows a close correspondence between (levels and determinants of) income and other performance measures for entrepreneurs, such as profit and survival.

wage employment. In addition, social ability benefits entrepreneurial incomes more than wages. The other measured abilities, that is, verbal ability and, in particular, clerical ability have better payoffs as an employee. The third analysis in this paper assesses the validity of Lazear's Jack-of-all-Trades theory. In support of this, we find that a more balanced portfolio of individual ability levels boosts earnings as an entrepreneur, while it leaves earnings as an employee unaffected.

The results, which survive various robustness checks, suggest that, if occupational choices were based on expected earnings differentials, higher levels of general, math, technical and social abilities, and more balanced portfolio's of abilities would all favor the choice for entrepreneurship, whereas higher levels of clerical and verbal abilities would stimulate the choice for wage employment. However, we observe a discrepancy between the drivers of occupational choice and the determinants of the premium income as an entrepreneur versus a wage employee. This observed discrepancy is in line with the evidence collected in support of the "returns to entrepreneurship puzzle." Despite longer working hours and more variable and often lower incomes, people choose to become and remain entrepreneurs and turn out more satisfied as such (Benz and Frey, 2008; Blanchflower and Oswald, 2008; Hamilton, 2000; Hyytinen et al., 2008; Parker, 2004; Van Praag and Versloot, 2007). Entrepreneurship choices are not primarily driven by income maximization.

Our study fits neatly in the empirical literature of occupational choices between entrepreneurship and wage employment and the drivers of performance in each of these "occupations" (e.g., Parker, 2004 for an overview). Many studies have focused on the effects of human capital (Van Der Sluis et al., 2008), most notably the levels of education and experience or the balance in the portfolio's of these (e.g., Lazear, 2005). To the best of our knowledge a systematic study of the returns to (the levels of and balance in) general and specific abilities in entrepreneurship vis-à-vis wage employment is novel.

Some limitations pertain to our study. We consider the self-employed and owner/managers of incorporated firms as the empirical equivalent of the entrepreneur.[4] We acknowledge the limitations of this definition, also including, for instance, independent shopkeepers and bookkeepers, in the set of entrepreneurs. Moreover, not all entrepreneurial activities take place in (newly founded) firms, initiated by their founders. Entrepreneurship in general refers to a type of

4. Thus, entrepreneurs in our sample are not necessarily founders, they may as well have bought an existing business. We presume that the majority will be founders, however. Parker and Van Praag (2010) calculate that 83% of the entrepreneurs in their representative Dutch sample have started up a firm whereas only 17% acquired their entrepreneurial positions through takeover of a (family) firm.

behavior: (pro-)active, innovative, dynamic. In this sense, one can be entrepreneurial both as an employee and as a business owner (Parker, 2004, 2010). Entrepreneurial behavior also implies choosing one's own actions, of acting on one's own account and responsibility. This dimension is usually captured in empirical studies by identifying business owners (self-employed and owner/managers of incorporated firms) as entrepreneurs. We define entrepreneurs accordingly.

The data set poses some other unavoidable challenges. For instance, ability measures administered at different ages and education levels within this age range are incomparable (Heckman et al., 2006). Age affects measured ability, whereas the causality of the relationship between education and measured ability goes both ways: "schooling causing test scores and test scores causing schooling" (Hansen et al., 2004, p. 40). Therefore, we develop and employ two sets of ability measures. Both control for the effect of age at measurement, whereas one does not control for the effect of education at measurement and the other does. The resulting estimates render upper and lower bounds of the returns to true ability, see Section 3.

Moreover, based on related studies, albeit for employees only, we acknowledge that separating the effect of ability on income from education effects is hard (Roberts et al., 2000; Cawley et al., 2001; Tobias, 2003). Another limitation is that there is no way of ensuring the comparability of the measurement of entrepreneurial and wage incomes (see Fairlie, 2005; Parker, 2004). In this respect, our study is no exception in the empirical literature, and it will be problematic only insofar as the possibly distinct ways of measurement affect the returns to ability. Moreover, little theory has been developed to guide empirical analysis of the value of abilities for entrepreneurs relative to employees and we do not contribute to a theoretical perspective ourselves.[5] The only exception is Lazear (2005) on the relative value of a balanced set of abilities for entrepreneurs vis-à-vis employees. Although we thus believe that our approach has some strengths and certainly novelty, it is not without limitations.

The remainder of this text is structured as follows. Section 2 discusses the measurement of ability and its previously established—or sometimes just postulated—role for labor market outcomes of wage employees and entrepreneurs. Section 3 discusses the data and how we employ them for the analysis. In Section 4, we present the results of the empirical analysis. Section 5 concludes.

5. The most general model addressing the relevance of abilities for economic performance is the matching or assignment model, but it does not explicitly distinguish between entrepreneurs and employees (see the survey in Hartog, 2001).

2. Abilities

Since the beginning of the measurement of intelligence, psychologists have always been divided on the nature of cognitive ability. Alfred Binet, who developed the first instrument to measure differences in child intelligence, assumed that intelligence was essentially unitary, that is, intelligence is one overriding quality that helps an individual deal with the environment (Binet and Simon, 1911). Thorndike (1904) opposed the idea of one overriding factor and acknowledged the existence of specific abilities only. Besides these two extreme viewpoints, two early streams acknowledge both. Spearman (1904) concludes that intelligence can be divided into a general factor and specific factors of which one or more have an additional influence on the ability to perform specific activities. Thurstone and Thurstone (1941) and Carrol (1993) represent the second stream by positing that general ability is a (linear) combination of various specific abilities.

We take an eclectic approach and, driven by the data, follow Thurstone and Thurstone (and Carrol) by assuming that general ability is a weighted sum of the individual's scores on specific abilities. Besides specific cognitive abilities, we analyze the (additional) effect of specific noncognitive abilities, inspired by a recent stream of research (e.g., Borghans et al., 2008; Heckman and Rubinstein, 2001; Heckman et al., 2006; Mueller and Plug, 2006).

2.1 General Ability

Economists and psychologists have shown ample evidence that general (cognitive) ability affects economic and social outcomes markedly (e.g., Borghans et al., 2008; Gottfredson, 2002; Heckman et al., 2006; Hernstein and Murray, 1994; Cawley et al., 2001).[6]

As noted in the introduction, there is no systematic empirical evidence on the relative role of general ability for the labor market outcomes of entrepreneurs vis-à-vis employees.[7] The claims by classic economists that general and specific abilities are required for successful entrepreneurship have thus not been tested, as yet. Most notably, Marshall claimed, in 1890, that general ability and intelligence "are required to enable one to attain great success in any pursuit and especially in business." Marshall defined general ability as:

6. Cawley et al. analyze the same data set as we do, but only consider wage employees.

7. Van Praag and Cramer (2001) find a significant positive effect of general intelligence on the performance of entrepreneurs (measured by venture size). Their study allows no comparison between entrepreneurs and employees. De Wit and Van Winden (1989) estimate an insignificant effect of general intelligence on income for both entrepreneurs and employees.

> To be able to bear in mind many things at a time, to have everything ready when wanted, to act promptly and show resource when anything goes wrong, to accommodate oneself quickly to changes, to be steady and trustworthy, to have always a reserve of force ... Marshall (1890, 1930, pp. 206–207).

This definition is remarkably similar to the definition of intelligence (or cognitive ability) proposed by an official taskforce of the American Psychological Association (APA): the "ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by taking thought" (Neisser et al., 1996, p. 77 [taken from Borghans et al., 2008]). We will test Marshall's claim that general ability is required for success, *especially in business.*

Horn and Cattell (1966) distinguish, based on their earlier work, between fluid and crystallized general intelligence. Fluid intelligence is abstract, adaptive intelligence used for solving new problems, and measured by tests that minimize the role of cultural knowledge. Crystallized intelligence, on the other hand, that has an applied character, is the ability to use skills and knowledge and is measured by tests that maximize the role of cultural knowledge. Roberts et al. (2000) conclude that the APA-based construct of general intelligence that we will use, that is, the Armed Services Vocational Aptitude Battery (ASVAB), coincides with crystallized rather than fluid intelligence, thus reflecting acculturated learning. It is hard to differentiate this kind of general ability from the effects of an individual's acquired education (Roberts et al., 2000; Cawley et al., 2001 and Tobias, 2003) because "Measured cognitive ability and schooling are so highly correlated that one cannot separate their effects without imposing strong, arbitrary parametric structure in estimation which, when tested, is rejected by the data." (Cawley et al., 2001, p. 419). We shall thus pay careful attention to this differentiation in our empirical approach.

2.2 Specific Abilities

As the assignment literature stresses, jobs are different sets of activities that provide opportunities for exploiting particular abilities. Entrepreneurship forms no exception. Among economists, Marshall was the first who stressed the importance of various specialized abilities for achieving successful entrepreneurship. The recent management literature has pursued the idea that certain (noncognitive) abilities (e.g., social ability) are relatively important for entrepreneurs (Baron, 2000;

Baron and Markman, 2003; Hmieleski and Ensley, 2004). However, little empirical evidence has supported such ideas so far.[8]

From the NLSY79, we extract five specific and distinct abilities, see Section 3: (i) Verbal ability; the knowledge to understand and process written material; (ii) Mathematical ability; the knowledge to perform mathematical calculations and logical thinking; (iii) Technical ability; the ability to understand physical and mechanical principles; (iv) Clerical ability or coding speed; the ability to process information quickly; and, finally (v) Social ability; the ability to form social contacts. The effects of all these abilities have been studied in various contexts (but not in their relative value for entrepreneurs and employees).

To date, the results on *verbal* ability have been ambiguous. Verbal ability is reported to have no value (Paglin and Rufolo, 1990; Dougherty, 2000), a negative impact (Bishop, 1991a), and sometimes a positive effect on labor market outcomes (Hause, 1972). Nonlinearities may be at play here (Dougherty, 2000; McIntosh and Vignoles, 2001). *Mathematical* ability has received most attention from researchers and returns are mostly found to be significantly positive (Taubman and Wales, 1974; Willis and Rosen, 1979; Paglin and Rufolo, 1990; Murnane et al., 1995; McIntosh and Vignoles, 2001). A minority of studies reports an insignificant or even negative return to math ability (Hause, 1972; Bishop, 1991a). Evidence on a positive impact of *technical* ability on income comes from Blackburn and Neumark (1993), but only for employees. *Clerical* ability has almost entirely been neglected. Exceptions are Bishop (1991a) and Murnane et al. (2001) who used the NLSY79 to find that clerical ability enhances employees' performance. The last type of ability we consider is noncognitive, that is, *social* ability. As Heckman and Rubinstein (2001) claim: "No single factor has yet emerged to date in the literature on noncognitive skills, and it is unlikely that one will ever be found, given the diversity of traits subsumed under the category of noncognitive skills." We pick social ability as it is receiving increasing attention in entrepreneurship research. Various studies have shown that the ability to disentangle patterns of social relationships and deal with social relationships accordingly has a positive influence on entrepreneurs' performance (Hartog, 1980; Baron, 2000; Wong and Law, 2002; Baron and Markman, 2003). Baron and Markman (2003) suggest that social ability is more important for the performance of entrepreneurs than of employees because entrepreneurs must interact with many different persons inside and outside the firm in environments that are often unstructured and uncertain. They find indeed that social perception, adaptability and

8. One reason for this is probably the lack of data. Most representative data sets do not include any measures of specific abilities and there are few data sets that include both entrepreneurs and employees as well as comparable measures of their labor market performance.

expressiveness are important determinants of entrepreneurial performance. Their analysis excludes employees.

2.3 Balanced Abilities

Recently, Lazear (2005) has developed a theory proposing that individuals with a balanced set of competencies across different fields, that is, "Jacks-of-All-Trades" (JATs), are more apt for entrepreneurship than those who have unbalanced sets of competencies, that is, specialists. In this view, employees may be specialists, but entrepreneurs require a broad set of competencies and are as strong as the level of their weakest skill.[9] Employees are the pawns in the division of labor, employers organize this division.

Empirical evidence supporting this theory has been provided by Lazear himself (2005), and Wagner (2003) and Silva (2007):[10] JATs have a higher probability of becoming an entrepreneur. "JAT" measures are based on individuals' choices of schooling curriculum and the variety of their job experience. Of course, curriculum and job variety may be endogenous to the decision to become an entrepreneur.

We modify Lazear's test in three ways. First, we use an alternative measure of JAT. We use the balance in an individual's scores across the five measures of specific abilities, measured at a relatively young age. This measure is probably not influenced by the anticipated decision to become an entrepreneur or by the anticipated relative earnings as such, and thereby does not suffer from endogeneity and unclear causality. Second, we do not focus on the *selection* into entrepreneurship, but rather on the *performance* of entrepreneurs relative to employees. The JAT theory states that JATs have a comparative advantage as entrepreneurs. A relevant way of testing this is measuring whether being a JAT has a more positive effect on the performance of entrepreneurs than of employees. Third, we study the JAT–performance relationship across the entire schooling distribution, unlike Lazear and Silva who both study samples from the top part of the schooling distribution.

3. Data and Methodology

3.1 Data

Empirical answers to our central questions are obtained by incorporating measures of ability into Mincerian income equations using panel data from the (representative part of) the National Longitudinal Survey of Youth (NLSY) 1979–2000 consisting of 6,111 individuals

9. Team entrepreneurship is an exception.
10. Astebro and Thompson (2007) test the theory and report no support.

aged between 14 and 22 years in 1979.[11] They have been interviewed annually up to 1994, and since then on a biannual basis. The maximum number of observations per individual is 19. Within each observed year, our sample selection includes all persons who are entrepreneurs or employees (defined below), while excluding students and people who are unemployed or otherwise not working. Given this selection criterion and omitting missing person–year observations, the resulting sample includes, on average and per annum, 4,500 entrepreneurs/employees, leading to a total number of person–year observations of almost 50,000. The average number of year-observations per individual is 11. In what follows, we first define the key variables, that is, our measures of ability levels and dispersion, occupational status, and incomes. We then present the descriptive statistics of both the key and control variables and discuss the empirical methodology.

3.1.1 Abilities Measured

The NLSY contains information on cognitive test scores derived from the Armed Services Vocational Aptitude Battery (ASVAB) administered in 1980 at age 15–23. The ASVAB is a test developed by the U.S. Department of Defense in the 1960s and used for recruiting purposes. It was added to the NLSY questionnaire with the purpose of generating a benchmark intelligence measure representative of the total USA population. The measure correlates strongly with other intelligence tests that are frequently used, such as the Otis-Lennon Mental Ability test and the Lorge–Thorndike Intelligence Test (Frey and Detterman, 2003). The ASVAB is highly rated among vocational psychologists and counselors. Ryan Krane and Tirre (2004, p. 346) write: "The ASVAB is distinguished by superior norms, a thorough investigation of test fairness and unsurpassed criterion related validity data." Bishop (1991b, p. 5) cites an authority on educational and psychological testing to note that data from the NLSY responses to the ASVAB are " . . .free from major defects such as high levels of guessing or carelessness, inappropriate levels of difficulty, cultural test-question bias, and inconsistencies in test administration procedures." Ryan Krane and Tirre also note that ". . . factor analysis of an earlier form of ASVAB suggests that it measures general cognitive ability, a verbal-mathematical ability, clerical speed and technical knowledge" and that it is "heavily g-saturated." As discussed, Roberts et al. (2000) conclude that this g is mostly crystallized ability.

Our set of specific abilities consists of four of the ten measures of cognitive abilities included in the ASVAB: (i) language or verbal ability measured by "paragraph comprehension"; (ii) mathematical

11. This is the original sample of 12,686 individuals minus the supplementary military and minority samples.

ability measured by "mathematical knowledge"; (iii) technical ability measured by "mechanical comprehension"; and (iv) clerical ability measured by "coding speed."[12] Aiming at including a varied set of abilities into the analysis, these four measures have been selected out of the ten available measures such that a reasonable number of measures can be used with minimal correlation levels between each of them. The resulting upper limit on correlation is 0.60 (The correlation matrix is available upon request from the authors).

The noncognitive specific ability measure we use, social ability, is formed by a measure of sociability at age six, measured by recall in the NLSY in 1980. Respondents were asked, "Thinking of yourself when you were 6 years old, would you describe yourself as: (1) extremely shy; (2) somewhat shy; (3) somewhat outgoing; or (4) extremely outgoing?"[13] This leaves us with five specific ability measures in total.

As was discussed in the introduction, ability measures taken at different ages and education levels within this age range are incomparable (Heckman et al., 2006). Age affects measured ability, whereas the causality of the relationship between education and measured ability is: "schooling causing test scores and test scores causing schooling" (Hansen et al., 2004, p. 40). Therefore, we develop two sets of the ability measures. The first set is calculated as the residual when regressing each measure on a set of age dummies in 1980 at the time the test was taken. We refer to this as "*ability | age*." The second set is formed by the residuals when regressing each measure on a set of age and education dummies in the year 1980 (cf. Blackburn and Neumark, 1993), "*ability | age + schooling.*" Both sets of (corrected) ability measures are not truly exogenous (innate endowments) because they are clearly affected by childhood rearing. But they are unlikely to be affected by future entrepreneurship status or prospects. The correlation levels between these five used measures are shown in Table I, both without (Panel A) and with (Panel B) correction for education.

A composite score of general ability is constructed from the (corrected) ASVAB sections including social ability by means of factor analysis (as in Cawley et al., 2001). Again, two scores are calculated, one based on *ability | age* and the other on *ability | age + schooling*. Table I shows the correlation between these composite measures of general ability and the specific ability measures. The correlation with

12. Other measured abilities in the ASVAB are: (v) general science, (vi) arithmetic reasoning, (vii) word knowledge, (viii) numerical operations, (ix) auto and shop information, and (x) electronic information.

13. The distribution of answers over these categories is 19, 43, 26, and 12%, respectively. Borghans et al. (2005) use the same sociability measure from the NLSY when studying determinants of task assignment and the effect of tasks involving personal interaction on wages.

Table I. Correlations Between the Used Measures for General Ability, Specific Abilities, Spread in Abilities and Education

Correlation Coefficients	1.	2.	3.	4.	5.	6.	7.	8.
Panel A: Ability measures without controls for education level at the time of the test (1980)								
1. General ability	1.000							
2. Verbal ability	0.856	1.000						
3. Math ability	0.861	0.664	1.000					
4. Technical ability	0.748	0.554	0.607	1.000				
5. Clerical ability	0.683	0.559	0.523	0.336	1.000			
6. Social ability	0.154	0.086	0.064	0.052	0.057	1.000		
7. Spread in abilities	0.022	0.021	0.004	0.021	0.028	0.002	1.000	
8. Education	0.582	0.487	0.616	0.349	0.382	0.085	0.000	1.000
Panel B: Ability measures with controls for education level at the time of the test (1980)								
1. General ability	1.000							
2. Verbal ability	0.839	1.000						
3. Math ability	0.857	0.643	1.000					
4. Technical ability	0.702	0.494	0.557	1.000				
5. Clerical ability	0.633	0.506	0.487	0.235	1.000			
6. Social ability	0.151	0.081	0.056	0.053	0.047	1.000		
7. Spread in abilities	0.016	−0.001	0.016	0.011	0.035	−0.041	1.000	
8. Education	0.420	0.331	0.470	0.267	0.212	0.084	0.005	1.000

Notes: The correlation levels have been calculated while using 1 year of observations.

social ability is low and explains why the results from our analyses remain the same when excluding social ability from the composite measure.[14] The composite score approximates the standard Armed Forces Qualifications Test (AFQT) score that is included in the NLSY. The results are the same when using that score.[15]

To test Lazear's JAT theory, a measure of the balance in the specific measured ability levels is required. The coefficient of variation of the individual scores on the five corrected measures of specific abilities will serve as an inverse measure of balance.[16] Unlike Lazear, we do not use

14. These results are not shown and can be obtained from the authors.

15. "The AFQT is a general measure of trainability and a primary criterion of eligibility for service in the armed forces. It has been used extensively as a measure of cognitive skills in the literature" (Heckman et al., 2006, p. 415). The results upon replacing the ASVAB based measure of general ability with the AFQT score can be obtained from the authors.

16. The balance in abilities is possibly also (negatively) affected by an individual's age and education at the time of the test. However, based on insignificant correlation

the variance as a measure of spread because it is a function of the means of the specific ability measures. Table I shows indeed that the correlation between the measure of spread, based on the coefficient of variation, and all ability scores is low.

Finally, to facilitate interpretation of the regression coefficients, we have standardized all ability variables (including the coefficient of variation): we subtracted the mean and divided by the standard deviation. Panel A of Table II shows the descriptive statistics of the two sets of standardized ability measures, separately for spells in entrepreneurship and paid employment. The different average scores of the two groups and the issue of selectivity will be discussed in Section 3.2 along with the rationale of using these two "corrected" sets of ability measures.

3.1.2 Occupational Status Measured

As noted in the Introduction, we define entrepreneurs conventionally as labor market participants whose main occupation is in self-employment or who are owner–director of an incorporated business. As usual, farmers are excluded from the sample of entrepreneurs. Furthermore, in line with common practice (Fairlie, 2005), we exclude "hobby" entrepreneurs from the sample by using a lower boundary of 300 hours per year worked as an entrepreneur.[17] An employee is defined as a person whose main occupation is a salaried job.

Occupational positions are administered at each interview. All entrepreneurship spells of at least six months have been recorded in case they were the main labor market activity of the respondent. Table II shows that we observe 3,000 entrepreneur spells in a total of 50,000 spells. On average, at any moment, 6% of the sample is an entrepreneur.[18] Nine hundred and forty-two individuals are observed in both entrepreneurship and in paid employment spells. Among their 15,749 spells, a quarter has been in entrepreneurship. These numbers will be relevant for the diff-of-diff analysis, that will effectively use only these "mixed": observations to measure the differential returns to high/low ability levels in entrepreneurship versus wage employment (see Section 3.2). Moreover, our sample of entrepreneurs does not suffer much from survivorship bias that plagues single cross-section samples: Returns to ability will not pertain to surviving entrepreneurs only.

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coefficients between the measure of spread and respondents' ages and education levels at the time of the test, we conclude no correction is required.

17. We tested whether the results in Section 4 are sensitive to increasing this number. Similar results are obtained when increasing the threshold number of hours to 500, 800 and 1,200, respectively.

18. The percentage is below the national average as we study a relatively young cohort (see Fairlie, 2005).

Table II. Descriptive Statistics of the Key and Control Variables by Occupational Status

	Ability Measures Without Education Controls				Ability Measures with Education Controls			
	Entr = 1 (n = 3,052)		Entr = 0 (n = 46,713)		Entr = 1 (n = 3,026)		Entr = 0 (n = 46,272)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Panel A: Ability measures								
1. General ability	0.0665	0.9595	−0.0043	1.0024	0.0385	0.9447	−0.0025	1.0034
2. Verbal ability	−0.0024	0.9994	0.0002	1.0001	−0.0241	0.9983	0.0016	1.0001
3. Math ability	−0.0268	0.9902	0.0018	1.0006	−0.0533	0.9546	0.0035	1.0028
4. Technical ability	0.2241	0.9914	−0.0146	0.9988	0.2025	0.9789	−0.0132	0.9999
5. Clerical ability	−0.0358	0.9429	0.0023	1.0036	−0.0519	0.9420	0.0034	1.0036
6. Social ability	0.1174	0.9991	−0.0077	0.9996	0.1192	1.0006	−0.0078	0.9995
7. Spread in abilities	−0.0049	0.8007	0.0003	1.01166	−0.0226	1.0405	0.0015	0.9973
Panel B: Income measures								
1. Hourly income	14.6580	29.7422	10.4819	15.6709	9.61		8.07	
2. Log(hourly income)	2.1651	1.0135	2.1092	0.6458	2.2628		2.0882	

Continued

Table II.
Continued

	Ability Measures Without Education Controls				Ability Measures with Education Controls			
	Entr = 1 (n = 3,052)		Entr = 0 (n = 46,713)		Entr = 1 (n = 3,026)		Entr = 0 (n = 46,272)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Panel C: Control variables								
1. Education (in years)	13.1261	2.4355	13.0714	2.3369				
2. Education father (in years)	12.3249	3.2070	11.8252	3.3421				
3. Education mother (in years)	12.1226	2.2579	11.7020	2.4358				
4. Male (dummy)	0.6342		0.5090					
5. Married (dummy)	0.6395		0.5144					
6. Live in the South of the U.S. (dummy)	0.2637		0.3143					
7. Live outside big city (SMSA) (dummy)	0.2217		0.2318					
8. Limited health condition (dummy)	0.0324		0.0238					
9. Hispanic (dummy)	0.0278		0.0434					
10. Black (dummy)	0.0377		0.0937					
Panel D: Industry dummies								
Construction	0.1996		0.0640					
Manufacturing	0.0535		0.2086					
Transportation, communic., & public utility	0.0367		0.0615					
Wholesale and retail trade	0.1312		0.2126					
Finance, insurance, and real estate	0.0264		0.0684					
Business and repair services	0.1570		0.0659					
Personal entertainment & recreation services	0.2178		0.0438					
Professional and related services	0.0962		0.1919					
Other	0.0816		0.0833					

3.1.3 Incomes Measured

We use incomes as an indicator of labor market performance. It is the only indicator that is (to some extent) comparable for entrepreneurs and employees; measures like company growth or supervisor ratings cannot be used. Gross hourly income is used as the performance measure for both groups and is constructed as the average annual total earnings (from wage and business income, see Fairlie (2005)), divided by the number of hours worked in that year. The second panel of Table II shows the income statistics of entrepreneurs and employees separately. Entrepreneurs have higher incomes (in line with Fairlie, 2005), but the magnitude depends strongly on the statistic.[19] The mean is 45% higher, the median is 19% higher but the mean of the logs is less than 6% higher. This signals markedly different distributions; indeed the variance is substantially higher for entrepreneurs (almost four times for hourly earnings and 2.5 times for the log of hourly earnings), though both have similar extents of (positive) skewness.

Parker (2004) documents factors limiting the comparability of entrepreneurs' incomes to wages. For instance, the self-employed have more opportunity to underreport (tax) income (Levitt and Dubner, 2006, p. 237); there may be failure to deal properly with negative incomes and "top-coding," with employee fringe benefits unavailable for entrepreneurs. Moreover, entrepreneurs' incomes may include returns to capital besides returns to labor. For all these reasons, income levels of entrepreneurs may only be compared with wages with great caution.

However, the extent to which all such biases affect the marginal returns to regressors, such as measured ability is probably limited. In an earlier study, Van der Sluis et al. (2005) explicitly evaluate the presence and effect of several of the potential problems of the income measure for entrepreneurs mentioned by Parker (2004) and Fairly (2005). They conclude that, based on the NLSY79, the returns to education for entrepreneurs (relative to employees) are robust under corrections for possible differential underreporting of income, entrepreneurs erroneously including capital income, possible risk premiums included in entrepreneurs' incomes and differences in the incidence of part-time work. Moreover, Van der Sluis and Van Praag (2007), analyze the relative returns to education upon the inclusion and exclusion of negative incomes.

Based on this, we are rather confident that regression coefficients on ability measures in income equations are comparable for

19. As will become clear when discussing the regression results in Section 4, the income premium for entrepreneurs turns negative when controlling for individual characteristics such as education and abilities, cohort effects, age effects and macroeconomic circumstances. This is a common finding for the US (Parker, 2004).

entrepreneurs and employees. Any comparison of the income *levels* of entrepreneurs versus employees will be interpreted with great caution.

3.1.4 Control Variables

Panel C of Table II shows the statistics of the control variables we use. Schooling is measured as the number of completed years of education (with a topcode of 20 years of schooling). Parental education levels are measured in the same fashion. Dummies are included for gender, marital status, geographic location in the United States, health conditions, and race. Moreover, each income equation includes a set of transformed year, birth year, and age dummies according to the method proposed by Deaton (2000) such that estimates are obtained while controlling for cohort effects, age effects, and macroeconomic circumstances.

Panel D of Table II shows the distributions of entrepreneur and employee spells over industries. As is well documented there are marked differences between the groups in terms of their distribution across industries; entrepreneurs are overrepresented in construction and various kinds of services, whereas employees are more active in, for instance, manufacturing (Parker, 2004). The basic specifications will exclude industry dummies as they are endogenous (see also Fairlie and Robb, 2008) and likely to bias the effects of ability on income.[20] We shall only add industry dummies to the set of controls included in our income regressions as a robust check.

3.2 Empirical Methodology

To answer the three questions posed, the estimation of income equations is required where we measure the returns to general ability, specific abilities and ability spread for entrepreneurs relative to employees. In what follows, we first discuss how we deal with the issue of separating the effects of ability and education. Second, we elaborate on our approach to dealing with selectivity. We then present the econometric specifications that we will employ.

3.2.1 Separating the Effects of Ability and Education

Separating the effects of education and ability on incomes is a difficult empirical matter (Roberts et al., 2000; Cawley et al., 2001; Hansen et al., 2004; Heckman et al., 2006). In particular, because ASVAB is said to measure mostly acculturated learning (crystallized intelligence). The

20. For example, certain (knowledge intensive) industries can be accessed only with superior levels of ability and these abilities will pay off accordingly, but this may not become evident in the within-industry distribution of incomes (where most people will be high ability/high income).

first decision is whether to include education levels (S) in income equations that aim at measuring the effect of ability measures. Omitting S would lead to positive omitted variable bias because schooling is correlated positively to both ability and income, albeit expectedly less so for the second than for the first set of corrected measures, see Table I. Its exclusion would hence lead to an overestimate of the true effect of ability on incomes.[21]

Including S as a regressor in the equation, though, leads in this case to the problem of *proxy control*, that Angrist and Pischke describe as "the inclusion of variables that might partially control for omitted factors but are themselves affected by the variable of interest" (2008, p. 66). They show intuitively that the "use of a proxy control that is increased by the variable of interest generates a coefficient below the desired effect" (p. 67). Angrist and Pischke value the use of proxy controls as follows: "While proxy control does not generate the regression coefficient of interest, it may be an improvement on no control at all" (p. 68). Angrist and Pischke conclude for the case we have, that is, income equations with controls for education and ability and where ability affects education: "You can safely say that the causal effect of interest lies between these two," that is, between the estimated effect with and without including education controls in the equation. Thus, the coefficient obtained without controlling for education should result in an upper boundary of the true effect whereas the one obtained while controlling for education yields a lower boundary of the true effect.[22]

On top of that the data are plagued by an additional issue, already discussed: Ability measures are incomparable across individuals because they have been administered at varying ages and education levels. We proceeded by creating two sets of ability measures from the original test scores: "*ability* | *age*" and "*ability* | *age* + *schooling*." The first will attribute part of the education effect also to measured ability. The omitted variable bias is positive in this case and the resulting ability

21. A large empirical literature investigates the consequences of omitting ability variables from schooling equations (see Angrist and Pischke, 2008, for some key early references, p. 61), but not vice versa.

22. Perhaps it is interesting to note here that an instrumental variables approach (where S is replaced by $\hat{S}$, which is then independent from ability) would result in an estimate of the relevant coefficient that is closer to the true causal value (and would render better estimates of the true effect of education on income). However, the quality of such an estimate hinges on the available identifying instruments for education. Using family background measures as such, a choice that has received some critique, we find coefficients of the ability measures whose values are indeed between the lower and upper boundaries implied by the estimates we have without using IV. The background measures used are the presence of a library card when young; of a newspapers/magazines, the number of siblings; the presence of a stepparent in the household, and education levels of the parents. The results are available upon request.

measures will pick up some of the effect of education in the income equations and thus provide an overestimate. However, the second set of ability measures will attribute the effect that ability has on education to education fully and will result in an underestimate of the true effect of ability on incomes.

In combination, we employ four ways of dealing with the complex interaction between ability, education, and incomes: including versus excluding education controls in the income equation and using ability measures that do versus do not control for education. The combination of not controlling for education in the income equation and not controlling for education in the ability equation will provide an overestimate, whereas the combination of controlling for education in the income equation and controlling for education in the ability equation will provide us with an underestimate of the true effect that must, hence, be in between these two limits.

3.2.2 Selectivity: Entrepreneurship or Wage Employment?

The available panel data include repeated measurements of each individual's labor market position (entrepreneur versus employee) and their incomes (and other time varying covariates). However, abilities have been measured only once in 1980. Thus, estimation by means of a fixed effects approach is not possible and we perforce apply a random effects approach (estimated by means of GLS) and assume zero correlation between the individuals and regressors.

However, the choice between entrepreneurship and salaried employment might be endogenous in an income equation. Occupational choices might be guided by better returns to ability and (related) unobserved characteristics in either one of the choices, leading to biased estimates of the returns to ability in a random effects framework. To address the issue of selectivity, we also use a diff-of-diff regression approach (which effectively comes down to introducing individual fixed effects into the equation, see Angrist and Pischke, 2008, p. 227). We thus estimate the differential effect of each ability measure on income in the case that the respondent is an entrepreneur versus a wage employee. Obviously, the ability measures as stand alone variables—and other variables that do not vary over time—are omitted from this specification. This specification contains only the *interaction* of ability (and schooling) with entrepreneurial status (that varies over time and is included also on a stand-alone basis) and we estimate the *difference* in returns to ability in entrepreneurial and employee spells. Identification is based on the 942 individuals who are observed to change status at least once. The diff-of-diff approach controls for unobserved individual characteristics that do not change over time and thus eliminates the bias originating in permanent disposition, inclination and aptness for entrepreneurial activity. It will not eliminate bias from unobserved characteristics that vary over time or from unobservable circumstances that stimulate an individual to seize an opportunity at a particular point in time and that are grasped more easily by some individuals (with specific abilities?) than others.[23]

3.2.3 Econometric Specifications

The income equations we estimate can all be derived from adding restrictions to the following equation that cannot be estimated in this general specification:

$$\ln y_{it} = \alpha + (\beta + \gamma E_{it})A_i + (\delta + \phi E_{it})SA_i + (\varphi + \eta E_{it})AD_i \\ + (\kappa + \lambda E_{it})S_i + \nu X_i + \mu E_{it} + \pi Z_{it} + c_i + \theta_i + \varepsilon_{it}.$$

The dependent variable is the log of hourly income (y), as defined above, A is general ability and SA consists of the five specific abilities. The measure of general ability and the measures of specific abilities are never included simultaneously into one equation, because A is a linear combination of the specific abilities. Moreover, ability measures are just entered linearly.[24]

AD is the measure of ability dispersion, that is, the inverse measure of *JAT*ness. Its coefficient is constrained to zero in the equations that are focusing on the effects of ability levels. As discussed, the ability measures come in two flavors: those obtained including controls for schooling at the time and those obtained without. S is schooling and is, as discussed, included in half of the income equations. X represents a vector of other time-constant individual characteristics (gender, ethnicity, parental education levels, birthyear dummies). E is the employment status dummy (1 for entrepreneurship), whereas Z includes time-varying controls (age and year dummies, health status, marital status, urbanization, region). Finally, c_i is an individual fixed effect, θ_i a random effect (the two are never used simultaneously, see below) and ε_{it} is a random draw for individual i at time t.

To answer the first question, that is, *to what extent does a composite measure of ability affect an entrepreneur's earnings relative to wages?*, we estimate three sets of equations (results are reported in Table III, Panels

23. We do not try to estimate a selection-model where the choice for entrepreneurship is modelled separately in a regression equation (2SLS) because of the lack of a valid identifying instrument.

24. We experimented with nonlinearities and interactions, see footnote 26, but these were hardly significant, whereas the interpretation of results became cumbersome. Heckman et al. (2006) estimate linear earnings functions for given education levels and impose linear separability of cognitive and noncognitive ability across occupations.

A to C). They have the following restrictions in common: $\delta, \phi, \varphi, \eta \equiv 0$, because we only look at the effects of general ability and exclude specific abilities and ability dispersion from the equations. Our first set of (random effects) estimates (Panel A) serves as a benchmark and does not distinguish between entrepreneurs and employees, that is, we impose an additional restriction on the parameter values of all interaction effects

TABLE III.
THE EFFECT OF GENERAL ABILITY ON INCOME

	I.	II.	III.	IV.
Panel A: Base line model (GLS-Random effects)				
General ability	0.1935	0.1572	0.1314	0.1095
	(0.0068)***	(0.0069)***	(0.0074)***	(0.0069)***
Entrepreneur dummy	−0.0894	−0.0904	−0.0879	−0.0884
	(0.00093)***	(0.00094)***	(0.00093)***	(0.0094)***
Education			0.0439	0.0523
			(0.0023)***	(0.0022)***
Ability regr include education controls	No	Yes	No	Yes
Income regr includes education controls	No	No	Yes	Yes
R^2 overall	0.4362	0.4212	0.4489	0.4458
No. of observations	49,764	49,297	49,764	49,297
No. of individuals	4,472	4,423	4,472	4,423
Panel B: Distinguishing entrepreneurs (GLS-Random effects)				
General Ability	0.1911	0.1546	0.1300	0.1076
	(0.0068)***	(0.0070)***	(0.0074)***	(0.0069)***
General Ability ∗ Entrepreneur	0.0359	0.0416	0.0236	0.0330
	(0.0100)***	(0.0101)***	(0.0120)**	(0.0106)***
Entrepreneur dummy	−0.0936	−0.0943	−0.0919	−0.0931
	(0.0094)***	(0.0095)***	(0.0094)***	(0.0094)***
Education			0.0433	0.0517
			(0.0024)***	(0.0022)***
Education ∗ Entrepreneur			0.0076	0.0089
			(0.0046)*	(0.0040)**
Ability regr include education controls	No	Yes	No	Yes
Income regr includes education controls	No	No	Yes	Yes
R^2 overall	0.4360	0.4211	0.4487	0.4457
No. of observations	49,764	49,297	49,764	49,297
No. of individuals	4,472	4,423	4,472	4,423

Continued

Table III. Continued

	I.	II.	III.	IV.
Panel C: Distinguishing entrepreneurial spells (Diff-of-diff)				
General ability * entrepreneur	0.0432 (0.0104)***	0.0458 (0.0105)***	0.0282 (0.0125)**	0.0347 (0.0110)***
Entrepreneur dummy	−0.0831 (0.0098)***	−0.0826 (0.0098)***	−0.0823 (0.0098)***	−0.0827 (0.0098)***
Education ∗ entrepreneur			0.0096 (0.0047)**	0.0116 (0.0042)***
Ability regr include education controls	No	Yes	No	Yes
Income regr includes education controls	No	No	Yes	Yes
R^2 overall	0.3027	0.3027	0.3512	0.3516
No. of observations	49,764	49,297	49,764	49,297
No. of individuals	4,472	4,423	4,472	4,423

Notes: Significance levels: *10%; **5%; ***1%. All regressions include the control variables discussed in Section 3, see also Table II, Panels A–C. Standard errors are adjusted for intragroup correlations where necessary.

to zero, that is, $\gamma, \lambda \equiv 0$. Whenever we estimate random effects we assume $c_i = 0$, the fixed effect, as is the case in the first set of equations and also in the second set that distinguishes between entrepreneurs and employees in a random effects framework (Panel B). The third set of estimates is based on the diff-of-diff approach and perforce assumes that $\sigma, \beta, \kappa, \nu = 0$, whereas θ_i is omitted from the equation. γ is the coefficient of interest when answering the first question.

To answer the second question, Do different cognitive abilities (e.g., math ability, technical ability) and social ability affect earnings of entrepreneurs and employees differently?, we assume throughout $\beta, \gamma, \varphi, \eta = 0$, because general ability as well as ability dispersion are removed from this set of equations. Again, we first estimate a benchmark without distinction between entrepreneurs and employees ($\phi, \lambda \equiv 0$) in a random effects framework ($c_i = 0$), then include the distinction between entrepreneurs and employees in a random effects framework ($c_i = 0$) and finally employ a diff-in-diff framework ($\alpha, \delta, \kappa, \nu = 0$, whereas θ_i is omitted from the equation). The results of these estimations will be reported in Table IV, Panels A, B, and C, respectively. ϕ is the vector of coefficients of interest when answering the second question.

Both the answer to question 1 in Table III and question 2 in Table IV consist of four columns: two including/excluding controls for education and each one based once on the first and once on the second set of

Table IV.
The Effect of Specific Abilities on Income

Ability regr include education controls	No	Yes	No	Yes
Income regr includes education controls	No	No	Yes	Yes
No. of observations	49,764	49,297	49,764	49,297
No. of individuals	4,472	4,423	4,472	4,423
Panel A: Base line model (GLS-Random effects)				
Verbal ability	0.0310	0.0135	0.0175	0.0094
	(0.0083)***	(0.0080)*	(0.0081)**	(0.0076)
Math ability	0.1170	0.1098	0.0688	0.0611
	(0.0079)***	(0.0078)***	(0.0081)***	(0.0077)***
Technical ability	0.0081	0.0129	0.0126	0.0146
	(0.0080)	(0.0079)	(0.0078)	(0.0075)*
Clerical ability	0.0525	0.0391	0.0451	0.0402
	(0.0070)***	(0.0070)***	(0.0068)***	(0.0066)***
Social ability	0.0181	0.0179	0.0168	0.0161
	(0.0053)***	(0.0054)***	(0.0051)***	(0.0052)***
Entrepreneur dummy	−0.0881	−0.0893	−0.0874	0.0881
	(0.0094)***	(0.0094)***	(0.0093)***	(0.0094)***
Education			0.0435	0.0514
			(0.0024)***	(0.0023)***
R^2 overall	0.4364	0.4231	0.4486	0.4459
Panel B: Distinguishing entrepreneurs (GLS-Random effects)				
Verbal ability	0.0335	0.0154	0.0203	0.0114
	(0.0083)***	(0.0081)*	(0.0081)**	(0.0077)
Math ability	0.1150	0.1081	0.0683	0.0602
	(0.0079)***	(0.0078)***	(0.0081)***	(0.0078)***
Technical ability	−0.0001	0.0057	0.0043	0.0072
	(0.0080)	(0.0080)	(0.0078)	(0.0076)
Clerical ability	0.0586	0.0442	0.0514	0.0452
	(0.0070)***	(0.0070)***	(0.0068)***	(0.0067)***
Social ability	0.0163	0.0162	0.0150	0.0144
	(0.0053)***	(0.0055)***	(0.0052)***	(0.0052)***
Entrepreneur dummy	−0.1181	−0.1163	−0.1209	−0.1168
	(0.0097)***	(0.0098)***	(0.0097)***	(0.0098)***
Verbal ability ∗ Entrepreneur	−0.0341	−0.0260	−0.0375	−0.0250
	(0.0137)**	(0.0131)**	(0.0137)***	(0.0131)*
Math ability ∗ Entrepreneur	0.0389	0.0332	0.0100	0.0203
	(0.0138)***	(0.0136)***	(0.0155)	(0.0145)
Technical ability ∗ Entrepreneur	0.1147	0.1056	0.1205	0.1072
	(0.0119)***	(0.0116)***	(0.0119)***	(0.0116)***

Continued

Table IV.
Continued

Panel B: Distinguishing entrepreneurs (GLS-Random effects)				
Clerical ability ∗ Entrepreneur	−0.1051 (0.0125)***	−0.0850 (0.0119)***	−0.1081 (0.0124)***	−0.0840 (0.0119)***
Social ability ∗ Entrepreneur	0.0318 (0.0092)***	0.0278 (0.0093)***	0.0311 (0.0092)***	0.0270 (0.0092)***
Education			0.0425 (0.0024)***	0.0509 (0.0023)***
Education ∗ Entrepreneur			0.0177 (0.0049)***	0.0083 (0.0042)**
R-sq overall	0.4379	0.4244	0.4501	0.4471

Panel C: Distinguishing entrepreneurial spells (Diff-of-Diff)				
Verbal ability ∗ Entrepreneur	−0.0414 (0.0143)***	−0.0333 (0.0137)**	−0.0468 (0.0144)***	−0.0342 (0.0137)**
Math ability ∗ Entrepreneur	0.0474 (0.0143)***	0.0388 (0.0142)***	0.0188 (0.0162)	0.0257 (0.0151)*
Technical ability ∗ Entrepreneur	0.1232 (0.0124)***	0.1137 (0.0121)***	0.1290 (0.0125)***	0.1156 (0.0121)***
Clerical ability ∗ Entrepreneur	−0.1036 (0.0130)***	−0.0841 (0.0124)***	−0.1067 (0.0130)***	−0.0832 (0.0124)***
Social ability ∗ Entrepreneur	0.0287 (0.0096)***	0.0254 (0.0096)***	0.0279 (0.0096)***	0.0243 (0.0096)**
Entrepreneur	−0.1095 (0.0101)***	−0.1065 (0.0101)***	−0.1121 (0.0101)***	−0.1077 (0.0101)***
Education ∗ Entrepreneur			0.0194 (0.0051)***	0.0106 (0.0044)**
R^2 overall	0.3059	0.3058	0.3550	0.3552

Notes: Significance levels: *10%; **5%; ***1%. All regressions include the control variables discussed in Section 3, see also Table II, Panels A–C. Standard errors are adjusted for intragroup correlations where necessary.

corrected ability measures. To answer question 3 (in Table V), *Does the balance in these measured ability levels affect an individual's earnings?* we proceed in the same way but estimate four columns controlling for A but not for SA ($\delta, \phi = 0$) and four columns the other way around ($\beta, \gamma = 0$), where each column includes the main variable of interest here, η pertaining to AD, ability dispersion. Panels A to C are otherwise comparable to the other tables.

Besides these income equations, we also estimate selection equations (Table VI) that are meant to give some insight, beyond what is suggested by the descriptive statistics in Table II, in the observable factors affecting occupational choice and the kind and extent of bias in the relevant income effects, resulting from selectivity. We estimate

TABLE V.
THE EFFECT OF INDIVIDUAL VARIATION IN ABILITIES ON INCOME

Ability regr include education controls	No	Yes	No	Yes	No	Yes	No	Yes
Income regr includes education controls	No	No	Yes	Yes	No	No	Yes	Yes
Income regr controls for general ability	Yes	Yes	Yes	Yes	No	No	No	No
Income regr controls for specific abilities	No	No	No	No	Yes	Yes	Yes	Yes
No. of observations	49,764	49,297	49,764	49,297	49,764	49,297	49,764	49,297
No. of individuals	4,472	4,423	4,472	4,423	4,472	4,423	4,472	4,423
Panel A: Base line model (GLS-Random effects)								
Variation in abilities measure	0.0014	−0.0009	0.0015	0.0011	0.0021	0.0001	0.0019	0.0014
	(0.0048)	(0.0056)	(0.0046)	(0.0053)	(0.0048)	(0.0056)	(0.0046)	(0.0053)
Entrepreneur dummy	−0.0894	−0.0904	−0.0879	−0.0884	−0.0881	−0.0893	−0.0874	−0.0881
	(0.0093)***	(0.0094)***	(0.0093)***	(0.0094)***	(0.0094)***	(0.0094)***	(0.0093)***	(0.0094)***
R^2 overall	0.4362	0.4212	0.4489	0.4459	0.4364	0.4231	0.4486	0.4459

Continued

Table V.
Continued

Panel B: Distinguishing entrepreneurs (GLS-Random effects)								
Variation in abilities measure	0.0025	0.0006	0.0026	.00247	0.0030	0.0012	0.0028	0.0024
	(0.0048)	(0.0056)	(0.0046)	(0.0053)	(0.0048)	(0.0056)	(0.0046)	(0.0053)
Entrepreneur dummy	−0.0939	−0.0950	−0.0922	−0.0937	−0.1180	−0.1174	−0.1207	−0.1178
	(0.0094)***	(0.0095)***	(0.0094)***	(0.0094)***	(0.0097)***	(0.0098)***	(0.0097)***	(0.0098)***
Variation in abilities ∗ entrepreneur	−0.0296	−0.0252	−0.0287	−0.0239	−0.0227	−0.0286	−0.0213	−0.0274
	(0.0086)***	(0.0088)***	(0.0086)***	(0.0088)***	(0.0086)***	(0.0088)***	(0.0086)**	(0.0088)***
R^2 overall	.4361	.4212	.4488	.4458	.4380	.4245	.4502	.4473
Panel C: Distinguishing entrepreneurial spells (Diff-of-Diff)								
Variation in abilities ∗ entrepreneur	−0.0297	−0.0221	−0.0291	−0.0208	−0.0226	−0.0259	−0.0213	−0.0246
	(0.0086)***	(0.0089)**	(0.0086)***	(0.0089)**	(0.0086)***	(0.0090)***	(0.0086)**	(0.0090)***
Entrepreneur dummy	−0.0835	−0.0833	−0.0827	−0.0834	−0.1094	−0.1075	−0.1120	−0.1086
	(0.0097)***	(0.0098)***	(0.0098)***	(0.0098)***	(0.0101)***	(0.0101)***	(0.0101)***	(0.0102)***
R^2 overall	.3028	.3028	.3513	.3517	.3060	.3060	.3550	.3553

Notes: Significance levels: *10%; **5%; ***1%. All regressions include the control variables discussed in Section 3, see also Table II, Panels A–C. Standard errors are adjusted for intragroup correlations where necessary.

TABLE VI.
THE EFFECT OF ABILITIES ON ENTREPRENEURSHIP SELECTION

Ability regr incl. education controls	No	Yes	No	Yes	No	Yes	No	Yes
Income regr incl. education controls	No	No	Yes	Yes	No	No	Yes	Yes
Panel A: Random effects probit model (GEE population averaged model)#								
General ability	−0.0622	−0.0491	−0.0278	−0.0251				
	(0.0231)***	(0.0231)**	(0.0264)	(0.0244)				
Verbal ability					−0.0084	0.0036	−0.0058	0.0043
					(0.0282)	(0.0269)	(0.0284)	(0.0269)
Math ability					−0.164	−0.1592	−0.1517	−0.1426
					(0.0267)***	(0.0259)***	(0.0285)***	(0.0271)***
Technical ability					0.1313	0.1156	0.1301	0.1151
					(0.0272)***	(0.0264)***	(0.0273)***	(0.0264)***
Clerical ability					−0.0037	0.0057	−0.0028	0.0046
					(0.0240)	(0.0234)	(0.0241)	(0.0234)
Social ability					0.0518	0.0527	0.0536	0.0539
					(0.0181)***	(0.0182)***	(0.0182)***	(0.0183)***
Variation in abilities	0.0034	−0.0125	0.0031	−0.0132	0.0033	−0.0121	0.0033	−0.0125
	(0.0159)	(0.0178)	(0.0161)	(0.0179)	(0.0156)	(0.0175)	(0.0157)	(0.0176)
Wald Chi-square	627.9	623.0	639.6	638.7	678.7	671.5	681.0	678.7
No. of observations	50,215	49,627	50,094	49,627	50,215	49,627	50,094	49,627
No. of individuals	4,508	4,452	4,501	4,452	4,508	4,452	4,501	4,452

Continued

TABLE VI.
CONTINUED

Panel B: Probit, dependent variable = ever been entrepreneur in sample period##, derivative effects estimated								
General ability	−0.0144	−0.0117	0.0079	0.0009				
	(0.0084)*	(0.0079)	(0.0095)	(0.0083)				
Verbal ability					−0.0055	0.0018	−0.0020	0.0011
					(0.0112)	(0.0106)	(0.0112)	(0.0105)
Math ability					−0.0562	−0.0518	−0.0388	−0.0376
					(0.0110)***	(0.0105)***	(0.0118)***	(0.0110)***
Technical ability					0.0463	0.0352	0.0427	0.0352
					(0.0110)***	(0.0104)***	(0.0110)***	(0.0104)***
Clerical ability					0.0038	0.0105	0.0049	0.0091
					(0.0094)	(0.0091)	(0.0095)	(0.0091)
Social ability					0.0198	0.0198	0.0209	0.0210
					(0.0075)***	(0.0075)***	(0.0075)***	(0.0075)***
Variation in abilities	0.0024	−0.0129	0.0018	−0.0138	0.0014	−0.0123	0.0013	−0.0130
	(0.0064)	(0.0090)	(0.0063)	(0.0094)	(0.0065)	(0.0090)	(0.0064)	(0.0093)
Wald Chi-square	32.0	34.9	52.8	55.3	71.9	68.4	81.0	81.8
No. of observations	3,333	3,294	3,326	3,294	3,333	3,294	3,326	3,294

Continued

TABLE VI. CONTINUED

Panel C: RE probit model (GEE population averaged model), dependent = transition to entrepreneurship###								
General ability	−0.0527	−0.0280	−0.0309	−0.0092				
	(0.0190)***	(0.0197)	(0.0216)	(0.0207)				
Verbal ability					−0.0017	0.0175	0.0016	0.0178
					(0.0239)	(0.0233)	(0.0241)	(0.0232)
Math ability					−0.1138	−0.1079	−0.1067	−0.0940
					(0.0233)***	(0.0225)***	(0.0253)***	(0.0237)***
Technical ability					0.0706	0.0594	0.0678	0.0590
					(0.0234)***	(0.0223)**	(0.0235)***	(0.0223)***
Clerical ability					−0.0110	0.0082	−0.0104	0.0076
					(0.0207)	(0.0198)	(0.0208)	(0.0161)
Social ability					0.0417	0.0419	0.0431	0.0424
					(0.0160)***	(0.0161)***	(0.0160)***	(0.0161)***
Variation in abilities	−0.0122	−0.0247	−0.0126	−0.0260	−0.0119	−0.0228	−0.0120	−0.0236
	(0.0125)	(0.0158)	(0.0125)	(0.0159)	(0.0123)	(0.0155)	(0.0123)	(0.0156)
Wald Chi-square	152.5	148.4	157.8	156.9	183.7	177.4	184.9	181.0
No. of observations	48,670	48,087	48,549	48,087	48,670	48,087	48,549	48,087

Notes: Significance levels: *10%; **5%; ***1%. All regressions include the control variables discussed in Section 3, Table II, Panels A–C. The estimates in Panel B have been obtained when omitting regressors that vary over time.
#The dependent variable in Panel A is 1 for each individual/year observation in entrepreneurship and zero in wage employment. ##The dependent variable in Panel B is 1 for individuals with at least one spell in entrepreneurship and zero for individuals who have never been entrepreneurs (and at least one year wage employee). ###The dependent variable in Panel C is 1 for a transition to entrepreneurship, that is, for person–year observations who are entrepreneurs in year t but not in t-1 and zero for person–year combinations who are employees in year t. Individual–year observations of entrepreneurs in year t and t-1 have been excluded. Including them leaves the results unchanged.

three common indicators of occupational choice. First we estimate a random effects model where the dependent variable takes on the value 1 for each individual/year observation for which we observe a spell in entrepreneurship and zero for observations in wage employment. The results from this random effects model are shown in Panel A. The second dependent variable (Panel B) takes on the value 1 for individuals for whom we observe at least one spell in entrepreneurship and zero for others (who have at least once been observed as a wage employee). Time varying independent variables are excluded here. The third approach employs a dependent variable (Panel C), which takes on the value 1 for an observed transition to entrepreneurship, that is, for person–year observations who are entrepreneur in year t but not in $t-1$. It is zero for all other person–year combinations who are employees in year t.

4. Results

We now present the results from estimating the income equations in Tables III–V followed by the occupational choice results (Table VI). The results from controls are omitted from the tables.

4.1 Returns to General Ability

Table III presents the estimation results for the income equation confined to the effect of (a standardized measure of) general ability. In the benchmark case in Panel A, where the interaction between occupational status and ability is suppressed, $\hat{\beta}$ is between 11 and 20%. Thus, increasing the measured level of general ability by one standard deviation, leads to a 11–20% increase in income. The lower estimate is obtained while including education into both the income and ability equations, whereas the upper bound is obtained while excluding education from both equations, $\kappa = 0$. Moreover, irrespective of whether ability and/or income are corrected for education levels, entrepreneurs earn, ceteris paribus and on average 9% lower incomes than comparable employees (see also Hamilton, 2000). Panel B shows that the return to general ability is 30% higher as an entrepreneur than as an employee (10.7 + 3.3, rather than 10.7) while education pays a 17% premium, consistent with earlier evidence of higher returns to education in entrepreneurship than wage employment (See footnote 1). A comparison of the four columns in Panel B reveals that the measured premium for entrepreneurs is barely sensitive to the corrections for education. The premium for entrepreneurship itself is estimated to be, as in Panel A, a negative 9% and independent of the specification. The third

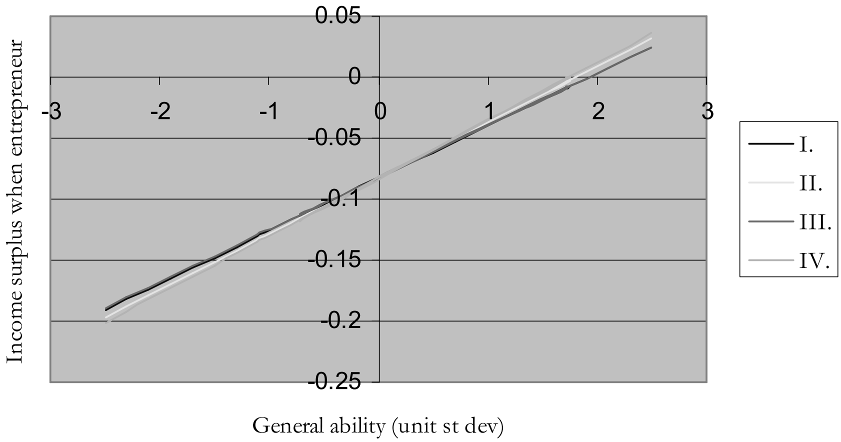

FIGURE 1. SURPLUS INCOME IN ENTREPRENEURIAL SPELLS GIVEN GENERAL ABILITY LEVELS

Notes: The graph is based on the estimates of Panel C (fixed effects) of Table III. When calculating the lines based on Columns 3 and 4, where education is included as a control variable, the individual's education level varies with the level of general ability corresponding with the correlation between general ability and education. To be precise, whenever general ability is increased by × standard deviations, education is increased by × times corr(general ability, education) times sd(education).

panel shows that our results are not biased by unobserved permanent individual factors: the diff-of-diff estimates tell the same tale. Thus we find clear support for Marshall's claim that general ability, while obviously relevant for economic success, is particularly relevant for entrepreneurs.

Figure 1 shows suggestive evidence about the implications of the different returns to ability for the absolute income levels individuals earn as entrepreneurs versus employees based on the four sets of estimates presented in Panel C.[25] The figure shows the percentage (points) premium earned as an entrepreneur versus a wage employee (on the

25. The discussion in Section 3 about the limited comparability of income levels for entrepreneurs and employees motivates why we refer to "suggestive evidence." In addition, the comparison in the graph is valid if two underlying assumptions hold. First, that the relationships between earnings and measured ability levels and dispersion are linear and second, that the income measures for employees and entrepreneurs are comparable in absolute levels. The first assumption seems to hold in our data. When we include abilities in quadratic form into the equations, their coefficients are almost all insignificant (results available from the authors) and the conclusions are not upset. However, there is little proof of the validity of the second assumption (although researchers commonly assume this comparability). Therefore, we interpret the results based on comparisons of income *levels* with great caution.

vertical axis), dependent on where a person is located in the distribution of general ability measured in standard deviations (horizontal axis′, where "0" is equivalent to the average level of general ability and is associated with a negative income premium for entrepreneurs of 8%, which is equal to the coefficient of the entrepreneur dummy in Panel C). The slopes of the lines indicate the differential income effects for entrepreneurs and employees of increasing general ability, including indirect effects brought about by the fact that higher ability levels are associated with higher education levels that lead, in turn, to higher incomes.

The differences between the lines for the different specifications are very small and they all bring out the same message: The higher returns to general ability for entrepreneurs only lead to higher income levels as an entrepreneur than as an employee for the top of the ability distribution. The minimum level of general ability at which estimated earnings are higher for entrepreneurs than for employees is between 1.74 and 1.92 standard deviations above the mean, corresponding to the upper 7.8% and 7.3% of the distribution of general ability.[26]

4.2 Returns to Specific Abilities

Table IV shows the results for the returns to specific abilities. The structure of the table is similar to Table III. For the pooled data, ignoring possibly differential returns, mathematical ability has the highest payoff (significant coefficients of between 0.12 and 0.06, depending on the specification), a common finding in the literature. The return to clerical ability is between 4% and 5% per standard deviation, whereas the return to verbal ability is between 1% and 3% (but insignificant when educational controls are included, in accordance with the mixed results found in our survey, Section 2). Technical ability is barely significant, and social ability boosts earnings significantly by 1.5 to 2% per standard deviation. As before, estimated coefficients are sensitive to controlling for education, especially for the abilities that are associated most strongly with scholastic achievement, that is, verbal and mathematical ability.

Considering differential returns by occupational status (Panel B), we see a substantial positive premium of technical ability in entrepreneurial status (10–12%) and a substantial negative premium

26. The accuracy of these estimates can be indicated by 95% confidence intervals (results are available from the authors upon request. For instance, for one of the lines (Line II) the lower and upper bounds of the estimated ability level in terms of standard deviations above the mean for which entrepreneurial spells are associated with higher incomes than employee spells are 0.8 and 3.3, respectively.

of clerical ability (8–11%). Social ability has 3 percentage points higher returns per standard deviation when entrepreneur, corroborating the anticipation formulated in Section 2. Verbal ability has a similar premium return when employee. The premium return on mathematical ability for entrepreneurs is of the same magnitude as the premium return on social ability, although the effect becomes smaller and less significant when education controls are included. Except for mathematical ability, the differences are barely affected by controls for education and are robust when applying a diff-of-diff estimation (Panel C).

Figure 2 shows, similar to Figure 1, (suggestive evidence about) the earnings advantage in entrepreneurial status for the three abilities that affect entrepreneurial incomes relative to employee incomes positively.[27] The lines within the figures (for different specifications) only differ visibly for technical ability, but they all bring the same message as before: To realize an earnings gain from entrepreneurial status seems to require top levels of abilities. The only exception is technical ability: the threshold is between 1.04 and 1.43 standard deviations, corresponding to the upper 18.6–29.6% of the technical ability distribution. Figure A2 shows that the 95% confidence interval for this estimate (line II) lies between 0.5 and 1.5 standard deviations. For mathematical and social ability, only individuals positioned in the very top of the distribution are financially better off as entrepreneurs. Earnings are higher as an entrepreneur than as an employee for the upper 3.9% of the distribution of math ability and for the upper 3.4% of the social ability distribution.

4.3 Returns to Being a Jack-of-All-Trades

Table V shows the results from testing the Jack-of-all-Trades theory of entrepreneurship (Lazear, 2005). As Panel A indicates, an individual's spread in measured ability levels is irrelevant for earnings if we do not distinguish between employee and entrepreneur status, irrespective of the inclusion of controls for education or ability levels into the equation.

Lazear's theory predicts that entrepreneurs benefit from being Jack-of-all-Trades, whereas employees would benefit from being specialists. We find significant support for the first prediction. Although earnings as an employee are unaffected by ability dispersion, the inverse measure of JAT, the impact for entrepreneurs is significant and negative, thereby supporting the positive effect of being a Jack-of-all-Trades.

27. Variation in the levels of the other measured abilities, that is, clerical and language ability, can never lead to higher incomes in entrepreneurship because both the coefficient for entrepreneurship and the coefficients for the effects of these abilities on the incomes for entrepreneurs relative to employees are negative.

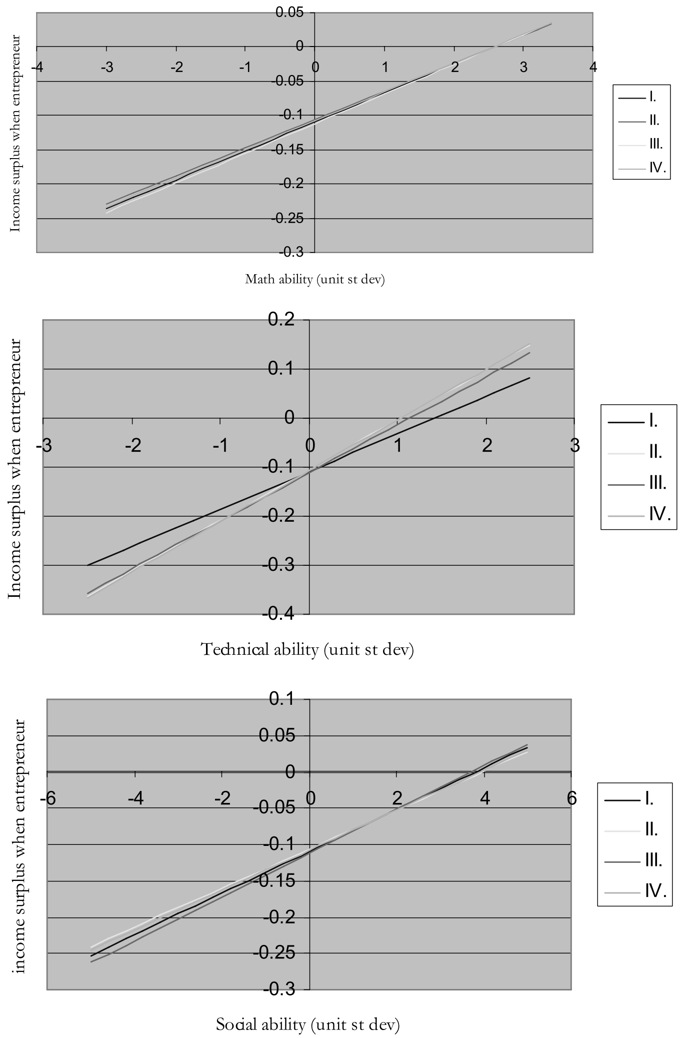

FIGURE 2. SURPLUS INCOME IN ENTREPRENEURIAL SPELLS GIVEN SPECIFIC ABILITY LEVELS

Notes: The graphs are based on the estimates of Panel C (fixed effects) of Table IV; lines correspond to columns. Along any line, levels of other specific abilities and education covary according to correlations. The effect of a change in a specific ability is not calculated at fixed values for the other abilities, but they vary according to the correlation with the depicted ability. Whenever the depicted ability is increased by × standard deviations, the other specific ability measures and education are increased by × times corr(depicted ability, other ability). The same holds for education.

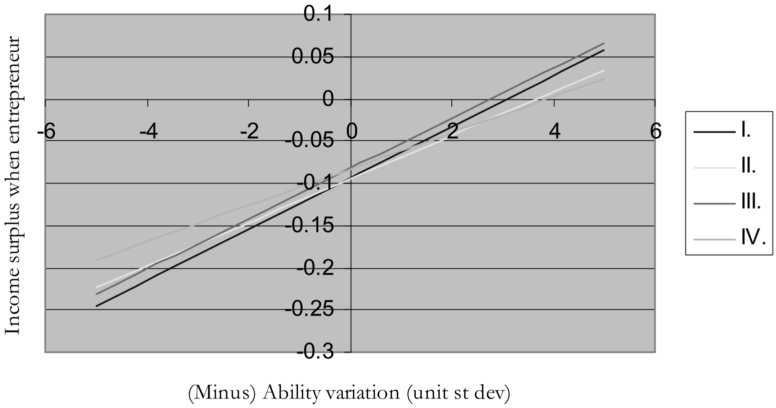

FIGURE 3. SURPLUS INCOME IN ENTREPRENEURIAL SPELLS GIVEN ABILITY DISPERSION

Notes: The graph is based on the estimates in Columns 1–4 of Panel C (fixed effects), Table V; the lines correspond to the first four columns. Along a line, the individual's general ability level (all lines) and education level (lines III and IV only) covary according to correlations (see text).

An increase by a standard deviation of variability reduces earnings in entrepreneurial status by 3%. This estimate is also independent of controls for education and abilities. Once again, the diff-of-diff results (Panel C) are virtually identical to the random-effects estimates (Panel B).

Figure 3 shows that, once again, the earnings advantage as an entrepreneur only holds for the top of the distribution: Earnings are higher as an entrepreneur for the upper 4.0 to 4.5% of the distribution of ability dispersion.

We conclude that labor market participants benefit more from their general ability as entrepreneurs than employees. Regarding specific abilities, entrepreneurship is associated with higher returns to technical, social and mathematical ability, whereas wage employment offers a premium return on clerical and verbal abilities. In support of the JAT theory, being a JAT is profitable when an entrepreneur, but not as employee.

4.4 Selection: Entrepreneurship Versus Wage Employment

Table VI shows the determinants of occupational choice in a probit framework, including the control variables discussed. The first of the three panels shows the estimates from a random effects probit model, as explained before, the second the estimates from a probit model explaining whether an individual has ever been an entrepreneur and the third specification explains transitions to entrepreneurship. All panels tell the same tale again: The effect of general ability is not so clear cut, but, if anything, affects the choice for entrepreneurship negatively. Regarding specific abilities, verbal and clerical ability have no effect on occupational choice, technical and social ability have a positive effect on the choice for entrepreneurship and mathematical ability a negative effect. These results for occupational choice are only partially in line with the relative returns we estimated, shown in Table IV.

The coefficient of "variation in abilities," the inverse JAT measure, is insignificant in all regressions explaining occupational choice, whereas the return to being a JAT was positive for entrepreneurs (and zero for employees). One might argue that the effect of JATness on entrepreneurial performance is a more relevant test of Lazear's theory than its effect on occupational choices that Lazear (2005) actually uses, assuming rational expectations: Entrepreneurship offers a relatively high return to being a JAT and would thus attract JATs. We do not find that a balanced set of abilities stimulates to opt for entrepreneurship, but we do find that the payoff to a balanced skill portfolio is higher in entrepreneurship than in salaried employment. The relationship between investments in JATness and occupational choice has been studied empirically and was supported by Lazear himself (2005) and Wagner (2003), whereas mixed support was reported by Silva (2007) and no support by Astebro and Thompson (2007). The effect of the innate rather than acquired skill portfolio on entrepreneurial success has not yet been studied.

If the choice for entrepreneurship would be dominated by earnings maximization, we would expect an alignment between the results in Table VI and Tables III–V. The abilities that increase the relative returns from entrepreneurship in terms of income as compared to wages (general ability, technical, social ability and being a JAT) should stimulate the inclination to become an entrepreneur, whereas higher levels of clerical and verbal abilities would stimulate the choice for wage employment. Moreover, one should observe relatively many Jack-of-all-Trades choosing to become entrepreneurs. These patterns of occupational choice are only partly borne out by the data. In fact, the only abilities that affect relative income from entrepreneurship and the choice for entrepreneurship in the same way are technical and social ability, which have a positive effect on both. Thus we observe a discrepancy between the drivers of occupational choice and the determinants of the premium income as an entrepreneur versus a wage employee.

This observed discrepancy is consistent with the evidence collected in empirical studies of the choice for and performance in entrepreneurship versus wage–employment: The "returns to entrepreneurship puzzle." Despite longer working hours and more variable and often lower incomes on average for entrepreneurs, people not only choose to become and remain entrepreneurs but they also turn out more satisfied as such (Benz and Frey, 2008; Blanchflower and Oswald, 2008; Hamilton, 2000; Hyytinen et al., 2008; Parker, 2004; Van Praag and Versloot, 2007). We show that the puzzle remains when looking at a specific driver of the differential financial returns in entrepreneurship versus wage employment, that is, abilities, instead of studying the differences in income levels themselves (that may be flawed with measurement issues, see Hyytinen et al., 2008). Recent empirical studies trying to solve this puzzle find that the choice for entrepreneurship is mainly governed by more autonomy and control over (the accruals from) one's own work as an entrepreneur compared to positions in wage employment (Benz and Frey, 2008; Hyytinen et al., 2008). In line with this, we conclude that the occupational choice between entrepreneurship and wage employment is not primarily driven by the maximization of expected income.

4.5 Robustness of the Results

The results lead to answers to the three core questions of the paper and they turned out quite robust to changes in the empirical definitions of the ability measures and the definition of the entrepreneur in terms of the minimum number of hours devoted to this activity. Moreover, the results are largely unaffected by the various choices made on how we deal with the relation between education and ability as well as with selectivity. Moreover, the determinants of occupational choice turn out to be invariant to changes in the definition of the dependent variable (compare Panels A, B, C of Table VI). We performed three additional checks.

First, the ASVAB tests have been executed in English. For individuals for whom English is not their first language, language problems may have affected their results, leading to a different relationship between measured ability and labor market outcomes. To analyze this issue, we replaced the entrepreneurship status dummy in the income equations with a "foreign language" dummy that is one for the 15% individuals in the sample who answered yes to "Was a foreign language spoken at home during the respondent's childhood"? and zero otherwise. Thus, we measure the difference in the income effects of ability between native and nonnative speakers of

English.[28] Note that we cannot run "diff-of-diff" analyses here because the foreign language variable does not vary over time. The results, that are available from the authors upon request, show that the effect of general ability, specific abilities and ability variation are no different for people raised with a foreign language, with one exception: Individuals who spoke a foreign language at home during their childhood benefit *more* from verbal ability than others in terms of their incomes. They earn a premium of 4.5% per standard deviation on this ability. When raised in a foreign language, a higher level of verbal ability probably makes more of a difference. As the results are otherwise similar to what we found before, we conclude that nonnative speakers have not influenced the results.

As a second robustness check, we have included controls for industries (see Panel D of Table II) into the income equations (available upon request). One might suspect that the (differences in) returns to (specific) abilities are related to differences in earnings across industries. This turned out not to be the case. Although there are marked average income differences across industries (some 50% difference between the highest and the lowest paying industry), signs, magnitudes and significance levels of the parameters of interest were unaffected by including industry dummies. The only parameter value whose magnitude changed was the entrepreneur dummy: the penalty to being an entrepreneur reduced from 8–10% to 4–7%. Entrepreneurs are apparently overrepresented in industries with lower average incomes. However, this does not impact their returns to ability.

Third, we should not overlook that we have investigated the effect of abilities on the *levels* of income as entrepreneurs compared to employees. However, if the higher *level* of income as an entrepreneur due to higher levels of abilities is associated with higher income *risk*, the premium *benefit* of being an entrepreneur versus an employee for a risk averse individual with high ability levels could be lower than the premium *return* to ability in terms of income levels. We explore this issue briefly—we do certainly not aim at a complete risk-analysis. We first briefly look at the income variation measured by the cross-sectional income variance within the group of entrepreneurs vis-à-vis the group of wage earners, which is substantially higher in the first group (see Table II), a common finding in other data sets too, even when controlling for observables (Elfenbein et al., 2010; Astebro et al., 2007; Ohyama, 2008). We note that the larger intragroup spread for entrepreneurs cannot be caused by a larger variance in ability levels: Table II shows

28. Strictly speaking, the NLSY-variable that we use as a basis for the "foreign language" dummy will (wrongly) assign individuals who are raised bilingually (speaking English and a foreign language at home) to the group of nonnatives.

that the variance in abilities (general ability, specific abilities, and ability dispersion) is not larger in the group of entrepreneurs than among employees.

We next calculate the standard deviation of the incomes over the years per individual and split the sample into a group of people who have ever been entrepreneur and others. We compare the variation of individual incomes over time between these two groups. Under conditions, one could take the income variance over time as a measure of income risk. In line with the cross-sectional results, the variance is much higher for individuals who have ever been entrepreneur than for the others (0.6018 vs. 0.4964 and the difference is significant, [t-value = 17.2]). However, the estimates of the determinants of this type of income variation—available from the authors upon request—show that none of the abilities affect income risk in general, and there are no significant differences between the two groups in the relationship between income risk and abilities.

We conclude that the results on the (distinct) effects of abilities on incomes for entrepreneurs and employees are not affected by (i) nonnatives for whom the relationship between test scores and income might be different (ii) industry differences. Moreover, some explorative evidence suggests that the effects of ability on income levels are not associated with similar effects of ability on income risk.

5. Conclusion

On average, 10% of the labor force in any developed country are entrepreneurs, that is, business owners (either self-employed or owner–managers of incorporated businesses), see Parker, 2004. Moreover, successful entrepreneurship has a profound effect on economic growth, labor demand, and innovation (see the survey by Van Praag and Versloot, 2007). Therefore, knowledge about the determinants of entrepreneurs' performance is relevant.

We find markedly different returns to ability for entrepreneurs and employees. The same individual has a 30% higher return to general ability when active as an entrepreneur than when working as an employee. Nevertheless, the results suggest that the expected earnings *levels* in entrepreneurship relative to wage employment are higher only for the upper echelon of the general ability distribution. This is due to the fact that, for the average individual, the expected earnings levels in spells of entrepreneurship are lower than in wage employment.

We also find differential returns to measures of specific abilities for entrepreneurs versus wage employees. In particular, the science-oriented part of the set of abilities generates higher returns in spells of entrepreneurship. One standard deviation increase in technical ability pays 12% more when active as an entrepreneur, whereas mathematical ability has a much smaller positive premium for entrepreneurs. In addition, social ability benefits entrepreneurial incomes more than wages. As in the case of general ability, expected earnings levels are higher in entrepreneurship than wage employment only for observations in the very right-hand tail of the distribution of these specific abilities on which entrepreneurs earn a premium relative to wage employees. This is due to the lower expected income in entrepreneurship for the average individual. The other measured abilities, that is, verbal ability and, in particular, clerical ability have better payoffs as an employee. Increasing one's measured level of clerical ability by one standard deviation increases the income premium in wage employment relative to entrepreneurship by 8 to 10%.

In support of Lazear's Jack-of-all-Trades theory, we find that a more balanced portfolio of individual ability levels boosts earnings as an entrepreneur. However, it leaves earnings as an employee unaffected.

The results are generally quite robust. For instance, all our conclusions are insensitive to including or excluding education in the regression equation or in the correction of ability scores. In this manner we are confident that our main conclusion is probably not affected by important empirical issues regarding the interrelationship between abilities and education. Furthermore, all our conclusions are obtained using various econometric specifications: The results obtained when estimating a random effects model are very similar to these obtained from a diff-of-diff specification where effects are identified based upon *changes* in incomes due to *changes* in occupational positions for various ability levels. This indicates that self-selection into occupations based on unobserved fixed individual characteristics is not driving the results. However, we cannot conclude that selectivity plays no part at all. We cannot exclude that some individuals (with particular ability sets) are better at identifying lucrative opportunities when they pass by and thus time their decisions to become entrepreneurs better. In that case the measured effect of abilities on income may not be completely causal.

Comparing these results to the (ability related) drivers of occupational choice, we conclude that there is a discrepancy between the drivers of occupational choice and the relative income from entrepreneurship versus wage employment. This conclusion is in line with the "returns to entrepreneurship puzzle" (Hyytinen et al., 2008). Despite lower average and more risky incomes, people not only choose to become and remain entrepreneurs but they also turn out more satisfied as such (Benz and Frey, 2008; Blanchflower and Oswald, 2008; Hamilton, 2000; Hyytinen et al., 2008; Parker, 2004; Van Praag and Versloot, 2007).

We show that the puzzle remains when looking at a specific driver of financial returns, that is, abilities, instead of income levels themselves. Recent empirical studies trying to solve this puzzle find that the choice for entrepreneurship is mainly governed by more autonomy and control over (the accruals from) one's own work as an entrepreneur compared to positions in wage employment (Benz and Frey, 2008; Hyytinen et al., 2008) and not so much by income maximization.

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