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Abstract

The notion of risk and entrepreneurship has been widely discussed in the entrepreneurship literature. Starting a business involves risk and requires a risk-taking attitude. Most studies have compared entrepreneurs with non-entrepreneurs such as managers or bankers. So far, little research exists on the risk attitudes of different types of entrepreneurs. This study aims to fill this gap. Our particular focus is on the entrepreneurs' motivations to start their business. The results show that opportunity entrepreneurs are more willing to take risks than necessity entrepreneurs. In addition, entrepreneurs who are motivated by creativity are more risk-tolerant than other entrepreneurs. The study contributes to the literature about risk attitudes of entrepreneurs and to the literature about necessity and opportunity entrepreneurship.

JEL codes: D81; L26; J60

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1. Introduction

Entrepreneurs are generally considered risk-takers. At the same time, entrepreneurs as a group are considered very heterogeneous in nature, ranging from ones like Bill Gates who grow their start-up into a multi-billion dollar business to ones like the small shop owner around the corner. Thus far, however, most of the literature about the risk attitudes of entrepreneurs has treated the group of entrepreneurs as homogenous and compares their risk attitudes with the risk attitudes of managers (e.g., Begley and Boyd, 1987; Brockhaus, 1980; Tan, 2001), bankers (Sarasvathy et al., 1998), or employees (Caliendo et al., 2009). Little research exists on the differences of risk attitudes *within* the group of entrepreneurs. This study addresses this gap. Our particular focus is on the motivation of entrepreneurs. We analyze two related research questions: how does the risk attitude of necessity and opportunity entrepreneurs differ? How is the entrepreneurs' source of work motivation associated with their risk attitude?

Our results show that entrepreneurs are not a homogenous group with regard to their risk attitude. Both the entrepreneurs' motivations to start their ventures (necessity versus opportunity) and their sources of work motivation are found to be strongly associated with the entrepreneurs' risk attitudes. With these findings, this study contributes to the literature on risk attitudes of entrepreneurs. The notion of risk and entrepreneurship is a widely examined topic in the entrepreneurship literature. Going back to the early works of Knight in the 1920s (Knight 1965) and Kihlstrom and Laffont (1979), a low level of risk aversion is regarded as a factor explaining whether an individual chooses to become an entrepreneur or not. In this study, we show that there exist remarkable differences with regard to risk aversion *within* the group of entrepreneurs. For example, necessity entrepreneurs are found to be *more* risk-averse, whereas entrepreneurs motivated by a high level of creativity are found to be *less* risk-averse than other types of entrepreneurs. The main contribution of this paper is to show that beyond what is known about the more obvious individual-specific determinants of risk aversion (e.g., gender, age, cognitive ability), there exist entrepreneurship-specific factors that are associated with entrepreneurs' risk attitudes (e.g., necessity-based entrepreneurship or creativity entrepreneurship).

Our findings also contribute to the understanding of necessity- and opportunity-based entrepreneurship. Despite the great public attention that the Global Entrepreneurship Monitor (GEM) has created by introducing this distinction in 2001 (Reynolds et al., 2002), very little is known about the two groups from a micro perspective. By showing that necessity entrepreneurs have a lower willingness to take risks relative to other entrepreneurs, we contribute to the discussion of the specifics of this particular group (e.g., Bergmann and Sternberg, 2007; Block and Sandner, 2009; Block and Wagner, 2010; Wagner, 2005; Wennekers et al., 2005; Wong et al., 2005). Since risk taking is considered a crucial aspect of entrepreneurial behavior (e.g., Caliendo et al. 2009; Douglas and Shep-

herd, 2002; Forlani and Mullins, 2000; Ibrahim and Ellis, 1993; Kan and Tsai, 2006; Moensted, 2007; Van Gelderen et al., 2000), we suggest treating them as a separate category in entrepreneurship research and practice.

The remainder of this paper is organized as follows. Section 2 summarizes the extant literature about the risk attitude of entrepreneurs. Section 3 introduces our data and variables. Section 4 shows the results of our empirical study, which are then discussed in Section 5. Section 6 concludes.

2. Literature review and research gap

The notion of risk and risk behavior is an important element in the entrepreneurship literature; risk-taking is considered an essential characteristic of entrepreneurs (e.g., Caliendo et al. 2009; Douglas and Shepherd, 2002; Forlani and Mullins, 2000; Ibrahim and Ellis, 1993; Kan and Tsai, 2006; Moensted, 2007; Van Gelderen et al., 2000). Brockhaus (1980) defined risk-taking propensity as the perceived probability of receiving the rewards associated with the success of a proposed situation. The underlying mechanism of risk is the probability distribution associated with the outcomes that result from taking different actions. Then, risk refers to the "unpredictability or possible downside variability of performance" (Miller, 2007). The risk-taking propensity of an entrepreneur is high if she is willing to knowingly take risks (Simon et al., 2000).

Entrepreneurs are often assumed to be less risk-averse than the general population. This assumption has been scrutinized in a number of studies, but the results are mixed. Brockhaus (1980), for example, compared entrepreneurs and managers and found that risk-taking does not distinguish either one group from the other. Similar results have been found by other scholars (Masters and Meier, 1988; Norton and Moore, 2006; Palich and Bagby, 1995). In other studies, however, it has been found that risk-taking propensity is higher among entrepreneurs than among other individuals (e.g., Begley and Boyd, 1987; for a meta-analytic review, see Stewart and Roth, 2001).

Several studies have discussed whether risk aversion is a personal trait or is rather a broader concept that spans not only personal attributes but also the context of business decisions. Ray (1994), for example, doubted that individuals have a generalized risk propensity. Instead, he argued that risk-taking is highly contextual. Thus, the entrepreneur's risk attitude must be viewed in the specific decision situations with which an entrepreneur is faced. Ray (1994) proposed that risk attitude should be analyzed as part of a complex decision-making process. McCarthy (2000) also argued that risk attitude is "not just a static personality trait forged by nature or nurture, but seems to reflect learning in a business context."[1]

[1] For similar arguments, see also Das and Teng (1997), Dermer (1997), and Janney and Dess (2006).

The above discussion shows that it might not be appropriate to look for a general risk attitude and to make a comparison between entrepreneurs and non-entrepreneurs along this dimension. Instead, one should assess the entrepreneur's risk attitude in the specific business context she faces. For example, it might be that an entrepreneur has a risk-taking propensity with her entrepreneurial decisions but is rather risk-averse when it comes to her private life (e.g. in terms of her car driving behavior). This study explicitly considers the context and uses both a general and an entrepreneurship-specific risk-taking measure. Moreover, we differ between several types of entrepreneurs and do not treat them all the same. In contrast to the large number of studies that have contrasted entrepreneurs with non-entrepreneurs, research on the differences in risk attitude *within* the group of entrepreneurs is still very scarce. Our focus is twofold: In the first place, we focus on the factors that drive individuals' intentions to become an entrepreneur such as the desire for a high level of creativity or a high income. In addition to that we analyze whether the decision to become self-employed was opportunity-driven or was mainly due to a lack of alternative employment options.

3. Data and variables

3.1 Data

To analyze the risk attitude of entrepreneurs, we conducted an online survey in Germany. The survey took place in April 2008. Through the newsletter news2use published by our cooperation partner gruendungszuschuss.de, we contacted 24,875 individuals with personalized e-mails.[2] The newsletter is targeted to reach early-stage entrepreneurs or individuals who plan to start a firm in the near future and contains practical and useful information about how to start and manage a start-up. To achieve a high degree of clarity and structure, the questionnaire was pre-tested in several iterations among a small group of selected entrepreneurs. The e-mail invitations for the survey were sent out on April 1st, 2008. A reminder was sent on April 16th, 2008. To increase the response rate, the participants could take part in a lottery of ten Amazon vouchers worth €30 each.

Our survey was answered by 2,330 entrepreneurs, which corresponds to a response rate of 9.36%. After several steps of data cleaning, we were left with a sample of 1,526 entrepreneurs, on which we base our results in the remainder of this study. Overall, 970 male and 556 female entrepreneurs participated in our study. The mean age of the entrepreneurs was 42.1 years, and the mean age of the start-ups was 21 months. These relations are similar to those of other studies on entrepreneurship in Germany (e.g., Kohn and Spengler, 2007; Sternberg et al., 2007). 66% percent of the entrepreneurs invested €10,000 or less in the start-up, and 86% started the firm without any team

[2] See http://www.gruendungszuschuss.de (assessed August 14th, 2009). A similar dataset has been used in a number of other studies (Block and Koellinger, 2009; Sandner et al., 2008).

members. Most of the respondents had a high level of education: 77% had a school degree that enabled them to attend a university (in German: 'Universität' or 'Fachhochschule'). Our sample is also representative with respect to the ratio of opportunity to necessity entrepreneurs, which is 2.53 in the German GEM (Sternberg et al., 2007) and 2.64 in our survey. The GEM is a representative population sample (Reynolds et al. 2005). Table A1 in the appendix provides descriptive statistics of our sample.

3.2 Variables

3.2.1 Measures of risk attitude

To analyze entrepreneurs' attitudes towards risk, we posed three different questions: first, the participants were asked to indicate their general willingness to take risks on a 7-point scale ranging from 1 ("complete willingness") to 7 ("complete unwillingness") (variable *general risk attitude*). Second, employing the same scale, we asked the participants to indicate their willingness to take risks in the specific context of their start-up (variable *risk attitude with regard to start-up*). Third, we asked a lottery question (variable *amount invested in an investment lottery*). They were told that they had just won €100,000 in a lottery and were asked how much of it they would invest in an entrepreneurial activity. They were given the information that they had a 50/50 chance of either getting back double the amount invested or losing half of it. They could invest between €0 and €100,000 (in intervals of €10,000). Table A2 in the appendix shows the exact wording of our questions.

Our risk measurements are very similar to the ones used in the German Socio-Economic Panel Survey (SOEP), which were validated in a field experiment (Dohmen et al., 2005) and used in a number of published studies thereafter (e.g., Caliendo et al., 2009; Dohmen et al., 2007, Jaeger et al., 2007).

3.2.2 Measures with regard to motivation

To classify opportunity and necessity entrepreneurs, the participants were asked to indicate whether they took advantage of a new business opportunity (variable *opportunity entrepreneur*) or whether they had no better alternatives for employment (variable *necessity entrepreneur*) or whether a combination of both applied (which is used as a reference category). The question is identical to the one used by the GEM, which introduced the idea to differentiate between necessity-based and opportunity-based entrepreneurship (see Reynolds et al., 2005). To record the entrepreneur's degree of motivation by creativity, the participants were asked to evaluate the following statement on a 5-point Likert scale: "A high level of creativity motivates me in my work as an en-

trepreneur" (variable *motivation by creativity*). Similarly, to learn the entrepreneur's motivation of being independent, we included an analogous statement: "A high level of independence motivates me in my work as an entrepreneur" (*motivation by independence*). Again, a 5-point Likert scale was used. Finally, to measure the prospect of high income as a motivating factor, the participants of the survey were asked to evaluate a similar statement: "A high level of income motivates me in my work as an entrepreneur" (variable *motivation by income*).

3.2.3 Control variables

To control for socio-demographic characteristics, we asked the participants to state their gender, age, nationality, marital status, and number of children. Industry and leadership experience as well as the highest school degree attained were recorded to control for the level and kind of human capital involved. To measure the entrepreneurs' financial situation, we asked the participants how long they could live off their wealth without any additional income, and we created a dummy variable indicating whether a participant could live more than a year simply on her savings or wealth. To control for the personality traits of the entrepreneur, we used a multi-item scale developed by Gosling et al. (2003). This scale encompasses ten items to measure the so-called 'Big Five' personality traits, i.e., *extraversion*, *agreeableness*, *conscientiousness*, *emotional stability*, and *openness to experience*. In addition, relevant information about start-up characteristics and the entrepreneur's context were recorded, including the age of the venture, the amount of initial investment in the start-up, and the industry in which the start-up is active. We also asked whether the entrepreneurs founded their company alone or if an entire team was involved. Furthermore, we were interested in whether the entrepreneur received government aid and if the new business generates sufficient earnings to cover her costs of living. To control for differences between respondents in East versus West Germany, we asked the entrepreneur to provide the first two digits of her zip code, which led to the dummy variable *West Germany*. We also sought to differentiate between entrepreneurs in rural and urban areas and asked the participants about the number of inhabitants of their hometown. The construction of the variables is described in more detail in Table A2 in the appendix.

4. Results

4.1 Univariate analyses

Figure 1 displays histograms of our three risk measures.

Figure 1 about here

The distributions of the risk measures peak around the middle value of the scale and are steeper than a normal distribution (the kurtosis has a value of about 3). The skewness is slightly negative (left-skewed) with the general risk measure and with the start-up risk measure; the skewness is slightly positive (right-skewed) with the investment lottery question. Most importantly, there is some variation in entrepreneurs' risk attitudes. Our goal in this study is to explain which factors are associated with this variation.

We focus on the lottery question, in which the entrepreneurs could decide how much money they would invest in a risky business opportunity (variable *amount invested in an investment lottery*).[3] T-tests and mean values were calculated to analyze differences in risk attitude within the group of entrepreneurs. Table 1 reports the results of these t-tests.

Table 1 about here

Motivation: Opportunity entrepreneurs are found to be less risk-averse than other types of entrepreneurs: they would invest *more* money in the investment lottery relative to other entrepreneurs (€50,612 vs. 44,209, $p<0.01$). In contrast, necessity entrepreneurs would invest *less* money in a risky business opportunity relative to other entrepreneurs (€39,733 vs. 48,647, $p<0.01$). The next three variables refer to sources of work motivation and their impact on the entrepreneur's risk attitude. Entrepreneurs who are motivated by a high level of creativity or independence are less risk-averse as compared to other entrepreneurs (€50,156 vs. 44,513, $p<0.01$; €48,991 vs. 44,810, $p<0.01$), whereas the variable *motivation by income* shows no effect (€48,151 vs. 46,735, $p=0.34$).

*Start-up characteristics***:** Several start-up characteristics show significant effects with regard to the entrepreneur's risk attitude. Entrepreneurs who have invested more than €10,000 in their start-up are found to be more risk-tolerant than other entrepreneurs (€53,665 vs. 43,801, $p<0.01$). The same is true for entrepreneurs who work more than 50 hours per week vs. entrepreneurs who work less than 50 hours per week (€50,282 vs. 44,837, $p<0.01$). If entrepreneurs start their business together with others, they seem to be more risk-tolerant than other entrepreneurs (€53,194 vs. 46,115, $p<0.01$). Finally, founders who start their venture from unemployment seem to be less risk-tolerant relative to other entrepreneurs (€ 45,092 vs. 48,410, $p<0.01$).

Socio-demographic characteristics and personality traits: The univariate analysis shows that the control variables matter. Entrepreneurs' risk attitudes vary with regard to gender, age, wealth, and leadership experience. For example, female entrepreneurs seem to be more risk-averse than

[3] The main results however stay the same when we use the other risk measures.

male entrepreneurs (€ 42,860 vs. 49,557, $p<0.01$). The same is true for young versus old entrepreneurs. Personality seems also to impact risk attitude. The two personality traits extraversion and emotional stability show significant effects.

4.2 Multivariate analyses

Table 2 shows the correlations between the main variables of interest and reports variance inflation factors (VIFs). The VIFs indicate that multicollinearity is not an issue; the maximum VIF is 1.33 (variable *motivation by creativity*). The correlation table also shows that the risk measures are correlated although not as strong as one might expect. The correlation between the general risk attitude and the start-up risk attitude is $r=0.64$ ($p<0.01$); the correlations between the investment lottery question and the other two risk measures are $r=0.27$ (general risk attitude) and $r=0.31$ (risk attitude with regard to start-up).

Table 2 about here

We estimated three different regression models to analyze the risk attitude of entrepreneurs. In Model I, we estimated an OLS model with *amount invested in an investment lottery* as the dependent variable.[4] In Models II and III, we estimated ordered logistic regressions and used *risk attitude with regard to start-up* and *general risk attitude* as the dependent variables. Table 3 shows the results of these estimations.

Table 3 about here

The motivation of entrepreneurs has an effect with regard to the risk attitude of entrepreneurs. Entrepreneurs who start their business for opportunity reasons (variable *opportunity entrepreneur*) are found to have a higher risk tolerance relative to other entrepreneurs. This statement is supported using *risk attitude with regard to start-up* (Model II: $\beta=0.288$, $p<0.05$) and *general risk attitude* (Model III: $\beta=0.393$, $p<0.01$) as dependent variables, but not in case of the investment lottery (Model I: $\beta=1{,}868$, $p=0.20$). In turn, entrepreneurs who start their business for necessity rea-

[4] We also estimated an ordered logistic regression but did not find large differences. The results are available from the corresponding author.

sons seem to have a lower risk tolerance than other entrepreneurs. Necessity entrepreneurs would invest on average about €5,200 less in the investment lottery ($p<0.05$). The coefficient is also negative in the other two models (Model II: $\beta=-0.440$, $p<0.05$; Model III: $\beta=-0.303$, $p<0.1$).

The following three variables deal with the way in which entrepreneurs are motivated in their daily work. Entrepreneurs who are motivated by a high level of creativity are found to have a higher risk tolerance than other entrepreneurs (variable *motivation by creativity*). This statement is supported in Model I ($\beta=2{,}531$, $p<0.05$) and Model III ($\beta=0.129$, $p<0.1$). The situation is different with the variable *motivation by independence*. In all three models, the coefficients are insignificant. An interesting result emerges with regard to the variable *motivation by income*: the variable has a positive effect with regard to the general risk attitude of entrepreneurs (Model III: $\beta=0.115$, $p<0.1$), but is insignificant when *amount invested in an investment lottery* (Model I) or *risk attitude with regard to start-up* (Model II) is used as the dependent variable.

Several variables were included in the regression for control reasons. Some results stand out: women have a lower propensity to take risks than men (e.g., Model I: $\beta=-4{,}396$, $p<0.01$). Entrepreneurs with a high level of extraversion are found to be less risk-averse than other entrepreneurs (e.g., Model I: $\beta=888$, $p<0.05$). Finally, entrepreneurs' risk attitudes differ with regard to the industry in which they start her venture. F-tests of joint significance of the industry variables produce significant results in all three models.

We find only few differences in the effects of the independent variables across the three different risk measures. It is only with the personality variables where larger differences can be recorded. They seem to have a stronger effect with the general risk measure than with the entrepreneurship-specific risk measures. For example, the effect of a higher level of extraversion is ß=0.167 ($p<0.01$) in Model III and ß=0.109 ($p<0.01$) in Model II.

4.3 Comparison of our results with the results of other studies

Some of our findings replicate the SOEP-based results of Dohmen et al. (2005), which supports our way to measure risk attitude. For example, we find similar effects for the gender and the wealth variable. Our main result concerning necessity entrepreneurship is in line with Wagner (2005), who reports that necessity entrepreneurs are more likely than opportunity entrepreneurs to report fear of failure as a reason not to start a business. This can be interpreted as evidence for a higher risk aversion of necessity entrepreneurs relative to opportunity entrepreneurs.

5. Discussion of the results

5.1 Motivation to start the venture and its effect on risk attitude

Necessity-based entrepreneurship: The notion of opportunity-based versus necessity-based entrepreneurship was first introduced by the GEM (Reynolds et al., 2002). The idea was to distinguish between entrepreneurs who started their business because they wanted to pursue an entrepreneurial opportunity and those entrepreneurs who have started a business because there were no other employment alternatives available. Necessity entrepreneurs are found to have a lower level of risk tolerance in all three models (see Table 3, Models I-III). How can we explain this finding? Previous research has found necessity entrepreneurs to be less satisfied with their venture than other entrepreneurs (Block and Koellinger, 2009). Research in social psychology has analyzed the link between happiness and risk perception: Lerner and Keltner (2001), for example, found that happy people tend to have a more optimistic perception of risk as compared to other individuals. Following this line of argument, necessity entrepreneurs should have a lower willingness to take risks. Another explanation is that necessity entrepreneurs do not show the typical characteristics of entrepreneurs (e.g., willingness to take risks), since they never wanted to become entrepreneurs in the first place. They started the business as there were no other employment alternatives available and were effectively pushed into entrepreneurship by external factors. Both explanations suggest treating necessity entrepreneurs as a separate category from other types of entrepreneurs. With some characteristics, necessity entrepreneurs might come closer to regular employees than to other entrepreneurs.

Opportunity-based entrepreneurship: The results of Model II and Model III suggest that opportunity entrepreneurs have a higher level of risk tolerance than necessity entrepreneurs (see Table 3). Similar to the argument about necessity entrepreneurs in the previous paragraph, we suggest that opportunity entrepreneurs are more enthusiastic about their venture than other entrepreneurs and that this has an influence on their risk attitudes. There is another argument that suggests a positive correlation between opportunity entrepreneurship and willingness to take risks: Osborn and Jackson (1988) as well as Thaler and Johnson (1990) found that outcome history has an influence on risk-taking behavior. Individuals who have been successful in prior risky situations were found to be more willing to take risks in later risky situations representing some kind of 'rollover' effect. We argue that opportunity entrepreneurs have been more successful in prior risky situations as compared to other entrepreneurs, particularly necessity entrepreneurs. They voluntarily decide to take the risk of a venture and are not pushed into entrepreneurship by external factors. Opportunity entrepreneurs might therefore represent a selection of entrepreneurs with a more positive outcome history.

5.2 Sources of work motivation and their influence on risk attitude

*Creativity***:** Entrepreneurs who are motivated by a high level of creativity are found to be more risk-tolerant relative to other entrepreneurs (see Table 3, Models I and III). Creativity refers to

the process of generating new ideas and concepts or creating new associations between existing ideas and concepts. Creativity has been associated with the process of opportunity identification and, thus, with entrepreneurial activities (Amabile, 1997; Gilad, 1984; Timmons, 1978; Ward, 2004; Whiting, 1988). We argue that entrepreneurs who are motivated by being creative care more about the creative process in itself rather than obtaining rewards in monetary terms. Thus, they are more willing to accept losses as a result of their investment decisions, which is why they should also have a higher willingness to take risks relative to other entrepreneurs. This is exactly what our results showed.

5.3 Implications for practice

Our findings offer some implications for practitioners. For example, banks and other lenders often make a distinction as to whether a credit user is a risk-taker. From the perspective of a bank, a high level of risk-taking is bad news because it inevitably increases the default risks of credits. With entrepreneurs taking high risks, a moral hazard problem may occur. If the entrepreneur fails with her venture, the bank looses its interest payments (in extreme cases, even the principal). If the entrepreneur is successful, the bank simply gets back the money agreed upon in the credit contract. Put differently, the bank does not benefit from a risky strategy that the entrepreneur pursues. The results of this study imply that banks should carefully assess the specific situation of the entrepreneur: for example, necessity entrepreneurs are more risk-averse than other entrepreneurs. Our results also carry some implications for entrepreneurship and innovation policy. Policy makers who support entrepreneurship in their country or region (e.g., through subsidized loans to entrepreneurs, regulatory exemptions, or tax benefits) with the goal of stimulating economic growth should be aware that not all entrepreneurs are those risk-loving types of entrepreneurs who grow their small start-up into a multi-billion dollar business. Simply encouraging more people to become entrepreneurs would be a bad public policy (Shane, 2009). The government might want to focus more on those entrepreneurs who are actually willing to take risks.

6. Conclusion

Our study shows that there are strong differences of the risk attitude within the group of entrepreneurs. Since willingness to take risks is considered one of the essential characteristics of entrepreneurship, this is an important finding. Necessity entrepreneurs were found to have a lower risk tolerance than other entrepreneurs. They might in fact resemble more non-entrepreneurs than they resemble other groups of entrepreneurs. To our knowledge, this is the first large-scale empirical study about the differences in risk attitude *within* the group of entrepreneurs. Yet, our variables captured only a relatively small portion of these intra-group differences. Further research therefore

seems promising and could focus on (1) differences in risk perception within the group of entrepreneurs, (2) comparing risk attitudes across different entrepreneurial decision-making situations, and (3) the effects of these differences on entrepreneurial outcome variables.

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Appendix

Table A1: Descriptive Statistics

Variables	Mean	Std. dev.	Median	Min.	Max.
Dependent variables					
General risk attitude (ordinal scale from 1 to 7)	4.38	1.23	4	1	7
Risk attitude with regard to start-up (ordinal scale from 1 to 7)	4.32	1.19	4	1	7
Amount invested in investment lottery (in €)	47,117	25,542	50,000	0	100,000
Motivation					
Opportunity entrepreneur (dummy)	0.45		0	0	1
Necessity entrepreneur (dummy)	0.17		0	0	1
Motivation by creativity (Likert scale from 1 to 5)	4.26	0.83	4	1	5
Motivation by independence (Likert scale from 1 to 5)	4.47	0.68	5	1	5
Motivation by income (Likert scale from 1 to 5)	3.74	1.05	4	1	5
Start-up characteristics					
Capital invested is < €10,000	0.66		1	0	1
Capital invested is between €10,000 and €25,000	0.20		0	0	1
Capital invested is between €25,001 and €50,000	0.08		0	0	1
Capital invested is > €50,001	0.06		0	0	1
Age of start-up (in months)	31.48	43.07	21	0	448
Working time (ordinal scale from 1 to 16)	8.13	2.70	8	1	15
Team (dummy)	0.14		0	0	1
Start-up from unemployment (dummy)	0.39		0	0	1
Government aid (dummy)	0.63		1	0	1
Income from start-up is sufficient to live (dummy)	0.58		1	0	1
Industry					
Consultancy, law, and training	0.25		0	0	1
Marketing, advertising, media, and design	0.17		0	0	1
IT and telecommunication	0.14		0	0	1
Trade and retail	0.07		0	0	1
Healthcare, fitness, and beauty	0.06		0	0	1
Engineering and construction	0.06		0	0	1
Commercial services	0.05		0	0	1
Sales and distribution	0.05		0	0	1
Language and translation services	0.04		0	0	1
Crafts	0.03		0	0	1
Household services	0.02		0	0	1
Manufacturing	0.01		0	0	1
Restaurants, catering, and hotel	0.01		0	0	1
Other	0.06		0	0	1
Socio-demographic characteristics					
Female (dummy)	0.36		0	0	1
Age (in years)	42.10	8.80	42	21	67
Having children (dummy)	0.51		1	0	1
Married (dummy)	0.64		1	0	1
Wealth (dummy)	0.30		0	0	1
Size of home town (ordinal scale from 1 to 6)	3.26	1.96	3	1	6
School degree enables attendance at university (dummy)	0.77		1	0	1
West Germany (dummy)	0.85		1	0	1
Leadership experience (dummy)	0.71		1	0	1
Industry experience (dummy)	0.67		1	0	1
Personality traits					
Extraversion (ordinal scale from 2 to 14)	9.94	2.43	10	3	14
Agreeableness (ordinal scale from 2 to 14)	9.03	1.66	9	2	14
Conscientiousness (ordinal scale from 2 to 14)	11.09	2.25	11	3	14
Emotional stability (ordinal scale from 2 to 14)	9.81	2.54	10	2	14
Openness to experience (ordinal scale from 2 to 14)	11.85	1.80	12	3	14

Note*:* N = 1,526 observations

Table A2: Description of Variables

Variable	Description
Risk	
General risk attitude	"Are you generally a person who is prepared to take risks, or do you try to avoid taking risks?"; ordinal scale ranging from 1 ("complete willingness") to 7 ("complete unwillingness")
Risk attitude with regard to start-up	"In your entrepreneurial decisions, are you prepared to take risks, or do you try to avoid taking risks?"; ordinal scale ranging from 1 ("complete willingness") to 7 ("complete unwillingness")
Amount invested in investment lottery	"Imagine you have won €100,000 in a lottery. After having received the money, you have the possibility to invest the money in an entrepreneurial activity. With a probability of 50%, you double the amount. With a probability of 50%, you would loose half of the invested money. How much money obtained from the lottery would you invest?" The participants could choose to invest between €0 and €100,000 (in intervals of €10,000).
Motivation	
Opportunity entrepreneur	Dummy=1 if entrepreneur states that she became an entrepreneur by taking advantage of a new business opportunity
Necessity entrepreneur	Dummy=1 if entrepreneur states that she became an entrepreneur since she had no better choices for work
Motivation by creativity	Statement: "A high level of creativity motivates me in my work as an entrepreneur"; 5-point Likert scale ranging from 1 ("do not agree at all") to 5 ("fully agree")
Motivation by independence	Statement: "A high level of independence motivates me in my work as an entrepreneur"; 5-point Likert scale ranging from 1 ("do not agree at all") to 5 ("fully agree")
Motivation by income	Statement: "A high level of income motivates me in my work as an entrepreneur"; 5-point Likert scale ranging from 1 ("do not agree at all") to 5 ("fully agree")
Start-up characteristics	
Capital invested	Amount of capital invested measured in six ordinal categories: < €10,000; €10,000-25,000; €25,001-50,000; €50,001-100,000; €100,001-200,000; > €200,000
Age of start-up	Number of months the start-up already exists
Working time	Average weekly working time measured in 16 ordinal categories: <15h; 16-20h; 21-25h; 26-30h; 31-35h; 36-40h; 41-45h; 46-50h; 51-55h.; 56-60h; 61-65h; 66-70h.; 71-75h.; 76-80h; >80h
Team	Dummy=1 if the start-up was founded by a team
Start-up from unemployment	Dummy=1 if the entrepreneur has been unemployed for more than one month right before starting the venture
Government aid	Dummy=1 if entrepreneur received government aid
Income from start-up is sufficient	Dummy=1 if entrepreneur can live on her income obtained from her start-up
Industry categories	Industry dummies (14 categories): 'consultancy, law, and training', 'marketing, advertising, media, and design', 'IT and telecommunication (incl. programming)', 'trade and retail', 'healthcare, fitness, and beauty', 'engineering and construction (incl. architecture)', 'commercial services', 'sales and distribution', 'language and translation services', 'crafts', 'household services', 'manufacturing', 'restaurants, catering and hotel', 'other'.
Socio-demographic characteristics	
Female	Dummy=1 if entrepreneur is female
Age	Age of the entrepreneur (in years)

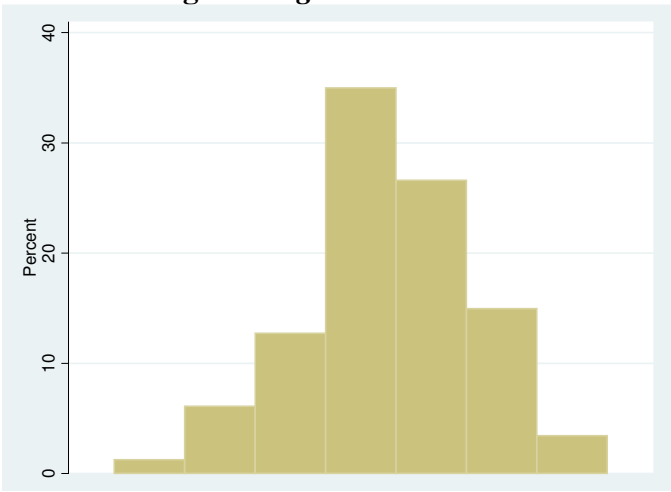
Table A2 (continued): Description of Variables

Variable	Description
Socio-demographic characteristics (continued)	
Having children	Dummy=1 if entrepreneur has one or more children
Married	Dummy=1 if entrepreneur is married
Wealth	Dummy=1 if entrepreneur can live longer than 12 months on her savings or wealth without receiving any additional income from the start-up
School degree enables attendance at university	Dummy=1 if entrepreneur has a school degree that enables her to attend a university (in German: "Fachhochschulabschluss" or "Abitur")
Size of hometown	Number of inhabitants of entrepreneur's hometown measured in six ordinal categories: ≤20,000; 20,001-50,000; 50,001-100,000; 100,001-500,000; 500,001-1,000,000; ≥1,000,001
West Germany	Dummy=1 if entrepreneur lives in West Germany (former area of the Federal Republic of Germany)
Leadership experience	Dummy=1 if entrepreneur had leadership experience when starting her venture
Industry experience	Dummy=1 if entrepreneur had obtained industry knowledge before starting her venture
Personality traits	
Extraversion	Extraversion of an individual: ordinal scale ranging from 2 ("very low degree") to 14 ("very high degree"); scale of Gosling et al. (2003)
Agreeableness	Agreeableness of an individual: ordinal scale ranging from 2 ("very low degree") to 14 ("very high degree"); scale of Gosling et al. (2003)
Conscientiousness	Conscientiousness of an individual: ordinal scale ranging from 2 ("very low degree") to 14 ("very high degree"); scale of Gosling et al. (2003)
Emotional stability	Emotional stability of an individual: ordinal scale ranging from 2 ("very low degree") to 14 ("very high degree"); scale of Gosling et al. (2003)
Openness to experience	Openness to experience of an individual: ordinal scale ranging from 2 ("very low degree") to 14 ("very high degree"); scale of Gosling et al. (2003)

Tables and figures to be inserted in the text:

Figure 1: Histograms of risk measures

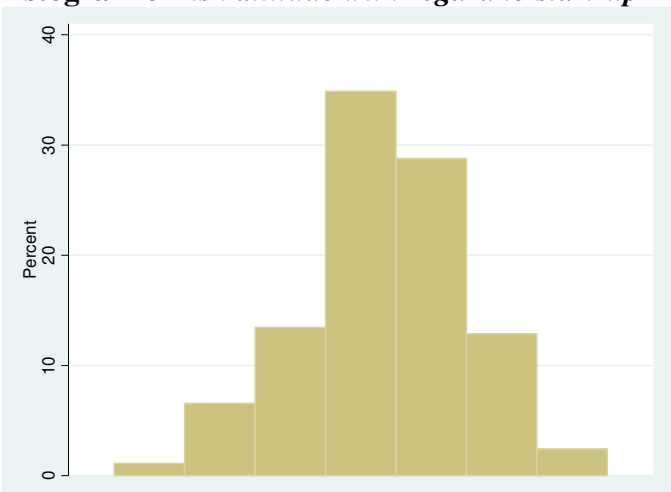
Histogram of *general risk attitude*



1 2 3 4 5 6 7
(1=complete willingness; 7=complete unwillingness)

Mean = 4.38
Median = 4
Std. dev. = 1.23
Skewness = -0.19
Kurtosis = 2.96
N=1,526 obs.

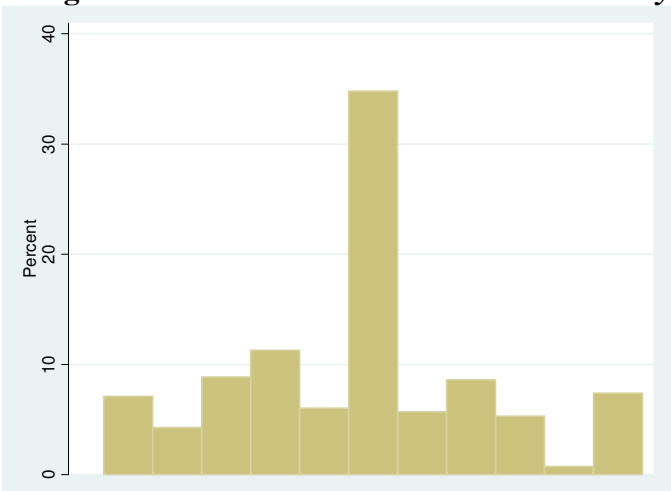
Histogram of *risk attitude with regard to start-up*



1 2 3 4 5 6 7
(1=complete willingness; 7=complete unwillingness)

Mean = 4.32
Median = 4
Std. dev. = 1.19
Skewness = -0.22
Kurtosis = 3.00
N=1,526 obs.

Histogram of *amount invested in investment lottery*



0 10 20 30 40 50 60 70 80 90 100
(amount invested in 1,000 €)

Mean = 47,116
Median = 50,000
Std. dev. = 25,542
Skewness = 0.16
Kurtosis = 2.77
N=1,526 obs.

Table 1: Univariate Analysis

Motivation	Groups [1]	N	Amount invested in investment lottery (in €) Mean	Std. dev.	p-value [2]
Opportunity entrepreneur	No	834	44,209	25,412	<0.01
	Yes	692	50,621	25,275	
Necessity entrepreneur	No	1,264	48,647	25,471	<0.01
	Yes	262	39,733	24,626	
Motivation by creativity (Likert scale from 1 to 5)	>4	704	50,156	26,171	<0.01
	≤4	822	44,513	24,712	
Motivation by independence (Likert scale from 1 to 5)	≥5	842	48,991	25,722	<0.01
	<5	684	44,810	25,146	
Motivation by income (Likert scale from 1 to 5)	>4	411	48,151	25,973	0.34
	≤4	1,115	46,735	25,382	
Start-up characteristics					
Capital invested	≥ €10,000	513	53,665	25,713	<0.01
	< €10,000	1,013	43,801	24,817	
Age of start-up	>21 months	741	46,383	25,672	0.28
	≤21 months	785	47,809	25,416	
Working time	>50 hours	639	50,282	26,897	<0.01
	≤50 hours	887	44,837	24,281	
Team	No	1,310	46,115	25,352	<0.01
	Yes	216	53,194	25,906	
Start-up from unemployment	No	931	48,410	25,612	0.01
	Yes	595	45,092	25,322	
Government aid	No	562	47,331	24,791	0.80
	Yes	964	46,992	25,982	
Income from start-up is sufficient	No	636	47,406	25,299	0.71
	Yes	890	46,910	25,727	
Socio-demographic characteristics					
Female	No	970	49,557	26,234	<0.01
	Yes	556	42,860	23,716	
Age of entrepreneur	>42 years	701	48,631	26,368	0.03
	≤42 years	825	45,830	24,762	
Having children	No	755	45,682	25,537	0.03
	Yes	771	48,521	25,485	
Married	No	549	46,430	24,769	0.43
	Yes	977	47,503	25,971	
Wealth	No	1,074	45,549	24,770	<0.01
	Yes	452	50,841	26,955	

Table 1 (continued): Univariate Analysis

Socio-demographic characteristics (continued)	**Amount invested in investment lottery (in €)**				
	Groups [1]	**N**	**Mean**	**Std. dev.**	**p-value** [2]
School degree enables attendance at university	No	353	45,269	26,242	0.12
	Yes	1,173	47,673	25,313	
Size of hometown	>100,000	715	47,413	25,197	0.67
	≤100,000	811	46,856	25,855	
West Germany	No	231	44,675	26,206	0.11
	Yes	1,295	47,552	25,408	
Leadership experience	No	446	43,677	24,521	<0.01
	Yes	1,080	48,537	25,830	
Industry experience	No	511	48,239	25,874	0.22
	Yes	1,015	46,552	25,368	
Personality traits					
Extraversion (ordinal scale from 2 to 14)	>10	660	50,000	26,155	<0.01
	≤10	866	44,919	24,857	
Agreeableness (ordinal scale from 2 to 14)	>9	553	46,221	24,664	0.30
	≤9	973	47,626	26,027	
Conscientiousness (ordinal scale from 2 to 14)	>11	762	46,247	25,879	0.18
	≤11	764	47,984	25,189	
Emotional stability (ordinal scale from 2 to 14)	>10	660	49,318	25,810	<0.01
	≤10	866	45,439	25,222	
Openness to experience (ordinal scale from 2 to 14)	>12	643	49,254	26,264	0.01
	≤12	883	45,561	24,903	

Notes: N=1,526
[1] With ordinal or continuous variables, the median is used to construct the groups.
[2] The p-values refer to a t-test on the equality of means.

Table 2: Correlations and Variance Inflation Factors (VIFs)

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	VIFs
1. Amount invested in investment lottery																		
2. Risk attitude with regard to start-up	0.31																	
	(0.00)																	
3. General risk attitude	0.27	0.64																
	(0.00)	(0.00)																
4. Opportunity entrepreneur	0.13	0.16	0.18															1.29
	(0.00)	(0.00)	(0.00)															
5. Necessity entrepreneur	-0.13	-0.16	-0.15	-0.41														1.23
	(0.00)	(0.00)	(0.00)	(0.00)														
6. Motivation by creativity	0.13	0.16	0.17	0.11	-0.13													1.33
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)													
7. Motivation by independence	0.08	0.12	0.12	0.17	-0.15	0.38												1.24
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)												
8. Motivation by income	0.03	0.09	0.11	0.10	-0.07	0.12	0.20											1.10
	(0.25)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)											
9. Capital invested (> €50,000)	0.13	0.08	0.08	0.09	-0.05	-0.01	-0.05	0.03										1.05
	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.57)	(0.04)	(0.24)										
10. Age of start-up	0.04	0.06	0.08	-0.01	0.03	0.02	0.01	0.03	0.05									1.20
	(0.12)	(0.01)	(0.00)	(0.71)	(0.21)	(0.35)	(0.70)	(0.24)	(0.04)									
11. Working time	0.15	0.13	0.15	0.07	-0.02	0.03	0.01	0.08	0.17	0.06								1.14
	(0.00)	(0.00)	(0.00)	(0.01)	(0.39)	(0.20)	(0.66)	(0.00)	(0.00)	(0.02)								
12. Female	-0.13	-0.11	-0.13	0.01	-0.01	0.05	0.04	-0.07	-0.02	-0.03	-0.25							1.21
	(0.00)	(0.00)	(0.00)	(0.60)	(0.63)	(0.07)	(0.09)	(0.01)	(0.40)	(0.22)	(0.00)							
13. Age	0.05	0.04	-0.03	-0.21	0.13	0.02	-0.11	-0.18	-0.01	0.23	-0.05	-0.10						1.07
	(0.05)	(0.11)	(0.19)	(0.00)	(0.00)	(0.42)	(0.00)	(0.00)	(0.61)	(0.00)	(0.05)	(0.00)						
14. Extraversion	0.12	0.20	0.27	0.12	-0.07	0.19	0.13	0.06	0.02	-0.01	0.10	0.18	-0.06					1.23
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.50)	(0.81)	(0.00)	(0.00)	(0.01)					
15. Agreeableness	-0.02	-0.04	-0.03	0.01	0.00	0.05	0.01	0.02	-0.02	-0.02	-0.07	0.09	-0.05	0.01				1.11
	(0.41)	(0.08)	(0.19)	(0.76)	(0.90)	(0.08)	(0.68)	(0.53)	(0.36)	(0.38)	(0.01)	(0.00)	(0.03)	(0.61)				
16. Conscientiousness	-0.02	0.01	-0.04	0.08	-0.08	0.07	0.08	0.02	0.01	-0.01	0.02	0.15	0.05	0.03	0.05			1.13
	(0.43)	(0.74)	(0.11)	(0.00)	(0.00)	(0.00)	(0.00)	(0.43)	(0.56)	(0.79)	(0.45)	(0.00)	(0.05)	(0.33)	(0.04)			
17. Emotional stability	0.08	0.07	0.12	0.09	-0.05	0.03	0.05	0.05	-0.01	0.03	0.01	-0.09	0.06	0.05	0.26	0.22		1.19
	(0.00)	(0.01)	(0.00)	(0.00)	(0.05)	(0.25)	(0.03)	(0.04)	(0.80)	(0.21)	(0.71)	(0.00)	(0.01)	(0.03)	(0.00)	(0.00)		
18. Openness to experience	0.09	0.23	0.25	0.08	-0.10	0.35	0.14	0.02	-0.01	-0.00	0.05	0.09	0.03	0.36	0.09	0.16	0.15	1.32
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.45)	(0.61)	(0.90)	(0.08)	(0.00)	(0.19)	(0.00)	(0.00)	(0.00)	(0.00)	

Notes: N=1,526 observations. VIF = Variance inflation factor (computed with *amount invested in investment lottery* as the dependent variable). The Pearson correlation coefficient is used for metric variables, the point-biserial correlation coefficient is used in the event one variable is dichotomous, and Cramer's V is used if both variables are dummy variables. Significance levels in parentheses.

Table 3: Regression Analysis

Dependent variable	Model I: OLS Amount invested in investment lottery		Model II: ordered logit Risk attitude with regard to start-up		Model III: ordered logit General risk attitude	
Independent variables	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Motivation						
Opportunity entrepreneur [1]	1,868.5	(1,441.2)	0.288 **	(0.110)	0.393 ***	(0.111)
Necessity entrepreneur [1]	-5,224.9 **	(1,807.2)	-0.440 **	(0.147)	-0.303 *	(0.147)
Motivation by creativity	2,531.1 **	(843.0)	0.086	(0.067)	0.129 *	(0.064)
Motivation by independence	1,235.9	(991.5)	0.136	(0.080)	0.055	(0.081)
Motivation by income	-56.4	(669.3)	0.083	(0.051)	0.115 *	(0.052)
Start-up characteristics						
Capital invested (€10,000-25,000) [2]	3,448.4 *	(1,623.0)	0.043	(0.129)	0.079	(0.130)
Capital invested (€25,001-50,000) [2]	8,666.5 **	(2,671.4)	0.250	(0.213)	-0.103	(0.202)
Capital invested (> €50,000) [2]	13,607.1 ***	(3,041.5)	0.597 *	(0.247)	0.467	(0.245)
Age of start-up	8.7	(17.4)	0.002	(0.001)	0.004 **	(0.001)
Working time	730.5 **	(272.1)	0.026	(0.021)	0.047 *	(0.020)
Team	1,682.7	(1,948.0)	0.066	(0.158)	-0.128	(0.155)
Start-up from unemployment	216.4	(1,362.9)	-0.176	(0.105)	-0.152	(0.107)
Government aid	-594.2	(1,420.6)	0.004	(0.113)	-0.160	(0.109)
Income from start-up is sufficient	-2,338.2	(1,402.0)	-0.177	(0.107)	-0.071	(0.110)
Industry categories (13 categories) [3]	p=0.041		p=0.010		p=0.046	
Socio-demographic characteristics						
Female	-4,395.5 **	(1,517.6)	-0.483 ***	(0.117)	-0.624 ***	(0.119)
Age	59.5	(89.9)	0.016 *	(0.007)	-0.006	(0.007)
Having children	1,610.3	(1,470.1)	-0.082	(0.117)	0.057	(0.116)
Married	-486.0	(1,390.2)	-0.083	(0.109)	-0.190	(0.110)
Wealth	3,946.6 **	(1,434.1)	-0.009	(0.107)	-0.049	(0.111)
School degree enables attendance at university	1,869.4	(1,619.5)	0.089	(0.120)	0.143	(0.120)
Size of home town	586.0	(340.1)	0.002	(0.026)	0.050	(0.026)
West Germany	810.0	(1,797.1)	0.037	(0.137)	-0.000	(0.125)
Leadership experience	678.9	(1,455.5)	0.103	(0.114)	0.145	(0.111)
Industry experience	-2,419.7	(1,462.4)	-0.020	(0.114)	-0.049	(0.112)
Personality traits						
Extraversion	887.6 **	(287.9)	0.109 ***	(0.023)	0.167 ***	(0.024)
Agreeableness	-244.1	(374.4)	-0.057	(0.031)	-0.065 *	(0.031)
Conscientiousness	-478.5	(297.6)	-0.025	(0.023)	-0.086 ***	(0.023)
Emotional stability	577.6 *	(279.3)	0.023	(0.022)	0.064 **	(0.021)
Openness to experience	320.6	(401.4)	0.166 ***	(0.033)	0.197 ***	(0.032)
Constant	10,071.5	(8,531.7)				
Diagnostics						
R^2	0.131					
Pseudo R^2			0.056		0.076	
F-test	5.60 ***					
Log likelihood			-2,274.09		-2,264.30	
Wald chi^2 (df)			256.0 (42) ***		318.8 (42) ***	

Notes*:* N = 1,526 observations. Robust standard errors in parentheses.
Significance levels: * $0.05 < p \leq 0.1$; ** $0.01 < p \leq 0.05$; *** $p \leq 0.01$; two-sided tests.
[1] Reference group: "a combination of both applied".
[2] Reference group: "capital invested < €10,000".
[3] Reference group: "consultancy, law, and training".