The Impact of Risk Attitudes on Entrepreneurial Survival*

Marco Caliendo†
IZA Bonn

Frank Fossen‡
DIW Berlin

Alexander Kritikos§
DIW Berlin

Working Paper
February 19, 2009

Abstract

Risk attitudes have an impact on the complete life cycle of entrepreneurs. Whereas recent research underpins the theoretical proposition of a *positive* correlation between risk tolerance and the *decision to become* an entrepreneur, the effects on *survival* are not as straightforward. Psychological research posits an inverse U-shaped relationship between risk tolerance and entrepreneurial survival. On the basis of recent waves of the German Socio-Economic Panel (SOEP), we examine the extent to which risk attitudes influence survival rates of entrepreneurs. The empirical results confirm that persons whose risk attitudes are in the medium range survive significantly longer as entrepreneurs than do persons with particularly low or high risk attitudes.

Keywords: Entrepreneurship, Risk Attitudes
Survival

JEL: D81, J23, M13

---

*The authors thank Friedel Bolle, Philipp Köllinger, Günther F. Müller, Alexander Schiersch and Viktor Steiner for valuable comments, and Davud Rostam-Afschar for excellent research assistance. Fossen thanks the German Research Foundation (DFG) for financial support of the project STE 681/7-1. The usual disclaimer applies.

†Marco Caliendo is Director of Research at the Institute for the Study of Labor (IZA) in Bonn and Research Fellow of the IAB, Nuremberg, e-mail: caliendo@iza.org. Contact details: IZA, Schaumburg-Lippe-Str. 5-9, 53113 Bonn, Germany, phone: +49(228)3894-512, fax: +49(228)3894-510.

‡Frank Fossen is Research Associate at the German Institute for Economic Research (DIW) in Berlin, e-mail: ffossen@diw.de

§Alexander Kritikos is Head of the Department Innovation, Manufacturing, Service at the German Institute for Economic Research and Research Fellow of the IZA, Bonn and of the IAB, Nuremberg, e-mail: akritikos@diw.de

1 Introduction

Recent empirical research supports the theoretical proposition of a positive correlation between risk tolerance and the *decision to become* an entrepreneur (see, e.g., Cramer, Hartog, Jonker, and Van Praag, 2002; Caliendo, Fossen, and Kritikos, 2009). Varied studies (Stewart and Roth, 2001; Hartog, Ferrer-i Carbonell, and Jonker, 2002) further show that the population of self-employed persons tends to be less risk averse than other persons, such as those who are regularly employed. These observations lead to the crucial question addressed in this paper: Do risk attitudes also represent a defining characteristic of entrepreneurial *survival*?

Prior economic research focuses only on the questions of whether and why entrepreneurs may need to be less risk averse than other persons, such as employees (Kihlstrom and Laffont, 1979).[1] To the best of our knowledge, the question of the extent to which individual risk attitudes might have an impact on survival rates of entrepreneurs has not been explored in economic literature. Accordingly, empirical research does not go beyond the examination of differences in risk attitudes between the groups of self-employed and regularly employed persons.

Psychological research pays little more attention to this question, as it argues that entrepreneurs should neither take the highest nor the lowest possible but instead 'well-calculated' risks to remain successful. Chell, Harworth, and Brearley (1991) suggest an inverse U-shaped relation between risk attitudes and entrepreneurial survival, where low risk attitudes characterize more risk-averse persons and high risk attitudes characterize the less risk averse. However, insufficient empirical research links risk attitudes to the survival rates of entrepreneurs. In a recent survey of the relationship between personality traits and business success, Rauch and Frese (2007) conclude that the effect of risk taking on entrepreneurial success is rather small, and this trait does not necessarily increase success probability, but the inverse U-shaped relationship simply has not been tested so far. A possible reason for this lack of empirical research is that reliable demographic data about individual risk attitudes were missing.

This paper aims to close the gap. We employ a representative data set, the Ger-

[1] See also subsequent discussions by Evans and Jovanovic (1989), Parker (1997), Cressy (2000), Norton and Moore (2006), and Kan and Tsai (2006).

man Socio-Economic Panel, which contained in the wave of 2004 several questions about subjective risk attitudes and objectively measurable risk preferences. Based on these data, we conduct a rigorous test whether the probability of entrepreneurial survival correlates with the willingness to bear certain risks. To answer this question consistently, we control for the labor status of all entrepreneurs in the sample, namely, whether they continue as self-employed or are in transition to an employed position or unemployment.

The rest of the paper is organized as follows: In Section 2, we discuss the potential inverse U-shaped relationship between risk attitudes and entrepreneurial survival. We describe the data in Section 3, with a special focus on the various measures of risk attitudes, which we use in our further analysis. In Section 4, we present the econometric approach, followed in Section 5 by a discussion of the results of our analysis. We conclude in Section 6 that risk attitudes have an impact on the survival of entrepreneurs. Specifically, we observe a non-linear relationship between risk attitudes and the probability of survival, which indicates that persons with medium range risk preferences survive significantly more often as entrepreneurs than do persons with particularly low or high risk preferences.

2 Risk Attitudes and their Impact on Entrepreneurial Success

According to Chell et al. (1991), there should be a non linear relation—more specifically, an inverse U-shaped relation—between risk attitudes and entrepreneurial survival, where low risk attitudes characterize more risk averse and high risk attitudes indicate less risk averse persons. The hypothesis we subsequently test therefore posits that among all entrepreneurs, the more risk averse and the particularly risk-seeking persons are more likely to fail as entrepreneurs than are persons whose risk-taking behavior falls within the medium range.

As our analysis focuses on active entrepreneurs, we discuss this hypothesis not in the context of their decision to become an entrepreneur. Rather given a continuous set of possible investments—each with a specific risk and expected return—we focus on entrepreneurs who have already chosen to expend initial investment into

one of these possibilities. Entrepreneurs make risky investments only if these investments will lead, ex ante, to higher expected returns than would safe investments, assuming those entrepreneurs are strictly risk averse. Accordingly, we assume that the expected returns of investments increase with their riskiness, but are subject to decreasing returns to scale if the risk level of the investment increases.[2]

These features of risky investments emerge from a simple model in which projects $Pr(p; y_s)$ are characterized by the probability of success $p \in (0; 1)$ and the payoff in case of success $y_s > 0$ being a measure of the project scale. Furthermore, all projects involve fixed costs which are equal to a constant fraction of the potential payoff, y_s/c. Thus, the actual returns to the project are $y = y_s - y_s/c$ in case of success, and $y = -y_s/c$ in case of failure. Then the expected return of a project is $E(y) = py_s - y_s/c$, and the variance is $Var(y) = p(1-p)y_s^2$. The relationship between the expected value and the variance of y is derived as

$$Var(y) = p(1-p)\left(p - \frac{1}{c}\right)^{-2}[E(y)]^2. \tag{1}$$

Entrepreneurs will only consider projects which satisfy $p > 1/c$ and thus have positive $E(y)$. It follows that for a given success probability p these projects exhibit a risk premium in that the expected returns increase with the scale of risk ($dE(y)/dVar(y) > 0$). The risk premium displays at the same time a decreasing marginal rate of increase as expected return and risk increase ($d^2E(y)/dVar(y)^2 < 0$). Entrepreneurs will choose along the mean-variance dimension the scale and risk level of the project that maximizes their expected utility (see Figure 1).

Insert Figure 1 about here

As a consequence, more risk averse entrepreneurs will choose less risky projects, where the marginal risk premium for an additional unit of risk is high. Less risk-averse entrepreneurs instead choose riskier projects with a small marginal risk premium. At high levels of risk, at which expected returns do not increase anymore (or even decrease), only risk-neutral (risk-loving) entrepreneurs carry out their projects.

[2]We cannot exclude the possibility that beyond a certain risk level of an investment, expected returns are even marginally decreasing.

Given these considerations the consequences for the survival rates of entrepreneurs are straightforward. First, we must bear in mind that, if a person must decide between continuing or finishing an entrepreneurial activity, he or she may be able to earn an alternative wage income, which then represents the opportunity cost of continuing to function as an entrepreneur. Second, we note that the realized return on investment might differ from the expected return, and the decision to continue as an entrepreneur may depend on a comparison of realized returns (not expected returns) with alternative wage incomes, especially if realized losses in connection with liquidity constraints do not allow continued entrepreneurship.

Having implicitly ordered the complete spectrum of entrepreneurs from those with the lowest risk tolerance to those with the highest, we hypothesize that very risk-averse entrepreneurs who have chosen the safest possible investments are most likely to generate returns below their opportunity costs.[3] As a second hypothesis, as the risk level of an investment increases step by step, its expected return should exceed earnings from wage income, although low or negative returns could be realized with moderate probability. Finally, if the riskiness of an investment increases far above average, we hypothesize that it becomes increasingly unlikely that this investment will succeed in terms of positive returns, or that in the case of failure, losses may become so large that the firm falls into bankruptcy (high fixed costs y_s/c in the model above).[4] Thus, if the complete spectrum of entrepreneurs is characterized by three risk categories, we should observe persons with low or high risk preference to close down their businesses with higher probability than persons with a medium level of risk preference.

[3]This expectation is plausible: If incomes of a safe investment exceed earnings from wage labor, every person would become an entrepreneur and realize a sufficient income. In this context, it is fair to ask why such persons become entrepreneurs at all. We cannot answer this question. However, we also cannot exclude the possibility that these persons had lower opportunity costs at the time of their decision.

[4]Recent research by Baron (2004) and Köllinger, Minniti, and Schade (2007) provides further explanations why particularly risk-seeking entrepreneurs might decide to start a business venture if low or even negative outcomes may arise with relatively high probability. In their research, they reveal that these persons tend be overconfident of being capable to exclude or reduce the probability of those low or negative returns. Moreover, the latter authors also refer to further effects increasing the probability of failure of high risk entrepreneurs. For instance, they observe an 'escalation of commitment' where this group is willing to make high risk investments for another time once they realized losses in the previous period. Interestingly, this observation is confirmed by recent research in neurosciences (see Bechara and Damasio, 2005).

3 Data Set and Risk Measurement

We base our analysis on the German Socio-Economic Panel (SOEP), an established, representative panel survey that contains detailed information about the socio-economic situation of approximately 22,000 persons living in 12,000 households in Germany.[5] Key to our analysis are new measures of risk attitudes that were added to the SOEP in the 2004 survey wave. Several questions deal with attitudes toward risk in general and in specific contexts, including occupation, the relevant domain for employment decisions. Respondents indicate their willingness to take risks on an 11-point scale ranging from 0 (complete unwillingness) to 10 (complete willingness). Another question corresponds to conventional lottery measures and asks respondents to state how much (in categories of fifths) of 100,000 euros, which they hypothetically had won in a lottery, they would invest in a risky asset.[6] The question indicates that there are equal chances respondents will double the amount invested or lose half of it.[7] In contrast with the other risk questions, which may incorporate both risk preference and risk perception, the lottery question holds the perception of the riskiness of a decision constant across respondents[8] by providing explicit stakes and probabilities.[9]

We use the yearly outcomes provided by those individuals who answered the risk question for the years 2000 to 2005, assuming the stability of risk attitudes at least over this relatively short period of time (see Barsky, Juster, Kimball, and Shapiro, 1997, for evidence that risk attitudes remain stable over time). As in most empirical studies on entrepreneurial choice, we use self-employment as a measur-

[5]The SOEP started in 1984 as a longitudinal survey of private households and persons in West Germany and then expanded to the territory of East Germany in June 1990. The central aim of this panel study is to collect representative micro-data about persons, households, and families. It is similar to the BHPS in the United Kingdom and the PSID in the United States. A rather stable set of core questions appears every year, covering the most essential areas, such as population and demography; education, training, and qualification; labor market and occupational dynamics; earnings, income and social security; housing; health; household production; and basic orientation. For a more detailed data description, see Wagner, Frick, and Schupp (2007).

[6]Parallel research also elicited individual risk attitudes by a lottery choice; see inter alia Fellner and Maciejovsky (2007)

[7]See Table A.1 in the Appendix for the original phrases included in the risk measures.

[8]Previous research indicates the potential for significant differences between (subjective) risk perceptions and (objectively measurable) risk preferences (see Palich and Bagby, 1995).

[9]Dohmen, Falk, Huffman, Sunde, Schupp, and Wagner (2005) validate the reliability of these survey measures of risk attitudes with a field experiment with real money at stake.

able proxy of the concept of entrepreneurship.[10] The classification of persons as self-employed stems from a survey question about the occupational status of the respondents. If respondents are employed or self-employed in more than one position, they report their status of their primary activity. We restrict the sample to persons between 18 and 65 years of age who have been self-employed at least once during the sample period. Overall, we observe 7,325 person-year observations in which self-employed persons are *at risk* of exiting self-employment, with 730 exits actually occuring.

Insert Table 1 about here

In Table 1, we provide mean values of the characteristics of those respondents who remain self-employed and those who exit. The table reveals significant differences between the groups (see the last column, which reports the p-value from a t-test of mean-equality). People exiting self-employment are more likely to be female, less educated, and younger than those who remain. The answers to the risk-related questions also differ between groups. For both kinds of risk measures, we observe that persons with a low risk profile are more likely to leave self-employment (except for people who invest nothing in the lottery question). However, to analyze the impact of risk attitudes on entrepreneurial survival, we require an econometric model that controls for relevant characteristics and covariates, as well as the duration of the self-employment, as we will present in the subsequent section.

4 Econometric Specification

To estimate the probability of exit from self-employment, conditional on the duration of the current spell in self-employment, we introduce a discrete time hazard rate model. We use yearly data, because the interviews occur once a year, and the covariates are not available for higher frequencies.

Respondents may experience multiple self-employment spells during the observation period. Therefore, we use the discrete non-negative random variable T_{ik}

[10] This broad definition of entrepreneurship is frequently used in economics and psychology as well; see Stewart and Roth (2001) or Rauch and Frese (2007).

to describe the duration of the k-th spell of individual i. When a spell terminates in year t (measured from the beginning of the spell), T_{ik} takes on a value of t. The hazard rate $\lambda_{ik}(t)$ is defined as the probability that spell k for person i ends in period t (i.e., a transition occurs) conditional on survival until the beginning of t:

$$\lambda_{ik}(t|X_i(t)) = P(T_{ik} = t|T_{ik} \geq t, X_i(t)), \tag{2}$$

where $X_i(t)$ is a vector of the characteristics and covariates of individual i in interval t, including the risk attitude. The probability of remaining self-employed in period t ("survival"), conditional on having survived until the beginning of t, is the complementary probability

$$P(T_{ik} > t|T_{ik} \geq t, X_i(t)) = 1 - \lambda_{ik}(t|X_i(t)). \tag{3}$$

The survivor function, which represents the unconditional probability of remaining in the current spell until the end of period t, can be written as the product of the survival probabilities in all periods before and in t:

$$S(t|X_i) = P(T_{ik} > t|X_i) = \prod_{\tau=1}^{t}(1 - \lambda_{ik}(\tau|X_i(\tau))). \tag{4}$$

Consequently, the unconditional probability of a transition in period t is the probability of survival until the beginning of period t, multiplied by the hazard rate in period t:

$$P(T_{ik} = t|X_i) = \lambda_{ik}(t|X_i(t)) \prod_{\tau=1}^{t-1}(1 - \lambda_{ik}(\tau|X_i(\tau))). \tag{5}$$

We employ the maximum likelihood method to estimate the model, which enables us to take into account completed spells as well as both left-censored and right-censored spells in the estimation. For a fully observed spell that ends with an exit from self-employment, the contribution to the likelihood function is given by equation (5). For a right-censored spell, the likelihood contribution is given by the survivor function (4), because we know only that the person "survived" until the end of the observation period, not when the spell will end. Combining these two

cases, the likelihood contribution of a spell k of an individual i can be written as

$$L_{ik}^{\text{non left-censored}}(\text{parameters}|c_i, X_i) = \left[\frac{\lambda_{ik}(t_{ik}|X_i(t_{ik}))}{1-\lambda_{ik}(t_{ik}|X_i(t_{ik}))}\right]^{c_{ik}} \prod_{\tau=1}^{t_{ik}}(1-\lambda_{ik}(\tau|X_i(\tau))), \tag{6}$$

where c_{ik} is a censoring indicator defined such that $c_{ik} = 1$ if a spell is completed and 0 if a spell is right-censored.

If a spell is left-censored in the SOEP, because person i enters the panel after spell k has already lasted u_{ik} years, we must condition on survival up to the end of period u_{ik}, which means dividing expression (6) by $S(u_{ik})$. Then the likelihood contribution of the spell is

$$\begin{aligned} L_{ik}(\text{parameters}|c_i, X_i) &= \left[\frac{\lambda_{ik}(t_{ik}|X_i(t_{ik}))}{1-\lambda_{ik}(t_{ik}|X_i(t_{ik}))}\right]^{c_{ik}} \frac{\prod_{\tau=1}^{t_{ik}}(1-\lambda_{ik}(\tau|X_i(\tau)))}{\prod_{\tau=1}^{u_{ik}}(1-\lambda_{ik}(\tau|X_i(\tau)))} \\ &= \left[\frac{\lambda_{ik}(t_{ik}|X_i(t_{ik}))}{1-\lambda_{ik}(t_{ik}|X_i(t_{ik}))}\right]^{c_{ik}} \prod_{\tau=u_{ik}+1}^{t_{ik}}(1-\lambda_{ik}(\tau|X_i(\tau))). \end{aligned} \tag{7}$$

Note that this more general notation includes equation (6) for spells that are not left-censored ($u_{ik} = 0$). In the SOEP, the retrospective employment history questions enable us to recover u_{ik} for self-employment spells and thereby deal with left-censoring.

The overall likelihood contribution of an individual i equals the product of the likelihood contributions of the K_i spells that the person experienced in the observation period. The sample likelihood function is the product of the individual likelihood contributions:

$$L(\text{parameters}|c, X) = \prod_{t=1}^{N}\prod_{k=1}^{K_i} L_{ik}. \tag{8}$$

We define a new binary transition indicator variable $y_{ik\tau} = 1$ if person i completes spell k in period τ, and 0 otherwise. Then the log-likelihood function can be written in the same form as the standard log-likelihood function for a binary regression model in which $y_{ik\tau}$ is the dependent variable and the data are organized

in person-period format (cf. Jenkins, 1995).

The functional form of the hazard rate is specified as a logistic hazard model:

$$\lambda_{ik}(t|X_i(t)) = \frac{\exp(f(t) + X_i(t)\beta)}{1 + \exp(f(t) + X_i(t)\beta)}, \tag{9}$$

where the function $f(t)$ represents the dependence of the hazard rate on the spell duration (baseline hazard), specified as a polynomial function of the third degree. This model is consistent with an underlying continuous time model in which the within-interval durations follow a log-logistic distribution (Sueyoshi, 1995).

The cumulative transition probability, or failure function, is the complementary probability of the survival probability in equation (4):

$$F(t|X_i) = 1 - S(t|X_i) = 1 - \prod_{\tau=1}^{t}(1 - \lambda_{ik}(\tau|X_i(\tau))). \tag{10}$$

This function is of special interest in this context because it describes the probability that a person exits self-employment during the first t years of self-employment.

5 Estimation Results

To estimate the main hypothesis of this paper, namely, an inverse U-shaped relationship between risk attitudes and survival, we employ two risk measures and six total sets of explanatory variables (Specifications 0-5). As the outcome variable, we consider employment status throughout the analysis, such that survival in self-employment represents the success measure, whereas a transition to regular employment or unemployment constitutes a failure.

Full estimation results are available in Table A.3 in the Appendix. In Specification 0, we initially test the impact of several basic socio-demographic and business characteristics—which in previous research had an impact on entrepreneurial success—without including any risk measures. Beginning with the socio-demographic variables, we observe gender and age effects. That is, women have a lower probability, younger persons have a higher probability of remaining self-employed. A

self-employed father has a positive effect on survival. This is in line with previous research showing that having a self-employed father increases the probability to become self-employed (see, e.g., Dunn and Holtz-Eakin, 2000; Caliendo et al., 2009). As a surprising result however, we discover that entrepreneurial survival may be a matter of marital status. Both married and separated persons suffer a significantly lower survival rate than singles. With respect to education and previous working experience, we find several well-known effects. Specifically, a university degree and previous working experience have significantly positive effects, whereas unemployment experience has a negative impact on the probability of remaining self-employed. Finally, we find an interesting wealth effect. Although wealth has a positive impact on the probability of business creation (see, e.g., Blanchflower and Oswald, 1998), this effect disappears when it comes to business survival: Capital income had no significant impact on the probability of remaining self-employed. All these control variables also appear in Specifications 1-5 where we test the impact of different risk measures on survival and to which we will turn now.

As described in Section 3, respondents indicate on a 0-10 scale the extent to which they are willing to take risks in occupational choices. This kind of risk measure portrays the subjective risk attitudes of entrepreneurs. In Specification 1, we present the impact of these answers on entrepreneurial survival for each possible answer between 0 and 10. In Specification 2, we consolidate answers 0-2 in low risk, 3-7 in medium risk, and 8-10 in high risk categories. In addition to the subjective question about risk attitudes, entrepreneurs also respond to the lottery question by dividing a fixed amount between a safe and a risky investment with a given success probability. This question thus reveals objectively measurable risk preferences. We analyze the results of the lottery question in Specification 3. In addition to these flexible specifications with dummy variables, we treat the willingness to take risk in occupational choices as a continuous variable and test a quadratic versus a linear impact on the exit rate (Specifications 4 and 5).

Insert Table 2 about here

We provide the estimation results of the logit model for the whole sample and the marginal effects of the risk measures in Table 2. The interpretation of the marginal effects is straightforward: A decrease (increase) in the probability of

staying self-employed occurs if the marginal effect is positive (negative). We also interpret the economic impact of these changes in relation to the mean exit rate (about 10% in the sample, see Table 1).

Always using the lowest risk category as the base category (i.e., no or low risk for occupational choices in Specifications 1 and 2; no risky investment in Specification 3), we test the impact of the two risk measures on entrepreneurial survival. In Specification 1, we observe that in comparison to persons who are willing to take no occupational risks at all, persons willing to take higher risks, between 1 and 8 on the 11-point scale, have a higher probability of remaining self-employed in a given year. The difference is statistically significant for the risk levels 2 and 5-8. Persons with parameter values of 9 or 10 for occupational risks reveal no significantly higher probability of entrepreneurial survival (compared to the base category). From an economic point of view, we emphasize that the largest increase in the probability of remaining an entrepreneur emerges for medium risks. A risk attitude of 5 or 6 on the 11-point scale increases the probability of survival as self-employed by 5 percentage points. As the predicted probability of failure is approximately 12.5% in the base category (i.e., complete unwillingness to take occupational risk), the economic impact of risk attitudes in the 5 or 6 point range is remarkable: Failure rates among these persons decline by 40% to about 7.5%. Overall, the estimation results confirm the hypothesized inverse U-shape depicting the relationship between risk attitudes and survival rates.

We confirm these observations with Specification 2, in which we consolidate the answers to the occupational risk questions into three categories. In comparison to entrepreneurs with low willingness to take risks in occupational choices (base category), the survival rate of entrepreneurs with medium risk tolerance is significantly higher, while the exit rate of entrepreneurs with high risk tolerance is not significantly different. This again reflects an inverse U-shape between risk attitudes and survival.

The analysis of Specification 3 reveals similar and complementary effects, such that higher failure rates provide the significant characteristic. Although people who decide to make medium-risk investments (between 40,000 and 80,000 Euros) do not suffer a higher probability of failure than those in the base category, the

less risk-averse (who put all their money into the risky investment) and more risk-averse respondents (who put only 20,000 Euros into the risky investment) suffer a significantly higher probability of failing as entrepreneurs. The highest marginal effect emerges for persons who choose the highest risk in the lottery. For them, the probability of entrepreneurial failure increases by 8 percentage points, doubling from 8% (in the base category) to 16%. Overall, the results of this specification again point to a U-shaped relationship between risk preference and failure rates.[11]

Insert Table 3 about here

The U-shape found in the flexible specifications suggests that the relationship between the risk attitude in occupation and the survival rate may be represented by a parabola. Table 3 shows the estimated logit coefficients for a linear (Specification 4) and a quadratic functional form assumption (Specification 5). The quadratic term in Specification 5 is significantly different from 0, so the linear specification is rejected (p-value of Wald test: 0.0071). We also tested a third degree polynomial, but the results were insignificant and its inclusion did not increase the log likelihood. These results further support the U-shape relationship. The minimum exit probability is reached at a risk tolerance level of 6. Figure 2 shows how the exit probability changes with risk tolerance on the scale from 0-10 for an individual with otherwise average characteristics, according to the estimated Specification 5.

Insert Figure 2 about here

Using the estimated hazard models, we further calculate the cumulative failure probabilities over several years according to the failure function of equation 10. Figure 3 depicts the cumulative failure probabilities of entrepreneurs with different risk attitudes over the duration of the self-employment spell (based on Specification 2), evaluated at the mean values of the remaining explanatory variables. For all three types of entrepreneurs, the growth in cumulative failure probabilities is greatest during the first years of self-employment because of the higher failure rates in the initial years of start-up firms. Figure 3 clearly shows that the relationship between risk

[11]The finding that people who invest the lowest amount possible (20,000 Euros) have a higher probability of failing than those who invest nothing certainly represents a surprising kink in this shape, however.

preferences and cumulative failure rates remains consistently U-shaped, regardless of the self-employment duration. Entrepreneurs who are willing to take medium-level risks thus have lower cumulative failure probabilities than their counterparts with low or high risk preferences.

Insert Figure 3 about here

Putting together the test results of Specifications 1-5, we can derive a straightforward conclusion with respect to our main hypothesis: There is an inverse U-shaped relationship between risk attitudes and the survival rates of entrepreneurs.

Sensitivity Analysis: We tested the sensitivity of our results with respect to various dimensions (see Table A.4 in the Appendix for a summary of the results).[12] Using different risk measures (i.e., the willingness to take general risks or risks on financial matters instead of occupational matters) do not change the result, neither does a different classification of the three categories for low-, medium-, and high-level risk attitudes (e.g., by changing the categories from 0-2, 3-7, 8-10, to 0-3, 4-6, 7-10). To assess whether early retirement decisions influence the results, we repeat the estimation of Specification 2 on a sample restricted to people up to 55 years. The test reveals an even more pronounced U-shape. Moreover, in a competing risk model where we distinguish between self-employment exits to dependent employment and to unemployment, the U-shaped relationship is observed for exits to dependent employment (349 transitions); whereas we do not observe it for the smaller number of transitions into unemployment (220 individuals). Lastly, the relationship remains stable in a single-risk model allowing for unobserved heterogeneity, where we specify an individual effect with an arbitrary discrete probability distribution with two mass points.

6 Conclusions

In this study, we empirically analyze whether the risk attitudes of active entrepreneurs have an influence on their survival probability. For this analysis, we employ a questionnaire that was part of the 2004 wave of the German Socio-Economic Panel

[12] Detailed estimation results are available on request by the authors.

(SOEP). Respondents were asked in two different ways about their willingness to take risks in occupational choices, revealing their subjective risk attitudes and their objectively measurable risk preferences. As we know from prior research, it is important to control for both kinds of risk measures. Moreover, the same survey indicates the occupational choices of all persons who answered the risk-related questions.

Research in economics has yet to determine whether risk attitudes have an impact on entrepreneurial survival. So far, only its impact on business creation has been analyzed. For this reason, we adopt an approach from psychological research, which hypothesizes that we should expect an inverse U-shaped relationship between risk attitudes and survival rates, with low (high) risk attitudes characterizing more (less) risk-averse persons. Our results confirm this hypothesis: Persons with particularly low or particularly high risk attitudes survive as entrepreneurs less often than do persons with a medium-level risk attitude. This result notably holds for all kinds of risk measures. It relativizes the approach of Kihlstrom and Laffont (1979) who argued that there should be a cut-off value with more risk averse persons being in employed positions and less risk averse persons being entrepreneurs. We show that there is no such relationship when it comes to entrepreneurial survival.

Our analysis further reveals that the economic impact of this variable is fairly strong. Specifically, the exit rates of medium-level risk takers drop by about 40% compared with those not willing to take any risk, whereas those of high risk takers are not significantly different from those of low risk takers. We thus conclude that risk attitudes ceteris paribus are a defining characteristic of entrepreneurship. Whereas previous research suggests that these attitudes have a significant impact on the decision to become an entrepreneur, we extend existing knowledge by showing that attitudes have a similarly strong influence on the survival rates of already active entrepreneurs. Furthermore, while the correlations between risk attitudes and business creation are consistently positive, we show that the relationship between risk attitudes and entrepreneurial success is inversely U-shaped.

Last but not leat it should be emphasized that besides risk attitudes there are also several non-cognitive personality characteristic such as locus of control, need for achievement or self-assertiveness which have an impact on entrepreneurial development as well (see inter alia Brandstätter (1997) or more recently Hansemark (2003),

Wijbenga and van Witteloostuijn (2007) and Caliendo and Kritikos (2008)). Future research has to find out how risk attitudes relate to these personality characteristics.

References

Baron, R. (2004). The Cognitive Perspective: A Valuable Tool for Answering Entrepreneurship's Basic "Why" Questions. *Journal of Business Venturing 19*, 221–240.

Barsky, R., F. Juster, M. Kimball, and M. Shapiro (1997). Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study. *The Quarterly Journal of Economics 111*, 537–579.

Bechara, A. and A. Damasio (2005). The Somatic Marker Hypothesis: A Neural Theory of Economic Decision. *Games and Ecnomomic Behavior 52*, 336–372.

Blanchflower, D. and A. Oswald (1998). What Makes an Entrepreneur? *Journal of Labor Economics 16*, 26–60.

Brandstätter, H. (1997). Becoming an entrepreneur — a question of personality structure? *Journal of Economic Psychology 18*, 157–177.

Caliendo, M., F. Fossen, and A. Kritikos (2009). Risk Attitudes of Nascent Entrepreneurs: New Evidence from an Experimentally-Validated Survey. *Small Business Economics 32*(2), 153–167.

Caliendo, M. and A. Kritikos (2008). Is Entrepreneurial Success Predictable? An Ex-Ante Analysis of the Character-Based Approach. *Kyklos 61*(2), 189–214.

Chell, E., J. Harworth, and S. Brearley (1991). The search for entrepreneurial traits. In E. Chell, J. Harworth, and S. Brearley (Eds.), *The Entrepreneurial Personality: Concepts, Cases and Categories*, Routledge Small Business Series, pp. 29–53. London: Thomson Learning.

Cramer, J., J. Hartog, N. Jonker, and C. Van Praag (2002). Low Risk Aversion Encourages the Choice for Entrepreneurchip: An Empircal Test of a Truism. *Journal of Economic Behavior and Organization 48*, 29–36.

Cressy, R. (2000). Credit Rationing or Entrepreneurial Risk Aversion? An Alternative Explanation for the Evans and Jovanovic Finding. *Economics Letters 66*, 235–40.

Dohmen, T., A. Falk, D. Huffman, U. Sunde, J. Schupp, and G. Wagner (2005). Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey. Discussion Paper No. 511, DIW Berlin.

Dunn, T. and D. Holtz-Eakin (2000). Financial Capital, Human Capital, and the Transition to Self-Employment: Evidence from Intergenerational Links. *Journal of Labor Economics 18*, 282–305.

Evans, D. and B. Jovanovic (1989). An Estimated Model of Entrepreneurial Choice under Liquidity Constraints. *Journal of Political Economy 97*, 808–827.

Fellner, G. and B. Maciejovsky (2007). Risk attitude and market behavior: Evidence from experimental asset markets. *Journal of Economic Psychology 28*(3), 338–350.

Hansemark, O. C. (2003). Need for achievement, locus of control and the prediction of business start-ups: A longitudinal study. *Journal of Economic Psychology 24*(3), 301–319.

Hartog, J., A. Ferrer-i Carbonell, and N. Jonker (2002). Linking Measured Risk Aversion to Individual Chracteristics. *Kyklos 55*, 3–26.

Jenkins, S. (1995). Easy Estimation Methods for Discrete-Time Duration Models. *Oxford Bulletin of Economics and Statistics 57*, 129–138.

Kan, K. and W.-D. Tsai (2006). Entrepreneurship and Risk Aversion. *Small Business Economics 26*, 465–474.

Kihlstrom, R. and J. Laffont (1979). A General Equilibrium Theory of Firm Formation Based on Risk Aversion. *Journal of Political Economy 87*, 719–748.

Köllinger, P., M. Minniti, and C. Schade (2007). "I think I can, I think I can": Overconfidence and Entrepreneurial Behavior. *Journal of Economic Psychology 28*(4), 502–527.

Norton, W. and W. Moore (2006). The Influence of Entrepreneurial Risk Assessment on Venture Launch or Growth Decision. *Small Business Economics 26*, 215–226.

Palich, L. and D. R. Bagby (1995). Using Cognitive Theory to Explain Entrepreneurial Risk Taking: Challenging Conventional Wisdom. *Journal of Business Venturing 10*, 425–438.

Parker, S. (1997). The Effects of Risk on Self-Employment. *Small Business Economics 9*, 515–522.

Rauch, A. and M. Frese (2007). Let's Put the Person Back into Entrepreneurship Research: A Meta-Analysis on the Relationship Between Business Owners' Personality Traits, Business Creation, and Success. *European Journal of Work and Organizational Psychology 16*, 353–385.

Stewart, W. and P. Roth (2001). Risk Propensity Differences Between Entrepreneurs and Managers: A Meta-Analytic Review. *Journal of Applied Psychology 86*, 145–153.

Sueyoshi, G. T. (1995). A Class of Binary Response Models for Grouped Duration Data. *Journal of Applied Econometrics 10*(4), 411–431.

Wagner, G., J. Frick, and J. Schupp (2007). The German Socio-Economic Panel Study (SOEP): Scope, Evolution and Enhancements. *Schmollers Jahrbuch 127*(1), 139–170.

Wijbenga, F. H. and A. van Witteloostuijn (2007). Entrepreneurial locus of control and competitive strategies - the moderating effect of environmental dynamism. *Journal of Economic Psychology 28*(5), 566–589.

Tables and Figures

Table 1: Mean Characteristics of Self-Employed/Exits from Self-Employment (SOEP 2000-2005) and t-Test of Equal Means

	Remaining in Self-Employment	Exiting from Self-Employment	p-value
female	0.330	0.534	0.000
highschool	0.406	0.353	0.006
apprenticeship	0.364	0.411	0.012
highertechncol	0.287	0.249	0.031
university	0.359	0.274	0.000
age (in years)	45.88	43.77	0.000
workexp10 (in years)	1.997	1.668	0.000
unemexp10 (in years)	0.038	0.081	0.000
disabled	0.035	0.038	0.668
german	0.940	0.910	0.002
fatherse	0.179	0.111	0.000
capitalinc (in Euros)	5.957	4.718	0.290
nchild	0.707	0.827	0.002
married	0.694	0.700	0.733
divorced	0.099	0.095	0.690
Risk Measures			
Occ. Risk Low (0-2)	0.178	0.209	0.052
Occ. Risk Medium (3-7)	0.633	0.625	0.692
Occ. Risk High (8-10)	0.189	0.166	0.152
Lottery 0€	0.567	0.534	0.098
Lottery 20k€	0.161	0.211	0.001
Lottery 40k€	0.149	0.164	0.299
Lottery 60k€	0.085	0.054	0.006
Lottery 80k€	0.022	0.013	0.145
Lottery 100k€	0.016	0.024	0.154
PY-Observations	6,595	730	

Note: The numbers indicate the fractions in the sample for which the variable is true (unless stated otherwise). p-values refer to t-tests of mean equality in the variables between both groups. See Tables A.1 and A.2 for a detailed description of the variables.

Table 2: Exit Probability from Self-Employment: Logit Estimation Results - Marginal Effects (SOEP 2000-2005)

	Spec. 1	Spec. 2	Spec. 3
Occupational Risk 0 (Reference)			
Risk 1	-.039		
Risk 2	-.048**		
Risk 3	-.031		
Risk 4	-.033		
Risk 5	-.053**		
Risk 6	-.054**		
Risk 7	-.041**		
Risk 8	-.052**		
Risk 9	-.013		
Risk 10	-.031		
Occ. Risk Low (0-2, Reference)			
Occ. Risk Medium (3-7)		-.017*	
Occ. Risk High (8-10)		-.012	
Lottery 0€ (Reference)			
Lottery 20k€			0.019*
Lottery 40k€			0.005
Lottery 60k€			-.016
Lottery 80k€			-.017
Lottery 100k€			0.078*
Control Variables[(a)]	Yes	Yes	Yes
Pseudo-R^2	0.103	0.1	0.1
Log Likelihood	-1620.695	-1626.385	-1654.817

Notes: ***/**/* indicates significance at the 1%/5%/10% levels.

[(a)] See Table A.3 for a full list of included explanatory variables.

Table 3: Exit Probability from Self-Employment: Logit Estimation Results for Linear and Quadratic Specifications - Coefficients (SOEP 2000-2005)

	Spec. 4	Spec. 5
Occ. Risk. Linear	-.029	-.177**
Occ. Risk. Squared		.016**
Control Variables[(a)]	Yes	Yes
Pseudo-R^2	0.099	0.101
Log Likelihood	-1627.758	-1624.224

Notes: ***/**/* indicates significance at the 1%/5%/10% levels.

[(a)] See Table A.3 for a full list of included explanatory variables.

Figure 1: Utility maximizing choices of risk-averse entrepreneurs (example)

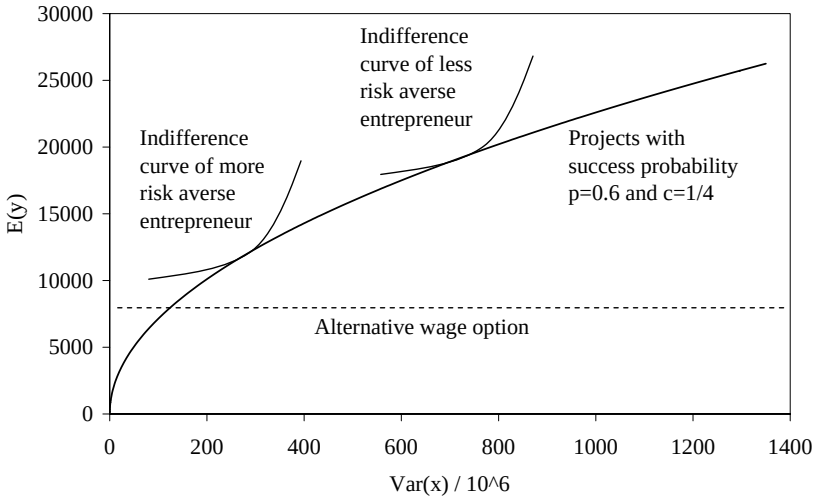


Figure 2: Estimated relationship between risk tolerance in occupation and yearly exit probability for an entrepreneur with average characteristics (quadratic specification)

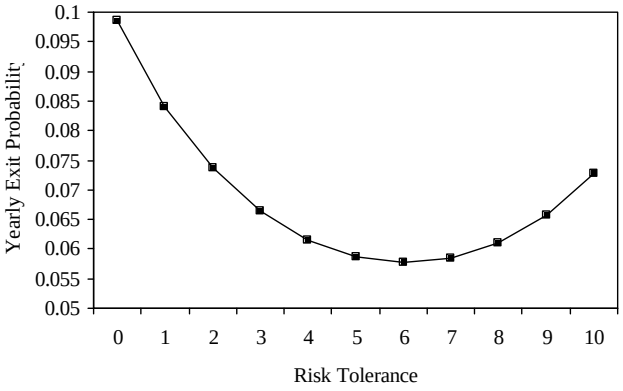
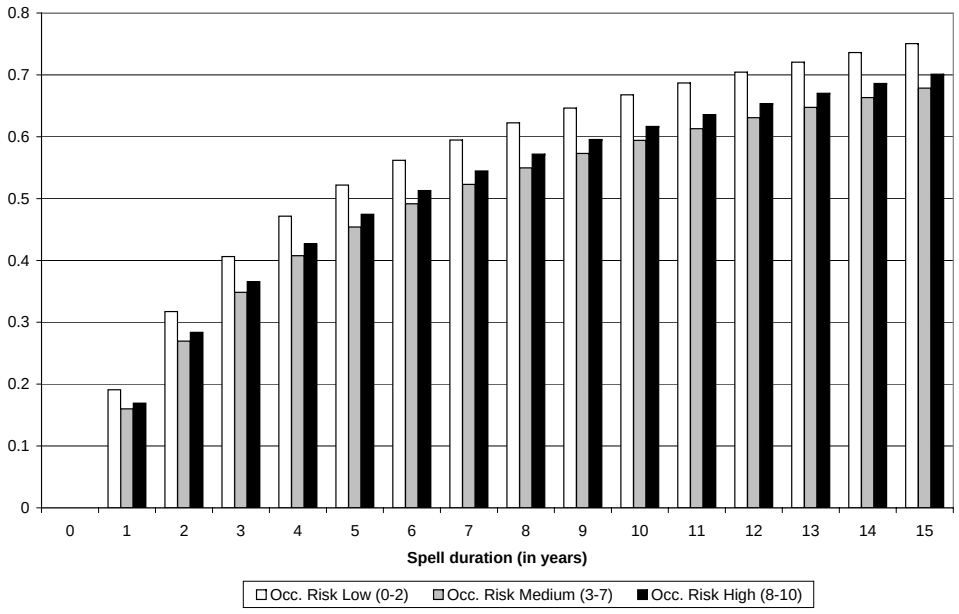


Figure 3: Cumulative exit probabilities for entrepreneurs with different risk attitudes



Notes: The calculation of the cumulative exit probabilities is based on the estimation results presented in Table A.3 (Specification 2).

A Additional Tables

Table A.1: Detailed Description of the Risk Measures

Variable Label	Description
Hypothetical risky investment after winning 100 thousand Euros in the lottery[(a)]	
Lottery 0€	Dummy for individuals who would invest nothing. Omitted category.
Lottery 20k€	Dummy for individuals who would invest 20 thousand Euros.
Lottery 40k€	Dummy for individuals who would invest 40 thousand Euros.
Lottery 60k€	Dummy for individuals who would invest 60 thousand Euros.
Lottery 80k€	Dummy for individuals who would invest 80 thousand Euros.
Lottery 100k€	Dummy for individuals who would invest 100 thousand Euros.
Willingness to take risks in occupation[(b)]	
Occ. Risk Low (0-2)	Dummy for individuals who indicated 0-2 on 11-point scale, omitted category.
Occ. Risk Medium (3-7)	Dummy for individuals who indicated 3-7 on 11-point scale.
Occ. Risk High (8-10)	Dummy for individuals who indicated 8-10 on 11-point scale.

[(a)] The original SOEP question for the hypothetical investment is: *Please consider what you would do in the following situation:*
Imagine that you had won 100,000 Euros in the lottery. Almost immediately after you collect the winnings, you receive the following financial offer from a reputable bank, the conditions of which are as follows: There is the chance to double the money within two years. It is equally possible that you could lose half of the amount invested. You have the opportunity to invest the full amount, part of the amount or reject the offer.
What share of your lottery winnings would you be prepared to invest in this financially risky, yet lucrative investment? 100.000 Euros, 80.000 Euros, 60.000 Euros, 40.000 Euros, 20.000 Euros, Nothing, I would decline the offer."

[(b)] The original SOEP questions for the different areas are: *People can behave differently in different situations. How would you rate your willingness to take risks in the following areas? Please tick a box on the scale, where the value* 0 *means: 'risk averse' and the value* 10 *means: 'fully prepared to take risks'.*
How is it in your occupation?.

Table A.2: Detailed Description of the Variables

Variable Label	**Description**
female	Dummy for females
east	Dummy for individuals who live in East-Germany
highschool	Dummy for individuals who have a high school degree ("Fachhochschulreife" or "Abitur")
apprenticeship	Dummy for individuals who finished an apprenticeship ("Lehre")
highertechncol	Dummy for individuals who finished a higher technical college or similar
university	Dummy for individuals who have a university degree
age	Age of individual
agesqr	Age squared
workexp10[(a)]	Years of work experience, divided by 10.
unemexp10[(a)]	Years of unemployment experience, divided by 10.
disabled	Dummy for handicapped / physically challenged individuals
german	Dummy for German nationality
nchild	Number of children under 17 in the household
married	Dummy for married and not separated individuals. Omitted category for marital status is "single"/"widowed".
separated	Dummy for married, but separated individuals
divorced	Dummy for divorced individuals
fatherse	Dummy for individuals whose father is/was self-employed
capitalinc	Income from interests, dividends and renting out in t (reported retrospectively in $t+1$) in 1000 Euros.
duration[(a)]	Tenure of current self-employment spell
duration-sq	duration^2
duration-cu	duration^3

[(a)] Uses information from the lifetime employment history in the SOEP.

Notes: Dummy variables equal 1 if condition holds and 0 otherwise.

Table A.3: Exit Probability from Self-Employment: Logit Estimation Results - Coefficients (SOEP 2000-2005)

	Spec. 0	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Spec. 5
duration	-.282**	-.284***	-.284***	-.288***	-0.285***	-0.283***
duration-sq	0.014***	0.015***	0.015***	0.015***	0.015***	0.015***
duration-cu	-.0002***	-.0002***	-.0002***	-.0002***	-0.000***	-0.000***
female	0.574***	0.53***	0.535***	0.553***	0.524***	0.530***
highschool	-0.022	-0.057	-0.07	-0.078	-0.063	-0.059
apprenticeship	0.132	0.175	0.184	0.2	0.191	0.186
highertechncol	-0.058	-0.072	-0.078	-0.052	-0.071	-0.072
university	-.316**	-.341**	-.332**	-.276**	-0.329**	-0.333**
age	-.086**	-.082**	-.082**	-.094**	-0.082**	-0.082**
agesq	0.001***	0.001***	0.001***	0.001***	0.001**	0.001**
workexp10	-.359***	-.438***	-.439***	-.429***	-0.436***	-0.435***
unemexp10	1.337***	1.250***	1.232***	1.260***	1.218***	1.246***
disabled	0.028	-0.077	-0.033	-0.029	-0.026	-0.06
german	-0.182	-0.226	-0.233	-0.173	-0.249	-0.216
fatherse	-.333**	-.324**	-.326**	-.312**	-0.331**	-0.316**
capitalinc	-0.00006	-0.0007	-0.0006	-0.0005	-0.001	-0.001
nchild	0.017	0.033	0.023	0.019	0.027	0.023
married	0.363**	0.344**	0.336**	0.355**	0.319**	0.349**
separated	0.481*	0.564*	0.548*	0.527*	0.545*	0.550*
divorced	0.28	0.248	0.235	0.222	0.226	0.25
d2001	-.358**	-.366**	-.369**	-.414**	-0.368**	-0.365**
d2002	-0.102	-0.193	-0.202	-0.248	-0.203	-0.194
d2003	-0.223	-.269*	-.283*	-.287*	-0.280*	-0.272*
d2004	-0.113	-0.225	-0.232	-.287*	-0.226	-0.226
d2005	-.305**	-.386**	-.395**	-.433***	-0.389**	-0.389**
constant					0.93	1.119
Occupational Risk 0 (Reference)						
Risk 1		-.412				
Risk 2		-.544**				
Risk 3		-.322				
Risk 4		-.344				
Risk 5		-.612***				
Risk 6		-.626***				
Risk 7		-.448**				
Risk 8		-.594***				
Risk 9		-.128				
Risk 10		-.323				
Occ. Risk Low (0-2, Reference)						
Occ. Risk Medium (3-7)			-.213*			
Occ. Risk High (8-10)			-.147			
Lottery 0€ (Reference)						
Lottery 20k€				0.231*		
Lottery 40k€				0.062		
Lottery 60k€				-.232		
Lottery 80k€				-.249		
Lottery 100k€				0.76**		
Occ. Risk Linear					-0.029	-0.177**
Occ. Risk Squared						0.016**
Obs.	5999	5300	5300	5354	5300	5300
Pseudo-R^2	0.092	0.103	0.099	0.1	0.099	0.101
Log Likelihood	-1827.857	-1620.695	-1627.463	-1654.817	-1627.758	-1624.224

Notes: ***/**/* indicates significance at the 1%/5%/10% levels.

Table A.4: Summary of the Sensitivity Analysis - Coefficients and Marginal Effects (SOEP 2000-2005)

	Coefficient	Marg. Effect
(1) Exit Probability from Self-Employment - Different Risk Measures		
Financial Risk Low (0-2, Reference)		
Fin. Risk Medium (3-7)	-.172*	-.013*
Fin. Risk High (8-10)	.209	.019
General Risk Low (0-2, Reference)		
Gen. Risk Medium (3-7)	-.316**	-.027**
Gen. Risk High (8-10)	-.270	-.024
(2) Exit Probability from Self-Employment - Different Occ. Risk Categories		
Occupational Risk Low (0-2, Reference)		
Occ. Risk Medium (3-7)	-.213*	-.017*
Occ. Risk High (8-10)	-.147	-.012
Occupational Risk Low (0-3, Reference)		
Occ. Risk Medium (4-6)	-.265**	-.021**
Occ. Risk High (7-10)	-.143	-.012
(3) Exit Probability from Self-Employment - Aged below 56 years		
Occupational Risk Low (0-2, Reference)		
Occ. Risk Medium (3-7)	-.295**	-.026**
Occ. Risk High (8-10)	-.255	-.023
(4a) Exit Probability to Dependent Employment		
Occupational Risk Low (0-2, Reference)		
Occ. Risk Medium (3-7)	-.312**	-.017*
Occ. Risk High (8-10)	-.154	-.009
(4b) Exit Probability to Unemployment		
Occupational Risk Low (0-2, Reference)		
Occ. Risk Medium (3-7)	-.040	-.001
Occ. Risk High (8-10)	-.135	-.003
Control Variables[(a)]	Yes	Yes

Notes: ***/**/* indicates significance at the 1%/5%/10% levels.

[(a)] See Table A.3 for a full list of included explanatory variables.