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Risk, Balanced Skills and Entrepreneurship

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Risk, Balanced Skills and Entrepreneurship*

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Abstract

This paper proposes that risk aversion encourages individuals to invest in balanced skill profiles, making them *more* likely to become entrepreneurs. By not having taken this possible linkage into account, previous research has underestimated the impacts both of risk aversion and balanced skills on the likelihood individuals choose entrepreneurship. Data on Dutch university graduates provides evidence which supports this contention. It thereby raises the possibility that even risk-averse people might be suited to entrepreneurship; and it may also help explain why prior research has generated mixed evidence about the effects of risk aversion on selection into entrepreneurship.

Keywords: entrepreneurship; jack-of-all-trades; risk; human capital; occupational choice

JEL *Classification:* D81, J24, L26, M13

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1 Introduction

Two of the most influential theories of individual selection into entrepreneurship are based on the concepts of risk aversion, RA (Kihlstrom & Laffont, 1979), and balanced skills, BS (Lazear, 2005). Specifically, if entrepreneurship is a more risky occupation than paid-employment, and if individuals vary in their aversion to risk, then it follows that the least risk-averse people are most likely to become the entrepreneurs (Kihlstrom & Laffont, 1979). Moreover, because entrepreneurship requires expertise in a variety of roles while paid-employment rewards specialists, people with balanced skills are most likely to become entrepreneurs as well (Lazear, 2005).

Despite the prominence and continued influence of wish to acknowledge Peter Berkhout for access to the data used in this manuscriptthe RA and BS theories, the evidence for them is decidedly mixed. For example, many psychology-based studies have failed to detect any difference between entrepreneurs and non-entrepreneurs in terms of their risk attitudes (Brockhaus, 1980; Shaver & Scott, 1991). Meta-analyses of risk aversion and entrepreneurial selection have also generated conflicting results (Stewart & Roth, 1991; Miner & Raju, 2004), with Miner & Raju (2004) concluding that the available evidence about the validity of the RA theory is inconclusive. Economics-based studies have also generated mixed findings (Åstebro et al, 2012). While some research suggests that entrepreneurs are indeed typically less risk-averse than employees (Cramer et al, 2002; Brown et al, 2011), others have reported insignificant differences between these groups (Barsky et al, 1997; Parker, 2008). And while several studies have measured balanced skills in terms of the number of prior job roles, and have generated evidence consistent with the BS theory (Lazear, 2005; Wagner, 2006; Hartog et al, 2010; Åstebro & Thompson, 2011), the robustness of these results has been called into question (Silva, 2007).

While RA and BS remain popular and influential theories, not least because of their persuasive and attractive internal logics, their lack of clear empirical support raises several troubling questions. For example, does the inconclusive evidence about the role of risk aversion mean that any differences of this sort do not affect occupational choice on net, perhaps because other factors dominate this choice (or because paid-employment is also risky: Parker, 1997)? Likewise, have the estimates of skill balance been weakened by using a flawed proxy, namely the number of prior job roles — or are they actually a mirage, masquerading as hard-to-measure personal abilities (Silva, 2007; Hartog et al, 2010), or preferences such as a 'taste for variety' (Åstebro & Thompson, 2011)? Lacking answers to these questions, our knowledge about reasons why people become entrepreneurs is bound to remain limited.

This paper proposes a different argument which may shed light on this issue. Specifically, we propose that balanced skills and risk aversion are not the independent constructs which previous research has taken them for. Given evidence that risk-averse actors like to diversify their human capital (e.g. Amihud & Lev, 1981), one might expect highly specialized employees to be left with few competitive options if returns from specialism suddenly become less valuable in fast-changing, uncertain environments (Abernathy & Wayne, 1974). Then risk-averse individuals who fear the loss of flexibility associated with highly specialized human capital may respond by diversifying their human capital investments. As a result, risk-averse people could ironically end up acquiring the balanced skill sets which, it is argued, are especially conducive to entrepreneurship.

As well as being of interest in its own right, the possibility that risk aversion and balanced skills are positively related implies, as we go on to show, that empirical studies (which have ignored this interdependence hitherto) are prone to have underestimated both of their impacts on entrepreneurial selection. In principle, this point might help to explain the weak and mixed body of evidence pertaining to the RA and BS theories.

The paper makes the following contributions. First, it extends our theoretical understanding of entrepreneurship as an occupational choice by proposing a novel association between the two hitherto separate concepts of risk aversion and balanced skills. Our simple formulation extends the theory of BS from a certain environment (as in Lazear, 2005) to a risky one. Risk is present in both occupations; and the acquisition of balanced skills is treated as a choice variable, rather than being taken as given as in previous work. Second, our theorizing proposes a richer empirical specification, which is estimated using a sample of recent graduates from universities in the Netherlands. The dataset has two attractive properties. One is that, in line with our theory, the survey respondents are homogeneous in terms of their education levels and labor market experience. The other is that, consistent with our theory, skills balance is measured prior to when occupational choices were observed, thereby avoiding problems of reverse causality. Furthermore, we depart from the conventional practice of proxying skills balance by the variety of prior labor market experience, which may be associated with unobserved abilities (Silva, 2007). Instead we propose a novel measure based on the observed multi-industry versatility of degree majors as well as on the spread of individual-level scholastic skills (whose levels we also control for). Third, the paper makes a further contribution by providing a platform for re-evaluating mixed prior evidence from tests of the RA and BS theories.

2 The model

There are two occupations, paid employment (P) and entrepreneurship (E), and two skills which generate returns in both occupations, x_1 and x_2. To abstract from issues of aggregate skill acquisition, which is not of interest here, assume that every agent obtains a unit endowment of total skill. This allows us to use the more compact notation $x_1 = x$ and $x_2 = 1 - x$ hereafter. In E, both skills are needed for any output to be produced, whereas in P, workers can specialize in one skill. People specialize if they choose $x^* = 1$ or $x^* = 0$. If $0 < x^* < 1$ they choose some mixture of skills. The production technology which maps x and $1 - x$ into returns differs in each occupation, as described below.

The timing of events in the model is as follows. Individuals (students) first undergo schooling, at which point x is determined. Students are uncertain about their idiosyncratic ability in both occupations, as well as future stochastic returns given those abilities. There are therefore two sources of risk, which will hereafter be connoted by 'idiosyncratic' and 'market' risk. Students choose x *ex ante*, i.e. before having any idea which occupation they will enter after leaving school. Instead, their choice is predicated on expectations about the distribution of occupational returns as explained below. After choosing their x (which then becomes fixed), students graduate and enter the workforce. At this point their abilities in the two occupations are revealed. Thus their idiosyncratic risk is resolved, but their market risk remains. They then make their *ex post* occupational choice given their x. Therefore, *ex ante* choices of x are not correlated with subsequent *ex post* occupational choices — an important feature of the model which bears on the empirical strategy adopted in Section 3 below.

In the following, we first outline our model for the case of certainty. This is the case analyzed by Lazear (2005) and others. We then extend the analysis to the case of risk, analyzing the problem of maximizing *ex ante* expected utility and choosing x. Finally, we analyze *ex* *post* occupational choices.

Certainty. Suppose specialization in $x = 1$ yields the return ω_1 in P while specialization in $x = 0$ yields return ω_2 in P. According to Lazear (2005), $y^P = \max\{x, 1-x\}$, so workers do best specializing in one skill or the other. In E, Lazear's return function is $y^E = \min\{x, 1-x\}$, so entrepreneurs do best if they have balanced skills: $x = \frac{1}{2}$.

For tractability, we will use generalized versions of Lazear's specifications which do not predetermine specialization choices by assumption — and, more importantly, which enable the model to be extended tractably to deal with the case of risk. We will first show that our specifications generate the same results in the case of certainty. Our specifications of the returns in each occupation are:

$$\begin{aligned} y^P(x) &= \omega_1 x + \omega_2(1-x) && (1) \\ y^E(x) &= \theta x(1-x)\,. && (2) \end{aligned}$$

In the benchmark case of certainty considered by Lazear (2005), all parameters in the set $\Omega := \{\omega_1\,, \omega_2\,, \theta\}$ are positive. It follows immediately that workers do best with $x = 1$ if $\omega_1 > \omega_2$ and with $x = 0$ if $\omega_1 < \omega_2$ (either solution is equally good if $\omega_1 = \omega_2$). Entrepreneurs do best with $x = \frac{1}{2}$. Hence employees specialize in one skill while entrepreneurs have balanced skills. Provided $\theta > 4\max\{\omega_1, \omega_2\}$, individuals with balanced skills do best in E, whereas those possessing specialized skills do best in P. These predictions mirror Lazear's.

Risk. Now we move into more novel territory by examining the roles of risk and risk preferences. Consider the standard utility function

$$U(y) = -e^{-\lambda y}\,,\ \lambda > 0 \qquad (3)$$

where λ is the coefficient of absolute risk aversion (ARA). To introduce idiosyncratic and market risk, make Ω stochastic, with $\omega_1 \sim N(\mu_1, \sigma^P + \phi)$, $\omega_2 \sim N(\mu_2, \sigma^P + \phi)$ and $\theta \sim N(m, \sigma^E + \psi)$ *ex ante.*[1] All agents are assumed to know the parameters of all of these normal distributions *ex ante*, which all have positive means and variances. Here, ϕ and ψ capture market risk, which is never resolved and cannot be insured against. The σ components of variance capture idiosyncratic risk (i.e. uncertainty about abilities), which is resolved

[1] Restricting the variances of ω_1 and ω_2 to be equal results in no loss of generality for the analysis below.

once students graduate and enter the workforce. At this point, individuals' abilities are revealed, so e.g. individual i knows their mean returns will be $(\mu_1 + a_{1i})$ and $(\mu_2 + a_{2i})$ in P and $(m + b_i)$ in E. Thus Ω remains stochastic *ex post*, but now with $\omega_{1i} \sim N(\mu_1 + a_{1i}, \phi)$, $\omega_{2i} \sim N(\mu_2 + a_{2i}, \phi)$ and $\theta_i \sim N(m + b_i, \psi)$: $\forall i$. All individuals use this information identically to calculate *ex ante* expected utility as

$$\max_x \{sEU(y^P) + (1-s)EU(y^E)\}\,. \tag{4}$$

The weights s and $1-s$ are the observable workforce shares in P and E, respectively. Individuals use this to make choices about x — but not occupational choice, since it pays to wait for idiosyncratic risk to resolve itself before making that choice.

The following assumption restricts admissible parameter values to ensure internal consistency of the model:

Assumption 1 *(a)* $|\mu_1 - \mu_2| \leq \lambda(\phi + \sigma^P)$*. (b)* $m > \lambda(\psi + \sigma^E)/4$*. (c)* $\min\{\mu_1, \mu_2\} > \lambda(\phi + \sigma^P)/2$*.*

Assumption 1(a) is needed to ensure that choices of x in P derived in (5) below are confined to the unit interval. Assumptions 1(b) and 1(c) ensure that positive mean effects dominate negative variance effects in terms of expected utility in both occupations.

As is well known, the combination of normally distributed payoffs with constant ARA utility (3) gives rise to simple mean-variance utility expressions (see e.g. Sargent, 1987, 154–55). So, for example, the sub-problem $\max_x EU(y^P)$ of (4) is equivalent to

$$\max_x \left\{\mu_1 x + \mu_2(1-x) - \lambda(\phi + \sigma^P)[x^2 + (1-x)^2]/2\right\}$$

The first order condition for this sub-problem yields

$$x^* = \frac{1}{2} + \frac{\mu_1 - \mu_2}{2\lambda(\phi + \sigma^P)}\,. \tag{5}$$

This equation implies that the optimal skill profile in P under risk generally differs from the skill profile under certainty analyzed above. Even if P was the only feasible occupation ($s = 1$), risk would give all employees some incentives to acquire more balanced skill sets, as can be seen in (5) as $(\phi + \sigma^P) \to \infty$. The reason is that, when it is unknown *a priori* which skill will be most valuable, workers have incentives to choose a skill profile which diversifies their labor market portfolio.

The optimal skill balance for the E sub-problem of (4) is as follows. Write the optimization sub-problem in E as $mh(x) - (m\zeta/2)[h(x)]^2$, where $h(x) = x(1-x)$ and, by Assumption 1(b), $\zeta = \lambda(\psi + \sigma^E)/m < 4$. The first order condition for this problem is

$$h'(x)[1 - \zeta h(x)] = 0\,.$$

But $h \in (0, \frac{1}{4}]$ while $\zeta < 4$, so $\zeta h(x) < 1$ and the above first order condition requires $h'(x) = 0$. This solves for $x^* = \frac{1}{2}$ in E. So introducing risk into E does not affect the incentives to obtain balanced skills in that occupation. We can now state the first proposition:

Proposition 1 *Greater risk aversion is associated with a more balanced skill profile except for the special case where returns to the two skills in P are identical.*

Proof. When $\mu_1 \neq \mu_2$, (5) can be differentiated to obtain $\partial|x^* - \frac{1}{2}|/\partial\lambda < 0$. Hence greater risk aversion is associated with a more balanced skill profile. When $\mu_1 = \mu_2$, (5) implies $x^* = \frac{1}{2}$ irrespective of λ — as in occupation E. ■

Naturally, agents' uncertainty about which occupation they will eventually choose provides another motive for obtaining skill balance. Computing the solution to the full *ex ante* problem (4) yields an optimal *ex ante* skill balance choice of $x^* = \frac{1}{2} + s\Delta$, where[2]

$$\Delta := (\mu_1 - \mu_2)/2\lambda(\phi + \sigma^P)\,.$$

We can now analyze the *ex post* occupational choice problem. Once the values of a_1, a_2 and b are revealed, each individual is able to make their occupational choice under conditions of market risk and conditional on x^*. Consider for example individuals who face mean returns $\tilde{\mu}_1 := \mu_1 + \tilde{a}_1$ and $\tilde{\mu}_2 := \mu_2 + \tilde{a}_2$ in P and mean return $\tilde{m} := m + \tilde{b}$ in E. To ensure that E is a non-empty occupation in equilibrium, we need a condition to ensure that mean returns in E are sufficiently high:

[2]Strictly interpreted, the model predicts the same x^* for everyone. This outcome is easily generalized by extending the model to allow people to have heterogeneous erroneous knowledge about, e.g., μ_1, μ_2 and/or m. A key assumption for the empirical analysis would then have to be that these errors are uncorrelated with subsequent occupational choices.

Assumption 2

$$\tilde{m} > \frac{\lambda\psi}{8} + 4\tilde{\mu}_1\left(\frac{1}{2}+\Delta\right) + 4\tilde{\mu}_2\left(\frac{1}{2}-\Delta\right) - 2\lambda\phi\left[\left(\frac{1}{2}+\Delta\right)^2 + \left(\frac{1}{2}-\Delta\right)^2\right]$$

where $\tilde{\Delta} := (\tilde{\mu}_1 - \tilde{\mu}_2)/2\lambda(\phi + \sigma^P)$.

We can now state the next proposition:

Proposition 2 *All else equal, an individual with a more balanced skill profile is more likely than an individual with a less balanced skill profile to choose occupation E over P.*

Proof. Denote by $\hat{x}$ the values of x which make individuals indifferent between P and E:

$$\begin{aligned}\tilde{\mu}_1\hat{x} + \tilde{\mu}_2(1-\hat{x}) \quad &- \quad \lambda\phi\left[\hat{x}^2 + (1-\hat{x})^2\right]/2 \\ &= \quad \tilde{m}\hat{x}(1-\hat{x}) - \lambda\psi\hat{x}^2(1-\hat{x})^2/2 \qquad (6)\end{aligned}$$

By Assumptions 1(c) and 1(b), the LHS of (6) is monotonic in x while the RHS is a $\cap$-shaped quadratic in x, with its maximum at one half. By Assumption 2 the LHS and RHS intersect. Hence there are two solutions to (6), denoted by $(\hat{x}_1, \hat{x}_2)$. Everyone with *ex ante* choices $x^* < \hat{x}_1$ or $x^* > \hat{x}_2$ chooses P while everyone with $\hat{x}_1 \leq x^* \leq \hat{x}_2$ chooses E. Hence more balanced skills are associated with the choice of E over P in an occupational choice equilibrium. ∎

Proposition 2 shows that Lazear's well-known occupational choice result extends to the new domain of risky returns in paid employment and entrepreneurship.

Finally, we examine the effects of risk aversion on occupational choice. Changes in λ have 'direct' and 'indirect' effects on occupational choice. The direct effect relates to risk averters' dislike of payoff variance in both occupations. The indirect effect relates to the impact on skill profiles (Proposition 1) which affect mean returns. The following proposition states the main result:

Proposition 3 *(a) The direct effect of risk aversion on occupational choice is ambiguous in general; a necessary condition for greater risk aversion to promote P over E is* $\psi >$

8ϕ. *(b) The indirect effect of greater risk aversion unambiguously increases the number of entrepreneurs.*

Proof. (a) Let $z^*|x^*$ be the difference in expected utility in E relative to P, conditional on x^*:

$$z^*|x^* = \tilde{m}x^*(1-x^*) + \frac{\lambda}{2}\left[\phi(x^{*2} + (1-x^*)^2) - \psi x^{*2}(1-x^*)^2\right] - \tilde{\mu}_1 x^* - \tilde{\mu}_2(1-x^*)\,. \quad (7)$$

The direct effects of risk aversion are given by

$$dz^*/d\lambda = [\phi(x^{*2} + (1-x^*)^2) - \psi x^{*2}(1-x^*)^2]/2\,.$$

This derivative is only certain to be negative if ψ is sufficiently large relative to ϕ, i.e. if

$$\frac{\psi}{\phi} > \frac{x^{*2} + (1-x^*)^2}{x^{*2}(1-x^*)^2}\,.$$

In E, $x^* = \frac{1}{2}$ so $\psi > 8\phi$ is the necessary condition. In P, $x^* \neq \frac{1}{2}$ so the ψ/ϕ ratio must be greater still. Hence the condition $\psi > 8\phi$ is necessary (but not sufficient) for an increase in λ to have a negative direct effect on incentives to choose E over P.

(b) Proposition 1 established that the indirect effect of greater λ on balanced skills in P is positive. Hence by Proposition 2, more employees prefer E to P. At the same time, the solution $x^* = \frac{1}{2}$ in E is invariant to λ (i.e. a greater λ decreases the height of the quadratic return function in E without affecting its skew). Since an increase in λ shifts individuals from P to E, the total number of entrepreneurs increases. ■

Proposition 3 shows that balanced skills have subtle implications for the effects of risk aversion on *ex post* occupational choice. On the one hand, when risk is present in both occupations the direct effects of risk aversion become ambiguous in principle (see also Parker, 1997). However, sufficiently pronounced income risk in entrepreneurship relative to paid employment predisposes risk-averse people to choose paid-employment over entrepreneurship. On the other hand, because greater risk aversion encourages people to acquire more balanced skill sets *ex ante*, and because balanced skills are more valuable in entrepreneurship *ex post*, greater risk aversion also serves to make entrepreneurship more attractive relative to paid employment through the indirect balanced skills channel. An empirical analysis of risk aversion and balanced skills in entrepreneurship needs to take account of these distinct mechanisms.

3 Empirical Methodology and data

3.1 Empirical methodology

Empirical analyses of entrepreneurship as an occupational choice usually run regressions which include either risk aversion or balanced skills variables, but not both. Below, we first outline the implications for tests of the RA and BS theories when one or other of the variables measuring risk aversion or balanced skills is omitted. We also explain our empirical strategy for testing the Propositions developed in the previous section when both variables are present.

Consider the following equation to be estimated using a sample of individuals i:

$$z_i^* = \beta_0 + \beta_1 \lambda_i + \beta_2 SB_i + \beta_3 X_i + u_i \qquad i = 1, \ldots, n \tag{8}$$

where z_i^* is a latent variable underlying a binary occupational choice variable [see (7) in the proof of Proposition 3] such that

$$z_i = \begin{cases} 1 & \text{if } i \text{chooses entrepreneurship: } z_i^* > 0 \\ 0 & \text{if } i \text{chooses paid employment: } z_i^* \leq 0 \end{cases} \tag{9}$$

Here λ_i and SB_i are individual-level measures of risk aversion and skill balance, respectively; X_i are a set of orthogonal control variables and u_i is a disturbance term. According to Proposition 1, λ_i and BS_i are directly related; let $\gamma > 0$ denote the coefficient of proportionality.

In terms of (8), Proposition 2 predicts $\beta_2 > 0$, while Proposition 3(a) predicts β_1 is ambiguous in principle though negative if entrepreneurship is much riskier than paid employment. Hereafter, suppose $\beta_1 < 0$, in accordance with the RA theory of Kihlstrom and Laffont (1979) (who ignored risk in P). Given these predictions, we can now deduce the bias that will occur if λ_i or SB_i are omitted from (8). First consider the case where SB_i is omitted. Then a standard result in econometrics (e.g. Greene, 2003) is that the bias from estimating

β_1 is $\gamma\beta_2$ — which is positive. Hence estimates of the risk aversion effect on choice for entrepreneurship will be upward biased, i.e. biased towards zero if $\beta_1 < 0$. This might explain why some studies which analyzed only risk aversion and not balanced skills found small or insignificant effects of risk aversion on entrepreneurial selection.

Second, consider the case where λ_i is omitted. Now the bias from estimating β_2 is $\gamma\beta_1$, which is negative if $\beta_1 < 0$. Hence estimates of the balanced skills effect on choice for entrepreneurship will be downward biased, i.e. biased towards zero. Likewise, it is possible that this might explain why studies which analyzed only balanced skills and not risk aversion detected only small or insignificant effects of balanced skills on entrepreneurial selection.

Our empirical strategy is as follows. First, we examine whether SB_i and λ_i are positively related by using OLS to estimate γ in a regression of SB_i on λ_i. This tests Proposition 1. Second, we estimate the effects of SB_i and λ_i by applying probit methods to (8) & (9). This tests Propositions 2 and 3(a). In each of these cases, we also take account of the possibility that skill balance and unobservables affecting occupational choices are more similar within degree fields than between them. We do so by additionally reporting clustered standard errors by degree field j ($j = 40$). And, we also provide estimates using robust estimation techniques to correct for heteroskedasticity.

Third, we statistically test the biases predicted above, which can be summarized as $\beta_1 < [\beta_1|\beta_2 = 0]$ and $\beta_2 > [\beta_2|\beta_1 = 0]$. This tests Proposition 3(b). Taking the case of $\beta_1 < [\beta_1|\beta_2 = 0]$ first, there are two steps to performing the test. First, (8) is estimated twice using Seemingly Unrelated Estimation. The first estimation includes SB and the second excludes it. This generates two sets of parameters and variance-covariance matrices.[3] Second, a Chi-squared statistic is computed and a test is performed to determine whether the differences between the two estimates of β_1 — the first of which left β_2 unrestricted and the second of which restricted it to zero — is statistically significant (see Clogg et al, 1995, for details). Finally, for the case $\beta_2 > [\beta_2|\beta_1 = 0]$ this procedure is then repeated first including and then excluding λ at the first step.

The theoretical model was structured such that SB was determined *ex ante* and independently from occupational choice *ex post*. As a result, SB is exogenous in the theoretical set up. This reason alone is sufficient not to adopt the alternative empirical approach of

[3]The `suest` routine implements this procedure in STATA: see Weesie (1999).

Instrumental Variable (IV) estimation of (8) and (9). Were IV to be used, SB_i would be related to λ_i and some other variables. IV would require valid identifying instruments, i.e., factors that affect the choice for investing in balanced skills but not the choice of entrepreneurship. Our dataset does not include variables that would qualify as identifying instruments in any case. By not using IV estimation we implicitly assume (in line with our model) that the investment in balanced skills is not affected by the prospect of a future occupational choice. This assumption does not seem implausible given that our measure of skills balance is based on choices of children between 12 and 18 years of age.

3.2 Data

3.2.1 Sample

Since 1999, the Dutch research institute SEO, in collaboration with the prominent weekly magazine 'Elsevier', has administered an annual survey designed to measure labor market prospects of recent graduates across colleges and universities in the Netherlands. Respondents fill out extensive questionnaires (two January's after graduation) about their tertiary education majors and secondary school grades. Respondents also provide information about their demographic backgrounds, current labor market situations, occupational status (e.g. unemployed, self-employed, wage-employed), and incomes. Because a measure of risk aversion was obtained only in the January 2004 interviews, we use data from that survey. The final sample comprises 3,002 respondents who graduated in 2002 with a Master's degree and who were working as paid employed or self-employed in January 2004.

An advantage of these data is that, consistent with the theory expounded in the previous section, the survey respondents are homogeneous in terms of education level and labor market experience. They differ however in terms of their investments in balanced skills. Moreover, the data are rich enough to measure balanced skills in two distinct ways, as explained below. Crucially, the choices giving rise to both measures of BS_i were made before any labor market participation decisions, thereby avoiding problems of reverse causality.

3.2.2 Variables

Occupational choice: self-employment versus wage employment. Consistent with the data, we operationalize entrepreneurship as self-employment, and use as the dependent variable an indicator variable taking the value one if the respondent is self-employed and zero if they are wage employed. Despite its widespread use in parts of the entrepreneurship literature, especially in studies (such as this one) which emphasize occupational choice in labor markets, self-employment has been criticized for including numerous 'casual' and low value-added businesses (Elfenbein et al, 2010). Similar to Elfenbein et al (2010), however, the present sample attenuates this problem to some extent by sampling only relatively highly-educated Master's graduates from the fourteen universities in the Netherlands. Reflecting the valuable human capital of this group, we believe that higher-value types of self-employment are likely to predominate in the sample. We acknowledge that self-employment may still be regarded as a questionable measure of entrepreneurship, despite the number of scholars who utilize it, including in the management field (Elfenbein et al, 2010; Folta et al, 2010; Nanda & Sørensen, 2010; Åstebro et al, 2012).

According to Table 1, only 2.8 per cent of the sample was self-employed at the time of the 2004 survey. Low rates of self-employment among recent graduates are commonplace (Dolton and Makepeace, 1990), owing to insufficient time for recent graduates to accumulate the financial and social capital needed to make a success of self-employment.

Risk attitude. Respondents were asked to value participation in a hypothetical lottery paying out $1,000$ euros with a 10 percent chance of success. The reservation price (p) for participating in such a hypothetical lottery has been shown to be a valid (inverse) indicator of risk aversion and behavior under risk (see Barsky et al, 1997; Cramer et al., 2002; Dohmen et al., 2012). Risk neutrality would imply a reservation price of 100 and risk aversion a price below 100. We measure risk aversion as $\lambda = 100 - p$. The average score on this measure of risk aversion is 75.0 (with a standard deviation of 21.5), see Table 1. Furthermore, the average value of λ in the subset of self-employed is significantly lower than in the subset of employees ($\lambda = 67.4$ versus $\lambda = 75.3$, $p < 0.01$) — in line with earlier applications (Cramer et al, 2002).

Table 1: Descriptive statistics of the key and control variables

	Variable	*N*	*Mean*	*SD*	*Min*	*Max*	*Correlations*									
							1	2	3	4	5	6	7	8	9	10
	Key variables															
1	Self-employed (dummy)	3002	0.028	0.165	0	1										
2	Risk aversion (λ)	3002	75.05	21.49	1	100	-0.07									
3	Generality	2782	0.089	0.035	.0252	.2121	0.09	0.07								
4	Grade variance	2905	0.421	0.355	-1.4006	1	0.00	0.06	-0.07							
5	Skill balance (SB)	2692	0.037	0.036	-.1379	.2121	0.04	0.06	0.85	0.34						
	Controls															
6	Male (dummy)	3002	0.487	.500	0	1	0.03	-0.35	-0.02	-0.02	-0.01					
7	Age (at graduation)	3002	25.6	1.4	22	29	0.07	-0.06	0.00	-0.05	-0.03	0.18				
8	Mother's education	2981	3.029	1.077	1	5	0.02	-0.01	0.04	-0.03	0.03	-0.05	0.03			
9	Father's education	2980	3.597	1.178	1	5	0.00	-0.03	0.04	-0.04	0.01	-0.01	0.08	0.56		
10	GPA_secondary	3002	7.129	0.637	5.3	9.6	-0.03	-0.12	-0.04	0.06	-0.01	0.15	-0.14	0.12	0.09	
11	GPA_tertiary	3002	7.278	0.518	6	10	-0.01	0.00	-0.03	0.10	0.02	0.04	-0.17	0.08	0.03	0.46

Skill balance. Our objective is to measure choices of skill balance prior to the acquisition of labor market experience by sample respondents. Our skill balance variable (*SB*) is computed as the product of two underlying measures. The first underlying measure, 'Generality', captures the variety of industries that a given degree major is observed to be used in. It therefore captures an 'external', usage-based aspect of skill versatility. The second underlying measure, 'Grade variance', records the spread of grades that individuals achieve across three different secondary school courses. It captures an 'internal', i.e. individual-specific, aspect of balance of innate skill competence.

Generality. Some degree majors confer a skill set which is useful in a variety of different industries after graduation, whereas other majors have only a narrow, or specialized, range of applicability. We define our *Generality* measure as the total number of distinct industry sectors employing graduates with a given major two years after graduation, scaled by the number of students graduating with that major. To minimize the impact of outliers, we only define this variable for degree fields with more than thirty graduates in the sample. Data on both employees and the self-employed were used to construct this measure. Appendix Table A1 lists all academic majors, the numbers of associated respondents, values of Generality, and self-employment rates. Majors such as sociology, applied computer science, languages and culture have high Generality scores, whereas medical sciences ranks lower. Appendix Table A2 lists the distinct industry sectors and the number of observations in each sector.

Grade variance. This construct measures the variation in grades received by respondents while in secondary school. The smaller this variation, the more balanced is a person's foundation of learning skills. *Grade variance* equates to $1 - stdev(\alpha, \beta, \gamma)$, where $\alpha =$ Grade Point Average (GPA) in humanities and languages, $\beta =$ GPA in hard sciences, and $\gamma =$ GPA in behavioral sciences.

Skill balance. We multiply 'Generality' and 'Grade variance' together to obtain a composite explanatory variable, *SB*. By combining a measure of skill balance which varies across degree fields with a measure which varies across individuals, *SB* provides a comprehensive overall measure of skill balance. We believe this is more informative than either of the underlying measures alone. For instance, 'Generality' on its own says relatively little about skill balance at the individual level, while 'Grade variance' on its own does not capture the industry context and applicability of diverse skills.[4] The main tables of results below

[4]Previous measures of balanced skills have emphasized individual level variation, relying heavily on

will present results based on SB, although for completeness the Appendix will also present results obtained for each of the underlying measures.

Control variables Besides the key variables described above, we include a set of control variables including gender, age (varying from 22 to 29), parental education levels (measured on a 1-5 scale), and ability levels. The latter is measured as mean GPA scores both in secondary and in tertiary education, expressed on a scale from 1–10, where 6 is deemed a pass grade in the Netherlands. Table 1 presents descriptive statistics and correlations between the variables. There are no obvious problems of collinearity. Self-employment is correlated negatively with risk aversion and positively with 'Generality' (though not with 'Grade variance'), while risk aversion is associated positively with skill balance. Interestingly, the two main measures of skill balance are negatively correlated, suggesting that they are capturing distinct aspects of SB.

4 Estimation results

We first test Proposition 1 by measuring the association between skill balance, SB, and risk aversion, λ, among employees. Column I of Table 2 presents the results for a 'baseline' specification without control variables. It offers clear support for the proposition that people who are more risk averse acquire significantly more balanced skill sets. These results continue to hold when control variables are included and alternative estimation methods, namely robust estimation and clustering, are used (columns II–IV). The results for the two underlying SB measures can be found in Appendix Table A3. Across the board, the results support Proposition 1.

Next, we test Proposition 2 by estimating a probit model of self-employment status. The results reported in Table 3 display a significant positive effect from SB. This supports Proposition 2 and is consistent with the BS theory (and Åstebro & Thompson's (2011) 'taste for variety' argument) — as well as prior empirical findings from Lazear (2005), Wagner (2006) and Åstebro and Thompson (2011). The positive association between bal-

the number of previous job roles (though Lazear, 2005, also proposed the diversity of subjects studied at college). Unlike numbers of job roles, our SB variable is not time-varying, so panel data estimation could not be used to control for person-specific fixed effects à lá Silva (2007), even if we had a panel.

Table 2: Risk aversion and skill balance (SB)

Variable	Specification (I)	Specification (II)	Specification (III)	Specification (IV)
Risk aversion (λ)	0.0001***	0.0001***	0.0001***	0.0001***
	(3.020)	(3.130)	(2.870)	(3.310)
Male		0.001		0.001
		(0.700)		(0.420)
Age (at graduation)		-0.001		-0.001
		(1.600)		(0.940)
Mother's education		0.001		0.001
		(1.040)		(0.940)
Father's education		0.000		0.000
		-(0.050)		(0.060)
GPA_secondary		-0.001		-0.001
		-(0.570)		(0.580)
GPA_tertiary		0.001		0.001
		(0.440)		(0.530)
Constant	0.029***	0.047**	0.029***	0.047
	(11.94)	(2.51)	(11.18)	(1.63)
N	2619	2596	2619	2596
R^2	0.033	0.0055	0.0033	0.0055
F	9.14	2.27	8.25	2.14
$Pr > F$	0.0025	0.0268	0.0065	0.0619
Control variables included	no	yes	no	yes
Robust estimation	yes	yes	no	no
Clustered estimation (j =*40*)	no	no	yes	yes

Note: J= 40 clusters. Absolute t-values are given in parentheses. The sample excludes self-employed entrepreneurs. They are based on robust estimates in specifications 1 and 2, and based on clustered estimates in specifications 3 and 4. ***/**/* denotes significance at the 1%/5%/10%-level.

Table 3: Self-employed entrepreneurship, risk aversion and skill balance (SB)

	Specification (I)	Specification (II)	Specification (III)	Specification (IV)	Specification (V)	Specification (VI)
SB	2.5818*	2.7175**	2.9830**	3.0573**		
	(1.94)	(2.08)	(2.16)	(2.29)		
Risk aversion (λ)			-0.0073***	-0.0075***	-0.0064***	-0.0060***
			(3.29)	(3.32)	(3.20)	(2.68)
N	2692	2669	2692	2669	3002	2975
$pseudo - R^2$	0.0058	0.0313	0.0230	0.0458	0.0129	23.93
Wald χ^2	3.78	27.00	13.00	38.99	9.91	0.0012
$Pr > \chi^2$	0.0520	0.0003	0.0015	0.0000	0.0016	0.0313
Control variables included	no	yes	no	yes	no	yes
Robust estimation	no	no	no	no	yes	yes
Clustered estimation (j =40)	yes	yes	yes	yes	no	no

Note: J= 40 clusters. Absolute t-values are given in parentheses. The results for specifications I-IV are obtained by clustered estimation methods where each cluster is an education degree field (with $n_j > 30$ observations). The results are similar when applying robust estimation instead of clustered estimation. Specifications V-VI do not include variables that require clustering. ***/**/* denotes significance at the 1%/5%/10%-level. The controls included in specifications (II), (IV) and (VI) are the same as in Table 2.

Table 4: Testing the indirect effect of risk aversion on self-employment

χ^2-test	Specification (I)	Specification (II)
Proposition 3b:		
$\beta_2 > \beta_2 \vert \beta_1 = 0$		
χ^2	4.18**	3.96**
P-value	0.0410	0.0465
N	2692	2669
Corrolary:		
$\beta_1 < \beta_1 \vert \beta_2 = 0$		
χ^2	5.55**	12.34***
P-value	0.0185	0.0004
N	3002	2975
Control variables included	no	yes
Clustered estimation (j =*40*)	yes	yes

Note: ***/**/* denotes significance at the 1%/5%/10%-level.

anced skills and self-employment status hold irrespective of whether control variables are included (specifications II and IV) or not (specifications I and III). Including the risk aversion variable, λ, does not change this result either (compare specifications I and II with III and IV). The results continue to hold using the underlying measure 'Generality', but not using the underlying measure 'Grade variance' (see Appendix Table A4 for details).

Table 3 reveals a significant negative association between risk aversion and self-employment. This result is consistent with both the RA theory and Proposition 3(a) in the presence of high relative levels of entrepreneurial risk. The significantly negative association persists irrespective of whether we include control variables [specifications (IV) and (VI)] or a measure of balanced skills [specifications (III) and (IV)]. In addition, the same results hold when the underlying measures of balanced skills are used instead of SB (see Appendix Table A4).

As noted in Section 2, Proposition 3(b) follows logically from Propositions 1 and 2, both of which received empirical support above. And as noted in Section 3, an implication of Proposition 3(b) is that excluding SB from (8) will increase the estimate of β_1 in this equation, while excluding λ from (8) will reduce the estimate of β_2. Inspection of Table 3 indicates that the coefficients change in the expected directions when these exclusion restrictions are imposed. But are these differences statistically significant? To answer this question, we adopt the testing approach outlined in the previous section, and report the χ^2 statistics in Table 4. These results clearly show that the expected biases are statistically significant.

Finally, if risk aversion has a negative direct, and a positive indirect, effect on entrepreneurship, what is the overall (net) effect and how does it vary across sample cases? The estimated net effect of risk aversion on entrepreneurship is certainly negative at the sample mean; but it turns out to be positive for 12 per cent of the sample cases. For these cases, the impact of risk aversion on the acquisition of balanced skills is so powerful that it actually turns risk aversion into a force promoting entrepreneurship.

5 Conclusion

For the applied researcher, accurate estimation of the effects of balanced skills and risk aversion is obviously a desirable objective. This paper has proposed that accurate estimation needs to take into account the possible interdependence between these two constructs. Such interdependence is also of interest in its own right. By making the acquisition of balanced skills more attractive, risk aversion can even end up as a positive force promoting entrepreneurship — contrary to what might be expected from theories of RA which ignore BS arguments.

We believe that our arguments and empirical findings may command interest beyond the community of entrepreneurship scholars, including among practitioners and entrepreneurs. Our results reveal, perhaps surprisingly, that some risk-averse people, long deemed inherently ill-suited to entrepreneurship, might actually be well-suited to this occupation after all. This insight could have implications for entrepreneurship educators, who often stress the 'negative' aspects of risk aversion for entrepreneurship without suggesting any positive aspects. It is also possible that young people under-estimate the future value of acquiring balanced skills, for instance by discounting the possibility of turning entrepreneur later in life. Our research suggests that the acquisition of balanced skills could be usefully encouraged at school and university since it builds a valuable future option for students.

It is also possible that some cultures or environments succeed, either deliberately or otherwise, in fostering balanced skills amongst their population, or in channeling risk aversion into the acquisition of balanced skills. For instance, formal education and corporate management training programs are known to differ in their emphasis on specialized relative to balanced skill acquisition. If governments genuinely wish to encourage entrepreneurship, a less specialized school curriculum might be one indirect, and long-term, way of doing so. Conversely, for firms concerned about losing employees to entrepreneurship (Hellmann, 2007) specialists might be favored over job candidates with balanced skills. Extending the logic in this paper, one is led to wonder whether there might be other unintuitive indirect relationships between balanced skills and individuals' preferences or personality traits. For example, people who have a 'need for achievement' may spend a decade and longer in a single field of study in order to attain the requisite expertise (Simon & Gilmartin, 1973). In contrast, those who have no such need for achievement may dabble in whatever interests come their way, culminating in a balanced skill profile. The same could be true of unconfident people having low expectations of their success or the rate of return to their human capital. Instead of being Jacks-of-all-Trades, such individuals might behave more like Åstebro and Thompson's (2011) 'hobos'. It would be interesting to explore how these personality factors interface with skill acquisition at school and university, varied job experience afterwards, and also participation in entrepreneurship. We leave this issue for future research.

To conclude, this paper has proposed a novel linkage between risk aversion and balanced skills which puts theories of entrepreneurial selection in a new light. The paper also carries implications for scholars concerned with interpreting the body of evidence on risk aversion and balanced skills theories of entrepreneurship. And finally, its findings should interest practitioners and educators who seek to promote entrepreneurship as an occupational choice.

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Table A1: Key variables (mean) by degree field

Degree Field (sample size)	Generality	Fraction Self-employed	Risk aversion	Degree Field (sample size)	Generality	Fraction Self-employed	Risk aversion
Dutch (40)	0.15	0.13	86.18	Applied Comp Sciences (48)	0.15	0.02	77.54
English (37)	0.14	0.03	87.62	Applied Math/Psysics (73)	0.11	0.01	72.78
Other languages (30)	.	0.07	84.50	Economics (104)	0.07	0.02	59.72
Philosophy, Theology (25)	.	0.04	79.76	Management Studies (126)	0.06	0.01	71.55
History (62)	0.08	0.06	80.63	Econometrics (67)	0.10	0.01	54.52
Language and culture, general (33)	0.21	0.12	88.52	Fiscal Economics (24)	.	0.00	58.96
History of Art (28)	.	0.11	80.00	Business Studies (80)	0.09	0.08	65.66
Corporate Communication (19)	.	0.00	78.95	Dutch Law (107)	0.06	0.01	74.56
Film, Television, Theater (26)	.	0.08	92.77	Notarial Law (48)	0.08	0.00	77.77
Alpha Information Sciences (70)	0.10	0.03	71.41	Fiscal Law (69)	0.07	0.01	71.30
Chemistry (38)	0.11	0.00	81.63	Health Studies (103)	0.07	0.02	80.81
Computer Science (34)	0.15	0.03	73.79	Medical Science (119)	0.03	0.00	77.54
Biology (104)	0.07	0.05	80.63	Biomedical Science (84)	0.07	0.00	81.81
Pharmacy (36)	0.14	0.06	69.44	Veterinary Science (29)	.	0.03	82.38
Theor. math & physics (53)	0.11	0.00	62.87	Sociology (32)	0.19	0.09	76.72
Gen. applied earth science (37)	0.16	0.05	83.19	Psychology (112)	0.06	0.00	82.44
Bioprocessing & Food Tech (80)	0.09	0.00	83.19	Politicology (36)	0.19	0.03	80.28
Building Engineering & Arch (92)	0.07	0.07	76.27	Pedagogy (77)	0.10	0.00	80.16
Mechanical Engineering (80)	0.08	0.00	65.86	Applied Education Studies (43)	0.14	0.02	86.12
Electrical Engineering (53)	0.11	0.02	68.49	Cultural Antropology (24)	.	0.00	84.33
Chemical Engineering (42)	0.10	0.00	79.57	Communication Sciences (67)	0.10	0.01	77.24
Civil Engineering (91)	0.07	0.03	65.13	Social-cultural Mgmt Studies (88)	0.09	0.01	78.13
Technology & Management (90)	0.08	0.01	62.19	Public Management (93)	0.06	0.03	76.23
Industrial Design (50)	0.12	0.22	70.60	Social Geography (84)	0.08	0.01	73.37
Aerospace Engineering (15)	.	0.00	89.67				
				Average	0.09	0.03	75.05

Table A2: Industries

Industry	N
Public Sector	303
Education	629
Business Service	728
Financial Service	137
Health Sector	475
Manufacturing	264
Retail and other	457

Table A3: Risk aversion and alternative measures of skill balance

	Specification (I)	Specification (II)	Specification (III)	Specification (IV)
Panel A		*Generality*		
Risk aversion (λ)	0.0001***	0.0001***	0.0001	0.0001*
	(3.29)	(3.39)	(1.28)	(1.68)
N	2707	2682	2707	2682
R^2	0.036	0.018	0.0036	0.0018
F	10.80	7.24	1.65	2.48
$Pr > F$	0.0010	0.0000	0.2064	0.0329
Panel B		*Grade variance*		
Risk aversion (λ)	0.0007**	0.0008**	0.0007*	0.0008**
	(2.27)	(2.35)	(1.90)	(2.49)
N	2823	2798	2823	2798
R^2	0.0018	0.0050	0.0018	0.0050
F	5.15	1.94	3.59	2.48
$Pr > F$	0.0234	0.0595	0.0641	0.0297
Control variables included	no	yes	no	yes
Robust estimation	yes	yes	no	no
Clustered estimation (j =*40*)	no	no	yes	yes

Note: J = 40 clusters. Absolute t-values are given in parentheses. The sample excludes self-employed entrepreneurs. They are based on robust estimates in specifications 1 and 2, and based on clustered estimates in specifications 3 and 4. ***/**/* denotes significance at the 1%/5%/10%-level.

Table A4: Self-employed entrepreneurship, risk aversion and skill balance (alternative measures)

Measure of Skill Balance	*Generality*				*Grade variance*			
	Spec (I)	Spec (II)	Spec (III)	Spec (IV)	Spec (I)	Spec (II)	Spec (III)	Spec (IV)
Skill Balance	5.640***	5.924***	6.389***	6.440***	-0.077	-0.096	-0.060	-0.080
	(3.91)	(4.18)	(4.09)	(4.29)	(0.58)	(0.71)	(0.49)	(0.59)
Risk aversion (λ)			-0.0083***	-0.0083***			-0.0063***	-0.0059***
			(4.36)	(3.93)			2.96)	(2.61)
N	2782	2757	2782	2757	2905	2880	2905	2880
$pseudo - R^2$	0.0293	0.0571	0.0509	0.0744	0.0005	0.0223	0.0130	0.0313
Wald χ^2	15.30	52.17	29.29	61.80	0.34	16.64	9.87	23.29
$Pr > \chi^2$	0.0001	0.0000	0.0000	0.0000	0.5604	0.0199	0.0072	0.0030
Control variables included	no	yes	no	yes	no	yes	no	yes
Robust estimation	no	no	no	no	yes	yes	yes	yes
Clustered estimation (j =40)	yes	yes	yes	yes	no	no	no	no

Note: J = 40 clusters. Absolute t-values are given in parentheses. The results for specifications I-IV are obtained by clustered estimation methods where each cluster is an education degree field (with $n_j > 30$ observations) when using BS_tertiary as the measure of skill balance. Robust estimates are shown when using BS_secondary as the measure of skill balance. The results are similar when applying robust (clustered) estimation instead of clustered (robust) estimation. ***/**/* denotes significance at the 1%/5%/10%-level. The controls included in specifications (II) and (IV) are the same as in Table 2.