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Estimating risky behavior with multiple-item risk measures

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ABSTRACT

We compare seven established risk elicitation methods and investigate how robustly they explain eleven kinds of risky behavior with 760 individuals. Risk measures are positively correlated; however, their performance in explaining behavior is heterogeneous and, therefore, difficult to assess ex ante. Greater diversification across risk measures is conducive to closing this knowledge gap. What we find is that performance increases considerably if we combine single-item risk measures to form multiple-item risk measures. Results are improved the more single-item measures they contain, and also if these single-item risk measures use different elicitation methods. Interestingly, survey items perform just as well as incentivized experimental items in explaining risky behavior.

1. Introduction

Analyzing decision making under risk requires a reliable measure of individual risk attitude. Most studies to date have opted for an existing method of eliciting individual risk preferences and take the response to this specific item as "the" individual risk attitude. However, risk attitudes across these measures are often inconsistent and the predictive power of the different methods used is typically low.

Therefore, our study uses seven well-established risk measures with 760 individuals and examines the ability of these measures to explain eleven kinds of risky behavior. When examining explanatory power, we follow Dohmen et al. (2011) and control for a set of individual socio-demographic characteristics (see also, e.g., Barsky, Juster, Kimball, & Shapiro, 1997; Tanaka, Camerer, & Nguyen, 2010). The results obtained demonstrate the limitations of narrow approaches, where isolated relationships between risk measure and behavior may depend on the specific risk measure chosen. While all

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single-item risk measures are able, to a certain extent, to explain risky behavior in our sample, the level of heterogeneity is considerable. While some measures perform better than others, it is unfortunately unclear which risk measure to choose ex ante. As a consequence of our analyses, we propose to diversify across risk measures.

Our main objective is to show that diversification across risk measures improves their ability to predict risk-related behavior. Averaging across single-item risk measures, i.e. creating a "multiple-item risk measure", substantially improves the predictive power of explaining behavior. While the advantage of diversification is known from findings of the forecasting literature (Timmermann, 2006, chap. 4), it questions the idea that there are various risk measures available which are all equally suited to elicit risk attitude. Our evidence, however, suggests that noise in single-item risk measures can be reduced by relying on multiple-item risk measures.

We employ seven well-established methods to elicit risk preferences using incentivized risk tasks: the certainty equivalent task (CE) (see e.g., Abdellaoui, Baillon, Placido, & Wakker, 2011), two choice set tasks (CSL and CS) following Eckel and Grossman (2002, 2008), and an investment choice task (CI) similar to Gneezy and Potters (1997). Alongside these four experimental methodologies (where abbreviations start with "C"), we use three non-incentivized survey items of risk attitude (where abbreviations start with "S"). Two of these stem from the study of Dohmen et al. (2011), i.e. general willingness to take risk (SG) and the willingness to take risk in financial affairs (SF). In addition, we also employ a hypothetical investment question (SI) which has been used by Barsky et al. (1997). We investigate the correlation between these seven risk elicitation tasks at the individual level. Measures of risk attitude are positively correlated, yet in most cases only to a low degree. This indicates remarkable differences between measures, conforming to results found in the literature. Deck, Lee, Reyes, and Rosen (2013) test for domain-specific risk attitudes using multiple risk tasks in a within-subject design (including versions of the choice sets and choice lists) to find that tasks are poorly correlated across elicitation methods. Similarly, Crosetto and Filippin (2016) compare a battery of incentivized and non-incentivized tasks to elicit risk attitudes and find that the estimated risk aversion parameters from the tasks vary greatly. Findings of low consistency between tasks are also found in developing countries. Nielsen, Keil, and Zeller (2013) examine the consistency of risk preferences based on eight hypothetical elicitation methods and a lottery game to smallholder farmers in Vietnam and find - similar to our results – statistically significant but weak correlations between tasks.

In the next step, we average across risk measures which we standardize for this purpose. We find that a simple average across the seven measures has the highest predictive power in our sample as it significantly explains 6 out of 11 kinds of risky behavior, whereas the single-item measures explain on average 2.6 kinds of behavior, ranging from 1 to 4. However, from a practical point of view (i.e. implementing this in the field), it seems rather expensive to collect and combine seven risk measures to form multiple-item risk measures. Hence, we investigate whether predictive ability can be maintained by combining any two risk items. We find that these combinations, indeed, are able to explain more types of risky behavior (on average 3.1) than merely employing a single-item measure (on average 2.6). These results also hold qualitatively if we exclude the willingness to take risk in financial affairs since this is a domain-specific risk measure.

Since predictive power still varies considerably between any two-item risk measures, we are trying to identify general principles for building successful but still relatively simple multiple-item risk measures. We find that including risk items with different elicitation methods make the multiple-item risk measure more reliable and predictive. By contrast, combining items from repeated answers seems less conductive to improving predictive power. Opting for incentivized experiments over easily implementable survey items does not appear to be effective, either. We are aware that our results for specific risk measures might be the consequence of our selection of risk measures, risky behavior, and sample population. We, therefore, hesitate to recommend the inclusion of any specific risk item. However, we do find that multiple-item risk measures outperform single-item risk measures. This leads to the concrete conclusion that researchers attempting to identify risk attitude should consider using two (or better yet: three) risk items with different risk elicitation methods to enhance external validity.

Our research relates to at least three strands of literature: (1) the wealth of studies which examine the within-sample consistency between various risk elicitation methods (e.g., Crosetto & Filippin, 2016; Deck et al., 2013; He, Veronesi, & Engel, 2016; Isaac & James, 2000; Loomes & Pogrebna, 2014). They find degrees of inconsistencies that are difficult to explain within any commonly used model of decision making under risk. (2) Studies assessing the validity of risk measures by predicting risky behavior (e.g., Barsky et al., 1997; Dohmen et al., 2011; Sutter, Kocher, Glätzle-Rützler, & Trautmann, 2013; Vieider et al., 2015). (3) Risk elicitation methods implemented in rural Thailand have been used in our earlier work and were part of a larger household survey: Hardeweg, Menkhoff, and Waibel (2013) replicate the study of Dohmen et al. (2011) and, therefore, use three non-incentivized risk items and two kinds of behavioral outcomes based on data from the second wave of the household survey in 2008. Gloede, Menkhoff, and Waibel (2015) use the "general willingness to take risk item" and the certainty equivalent (CE) task from the third wave of the household survey in 2010 to examine whether the experience of shocks influences individual risk attitude. In a later study, Menkhoff and Sakha (2016) examine changes in risk attitude over time using the certainty equivalent (CE) task. The seven risk items used in this study have been elicited in a separate survey implemented in 2013 and are exclusively analyzed in the current research.

Our paper is organized in seven sections. Section 2 presents the survey data and risk elicitation methods. Section 3 displays the descriptive statistics of our sample and outlines the experiments with correlations between risk measures. Section 4 shows the results on the predictive ability of single-item risk measures. Section 5 outlines the performance of the various multiple-item risk measures. Section 6 introduces various robustness checks and Section 7 concludes.

2. Descriptions of the survey and the risk elicitation tasks

2.1. Implementation of the survey and the risk elicitation tasks

In August 2013 we conducted a risk survey in the province of Ubon Ratchathani, in northeastern Thailand. The risk survey included experiments with households that had also participated a few months earlier in the fifth wave of a larger household panel survey. The risk survey was conducted with 760 rural households in 98 villages. Due to the linkage to the household survey, we are able to relate risk preferences to wider sociodemographic characteristics of the respondents including: household demographics, education, consumption, assets, credit and investment, employment, and health behavior.

The implementation of risk elicitation tasks included a thorough training of enumerators, double translation of the survey from Thai to English and back again, and pretests of these tasks in three villages to ensure that participants understood their tasks. The tasks were conducted individually and always in the same order. While it may be possible that participants learned during the course of applying risk tasks and thus the order may have had an influence on outcomes, we decided against randomization of task order, mainly to avoid this extra element of organizational complexity.

The risk experiments took half an hour to conduct, while the entire risk survey including follow-up questions needed two hours to complete. After having played all seven risk tasks, the respondents had to pick a number from a non-transparent bag to determine which of the four incentivized tasks was to be played out with real money. This procedure was announced ex ante and was chosen to reduce any impact from portfolio or wealth effects. All subjects received a show-up fee of 50 Thai Baht (THB) (approx. 1 Euro). Average additional earnings from the randomly chosen task were 150 THB, i.e. approximately 4 Euros which is slightly less than a full day's wage for an unskilled worker. Detailed information about the data collection process is provided in Appendices A.1 and A.2.

2.2. Risk elicitation tasks

We begin our risk survey with two non-incentivized self-assessment questions concerning risk attitude which were used to analyze risk preferences (e.g., Dohmen et al., 2011). Details of risk elicitation methods can be found in Appendix A.3. The first item is the general risk question from the German socio-economic panel study (GSOEP). Subjects were shown a scale with integers from 0 (=fully avoiding risks) to 10 (=fully prepared to take risks) and asked to point to the integer best matching their willingness to take risks. The second question is a domain-specific variation of the first question referring to the financial affairs of the household and originates from the U.S Federal Reserve Board's Survey of Consumer Finances. The third non-incentivized risk measure is the hypothetical investment question which has been used, for example, by Barsky et al. (1997). Variations of the latter question appear in several large panel surveys of U.S. households: the Health and Retirement Study (HRS) and the Panel Study of Income Dynamics (PSID).

Afterwards, we conducted four incentivized experiments. The first is a choice list task and has been implemented by Bruhin, Fehr-Duda, and Epper (2010), Abdellaoui et al. (2011), Dohmen et al. (2011), Sutter et al. (2013) and Vieider et al. (2015). Table A1 in Appendix A illustrates the basic payoff matrix presented to subjects. The first row shows that the lottery offers a 50/50 chance of receiving either 0 or 300 THB and alternatively a safe payoff of 0 THB. The expected value of this lottery is 150 THB. Therefore, it is rational to choose the lottery. The second row, however, already offers a safe payoff of 10 THB. This provides the opportunity for risk-averse individuals to opt for the safe payoff over the lottery. The value of the safe payoff is increased by 10 THB in each row. Overall, 20 decisions have to be made until the safe payoff reaches 190 THB. Thus, we do not offer the full range of certain values up to the highest outcome of the lottery due to time constraints. This may explain why there is a slight accumulation of responses in the last row (see also Dohmen et al., 2011). Switching rows from the lottery to the safe payoff designate individuals' risk attitude. We do not allow switching back and forth.

The second and third experiments are choice set tasks based on the study by Eckel and Grossman (2002, 2008). In both tasks, subjects are asked to choose one of the six gambles presented in separate rows, where each row represents a gamble with a 50/50 chance of receiving a high or a low payoff. Gamble 1 is a safe alternative where the high and low payoffs are identical. In moving down from gamble 1 to gamble 5, there is a linear increase in expected returns as well as an increase in the standard deviation of the payoffs; between gamble 5 and 6, only the standard deviation increases but not the expected return. In the second task, a loss of 30 THB is possible between gamble 5 and 6. Under expected utility theory (EUT) risk-averse subjects should choose lower-risk, lower-return gambles (i.e. gamble 1–4) whereas risk-loving subjects are expected to choose gamble 5 or 6. Strictly speaking, risk neutrality does not rule out choosing gamble 6 and there is no obvious way to distinguish between risk neutrality and risk-loving agents among those who choose gamble 6.

In the last experiment, developed by Gneezy and Potters (1997), subjects are asked to divide an allocation of 100 THB between a safe asset and a risky investment. If the risky investment is successful (50% chance), three times the invested amount is paid to the subject along with the amount set aside in the safe option. If the investment is unsuccessful, subjects only receive the amount set aside in the safe option. Under the EUT, a risk-neutral or a risk-loving person should invest the full amount in the investment task (CI).

3. Descriptive statistics

3.1. Individual characteristics

Table 1 presents individual characteristics of our sample in two panels. Panel A describes seven standard socio-demographic characteristics used in the literature (e.g., Dohmen et al. (2011)) which we will regularly use as control variables in our regressions. A large proportion of our sample are women (58%), participants' average age is 54, and their average height is 1.58 m. 98% have attended some sort of schooling at some point for an average of 5.7 years of school education. As would be expected given the average age of respondents, 83% of our sample are married and live in households with approximately four other household members. The log per capita income of 7.57 reflects an annual total household income level of US$8557 PPP.

Panel B summarizes answers on various behavioral items and further sample characteristics (for details see Appendix B). After the completion of the risk experiments, we ask the respondents six algebra questions. Our respondents have moderate algebra skills (3.63 out of six exercises are solved correctly on average). Additionally, more than 60% of the respondents describe farming as their main activity while 8% report that they are self-employed. About 31% of our sample played some sort of lottery at least once over the past 12 months, spending an average of about 2% of their annual income on lottery participation ($171). 70% of our respondents hold insurance policies (i.e. 1.95 insurance policies on average per household).

Although the majority of health care services in Thailand are delivered by the public sector, still 6% choose an additional health insurance package. Additionally, 8% pay for an accident insurance. Our sample households made on average $5084 worth of investments in the agricultural and non-agricultural sector in the last two years, around 40% of their total income. It must be noted, however, that there is a large share of people who do not make any investments. Furthermore, 70% of the respondents borrowed money in the last two years. When asked for its purpose, around 8% report borrowing for business purposes. Moreover, at least 49% of our subjects adopt precautionary measures against future shocks and risks. It ranges from zero to eight risk-mitigating activities. Finally, with regard to the body mass index (BMI) of our respondents, we find that the majority can be classified as having normal weight. Following the WHO definition, 29% of our sample can be classified as being overweight.

Table 1
Descriptive statistics.

Variable	Mean	Std. dev.	Min.	Max.	*N*
Panel A: Individual characteristics					
Female	0.575	0.495	0	1	764
Age	54.496	12.465	17	79	764
Height	158.148	7.641	140	185	749
Years of schooling	5.674	3.113	1	17	737
Marital status	0.831	0.375	0	1	751
Household size	4.102	1.722	1	12	749
Log per capita income	7.610	1.019	2.33	11.631	749
Panel B: Behavioral variables					
Basic algebra	3.632	1.311	0	6	763
Farmer	0.655	0.476	0	1	760
Self-employed	0.083	0.272	0	1	761
Lottery spending (past)	171.32	971.93	0	24800	759
Lottery spending (future)	28.880	172.350	0	2934	759
Amount of investment	5083.793	12215.916	0	124496	764
Plan to invest	0.473	0.500	0	1	764
Borrowing (general)	0.713	0.452	0	1	764
Borrowing (business)	0.082	0.275	0	1	764
Risk-mitigating activities	0.496	0.500	0	1	764
Number of risk-mitigating activities	0.928	1.213	0	8	764
Number of insurance (General)	1.959	1.753	0	1	764
Number of insurance (Health)	0.058	0.233	0	1	764
Number of insurance (Accident)	0.076	0.265	0	1	764
Body mass index	23.067	3.727	12.889	39.184	742
Overweight	0.299	0.458	0	1	764

Notes: Height is in cm. Household size is the headcount of persons living in the household for at least 180 days. Log per capita income refers to the natural logarithm of income divided by OECD adult equivalents AE (AE = 1 + 0.7*(adults-1) + 0.5*children). Lottery expenditure is the total annual lottery expenditure in the last 12 months. Future lottery expenditure is the expected lottery expenditure in the next drawing. Investment is amount of investment reported by the household. Results have been calculated in purchasing power parity adjusted US dollars. In February 2008 the International Comparison Program published purchasing power parities stating that 15.93 THB equal 1 PPP USD. Planned investment is if the household plans any investment in the next five years. Risk-mitigating measures indicate whether respondents took up any measures in order to prevent any future shocks/risks. Health and accident insurances are the voluntary health/accident insurance policies that households are holding. BMI is computed weight/height^2. Overweight are those having a BMI > 25. We employ the subsample between 17–79 years old.

3.2. Results on risk measures

Table 2 shows the summary statistics of all seven risk elicitation methods in the order of the survey. Panel A provides the original values. Panel B normalizes the seven scales between zero (indicating highest risk aversion) to one (indicating highest risk-seeking) to facilitate comparability. We will use normalized values for all analyses in our the paper. It can be inferred that the general willingness to take risk (SG) task has a normalized average value of 0.68 for our sample in Panel B, which equals 6.85 in Panel A. The average value is higher than in the study of Dohmen et al. (2011) for Germany and also higher when compared to responses of similar households in the same province of Thailand in 2008 (Hardeweg et al., 2013). This result is driven by the large number of respondents choosing the highest risk-seeking category of 10. This is also the case for financial matters, the financial willingness to take risk (SF) task, albeit less than in the general question which corresponds to the study of Dohmen et al. (2011) where respondents report lower self-assessment values in the financial domain of the question. Overall, a relatively high degree of risk tolerance using the qualitative self-assessment question eliciting risk attitude is revealed which is in line with Charness and Viceisza (2012) who conducted the general willingness to take risk (SG) task in rural Senegal. In the robustness section (Appendix F.4), we will show that our main results are not distorted due to unusually risk-seeking answers.

Turning to the hypothetical investment question (SI), the average amount of the hypothetical investment the subjects choose to make is 50.88 THB (results are divided by 1000 to rescale estimates). The normalized mean value is 0.50 (Table 2, Panel B). We find that the respondents tend slightly towards investing more than 50%. 60% of respondents choose the median amount of 50.00 THB. This result is similar to Hardeweg et al. (2013).

The average switching row in the certainty equivalent (CE) task is 7.94 corresponding to a normalized mean value of 0.36. We find that 76% of the respondents are risk averse because they choose to switch before row 16, while 3% are risk-neutral and 21% are risk seeking. Qualitatively similar results for risk averse behavior are found, for example, by Harrison, Lau, and Rutström (2007) in Denmark, Dohmen et al. (2011) in Germany, and Hardeweg et al. (2013) in Thailand.

For both choice set tasks, we find the mean lottery choice to be 3.15 while the median was 3. The normalized mean values are 0.54 for the choice set with loss (CSL) and 0.50 for the choice set without loss (CS), respectively. Comparing means for each pair of treatments, we are able to reject the null hypothesis of no difference by treatment. Respondents in the choice set with loss (CSL) task tend to opt in a greater scale for the risky gambles, i.e. gambles 4 and 5 than in the choice set without loss (CS) treatment. In the study of the Eckel and Grossman (2008), the mean gamble choice made by all subjects in the choice set with loss (CSL) task was 3.45, the median was 3. For the choice set without loss (CS) task, the average choice was slightly lower at 3.36 – similar to our finding. Hence, the overall image of risk-averse respondents is confirmed with both choice sets.

Concerning the last incentivized task, the investment task (CI), we find that people invest less in the risky option than in the hypothetical investment question (SI). This yields a normalized mean value of 0.36 which is lower than the choice set

Table 2
Descriptive statistics of risk eliciation methods.

Variable	Mean	Std. dev.	Min.	Max.	*N*
Panel A: Original values					
General willingness to take risk (SG)	6.85	3.02	0	10	764
Financial willingness to take risk (SF)	6.47	3.28	0	10	764
Hypothetical investment question (SI)	50.88	21.38	0	100	764
Certainty equivalent (CE)	7.94	7.14	1	20	763
Choice set with loss (CSL)	3.18	1.56	1	5	763
Choice set without loss (CS)	3.03	1.49	1	5	764
Investment experiment (CI)	36.37	30.56	0	100	764
Panel B: Normalized values					
General willingness to take risk (SG)	0.679	0.306	0	1	764
Financial willingness to take risk (SF)	0.641	0.331	0	1	764
Hypothetical investment question (SI)	0.503	0.216	0	1	764
Certainty equivalent (CE)	0.360	0.374	0	1	763
Choice set with loss (CSL)	0.539	0.391	0	1	763
Choice set without loss (CS)	0.504	0.371	0	1	764
Investment experiment (CI)	0.358	0.206	0	1	764

Notes: This table shows the original and normalized values of all risk elicitation methods. Normalized values range between 0 (highest risk aversion) and 1 (highest risk seeking). The first three are non-incentivized. The general willingness to take risk item asks on an 11-point Likert scale "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?" The financial willingness to take risk, also an 11-point Likert scale, asks "When thinking about investing and borrowing are you a person who is fully prepared to take risk or do you try and avoid taking risk?" The hypothetical investment question asks "Imagine you just won 100,000 Baht in a lottery and you can invest this money in a business. There is a 50% chance that the business is successful. If the business is successful you double the amount invested after one year. If it is not successful you will lose half the amount you invested. What fraction of the 100,000 Baht would you invest in the business?" Results are divided by 1000. Four incentivised experiments follow. The certainty equivalent task is an experiment with a lottery that offers a lottery with a 50/50 chance of receiving either 0 or 300 THB and alternatively a safe payoff of 0 THB. The value of the safe payoff is increased by 10 THB in each row. In the choice set experiments subjects must play out one of five possible gambles. All the gambles involve a 50/50 chance. The first choice set with potential loss involves a negative payoff of −30 THB. In the investment experiment subjects have to decide to allocate a fraction of 100 THB in a risky business or a safe choice.

Table 3
Spearman's rank correlations across elicitation methods.

	SG	SF	SI	CE	CSL	CS	CI
SG	1.000						
SF	0.359***	1.000					
	(0.000)						
SI	0.086**	0.122***	1.000				
	(0.018)	(0.001)					
CE	0.034	0.000	0.083**	1.000			
	(0.356)	(0.998)	(0.022)				
CSL	0.094**	0.027	0.063	0.100***	1.000		
	(0.010)	(0.451)	(0.082)	(0.006)			
CS	0.031	−0.014	0.008	0.074**	0.436***	1.000	
	(0.398)	(0.695)	(0.820)	(0.042)	(0.000)		
CI	0.030	0.046	0.201***	0.030	0.078**	0.098***	1.000
	(0.404)	(0.203)	(0.000)	(0.405)	(0.032)	(0.007)	
N: 760							

Notes: The table reports pairwise Spearman rank correlation coefficients for the subsample with age of 17–79. Statistical significance is in parenthesis.
** Significance at the 5% level.
*** Significance at the 1% level.

tasks and similar to the certainty equivalent (CE) task. Only 7% choose to invest their entire endowment in the risky option, while nearly 30% chose to invest nothing, indicating risk-averse behavior (similar results are found in Charness & Villeval, 2009). Hence, the aggregate behavior between the choice set tasks and the investment task (CI) experiment suggests that a higher proportion of subjects appear to be risk averse in the investment game. The observed greater risk aversion can plausibly stem from an aversion towards investing in an environment where there is an apparent case of losing the invested amount (Crosetto & Filippin, 2016). Large differences in the design of the seven risk tasks, however, do not allow for direct comparisons of mean values across tasks. Concerning the determinants of risk attitude (Appendix C, Table C.1), we obtain significant relationships with the expected signs. We find, for instance, that being married or having higher income is positively correlated to risk taking.

3.3. Correlations of risk measures

Table 3 depicts Spearman rank correlations between various elicitation methods. We observe mostly positive correlations. 11 out of 21 coefficients are statistically significant and all of these significant coefficients are positive. Some coefficients have higher correlations, such as between the two self-assessment questions (general and financial willingness to take risk item: 0.36) or both choice set tasks (choice set with and without loss: 0.44). Other coefficients are more on the moderate side (i.e. hypothetical investment question and the investment experiment: 0.20). Moreover, the degree of correlation is higher for tasks with similar elicitation methods than across elicitation methods.

Low correlation between tasks is a recurrent finding in the literature. Crosetto and Filippin (2016), for instance, perform a comparative analysis of five tasks, incentivized and non-incentivized alike, and also find low correlations. Their explanation is that when facing multiple decisions under uncertainty, subjects could maximize their utility in every period, thereby making the best choice every time. For example, subjects could make risk-averse decisions in the first two choices and risk-seeking decisions in the second two. If this is the case, low correlation across tasks would be an artifact of the multiple decision framework rather than reflecting idiosyncratic features of different tasks. However, such effects should be marginal in our setting as participants were not informed about the number and kind of tasks to be performed at the beginning of the risk survey.

Deck et al. (2013) test for considerable variation in risk taking behavior across tasks using domain-specific risk attitudes and survey items in a within-subject design and find, in some cases even negative correlations between results of the different methods. This result is comparable to the study of Vieider et al. (2015). They examine individual correlations between different incentivized measures and survey questions for 30 countries and find low within-country correlation coefficients between tasks ranging from slightly negative to 0.40. Between-country correlations of the respective risk measures reveal positive correlations ranging between 0.26 and 0.48. This indicates that differences between measures within a country are larger than differences for measures across countries. Overall, we find significant but low correlation across tasks. Further, we infer that the degree of correlation is highest when two measures rely on similar elicitation methods, such as the two survey items (general and financial willingness to take risk) or the two choice sets (choice set with and without loss).

4. Risk measures and risky behavior

In this section, we relate all the seven measures of risk attitude to eleven risk behavior items that according to theory should be greatly affected by risk attitude. We cover five domains of risky behavior: playing the lottery, risky employment, financial behavior (investment and borrowing), risk avoidance (insurance), and health behavior. We find unequivocal evidence that the significant direction of prediction is always correct but that the degree of predictability is relatively low.

Playing the lottery. The relationship between playing the lottery and risk attitude is expected to be close because participation in a lottery is a risky decision (see e.g. Clotfelter & Cook, 1990). Our survey ascertains the purchase of lottery tickets for the total household in the last 12 months relative to household income. In addition, we ask the respondent how much she/he is willing to spend in the next lottery drawing. We rely on least squares regressions to estimate the effect of risk attitude on each risky behavior. Each row in Table 4 can be seen as a separate regression using one risk item and several control variables which have been previously identified as influencing risk attitude such as gender, age, height, marital status, household size, education and income (Dohmen et al., 2011). Table 4 does not present all 77 (7 times 11) coefficients of the risk measures but only the significant coefficients (5% significance level as minimum) in order to keep information clear. To simplify the presentation of the results in Table 4, all other coefficients of these 77 regressions are suppressed (some fully specified results are shown in Appendix D).

Looking at column (1) in Table 4, we find that risk attitude is significantly correlated to past lottery ticket purchases for two risk measures, i.e. the general willingness to take risk (SG) and the choice set without loss (CS) task, while employing a set of control variables. Both risk measures exhibit the expected positive signs, indicating that risk tolerance is associated with higher lottery expenditure.

With regard to the future lottery spending (see column 2), we also find as before that increased future spending on lottery tickets is positively correlated with increased risk-seeking behavior in the choice set without loss (CS) task. In addition, we find that the choice set with loss (CSL) and the incentivized investment (CI) tasks also significantly reveal the expected positive relationship between future lottery spending and more risk tolerance.

Risky employment. Entrepreneurship is another prominent example of risky behavior since entrepreneurs and their business formation are embedded in constant financial uncertainty. Economic theory predicts that entrepreneurs, as business owning residual claimants, are less averse towards risk and uncertainty than others (Kihlstrom & Laffont, 1979). This contrasts with the decision to become a farmer. Being a farmer in a poorer rural area is often the last resort of those who are not entrepreneurial or mobile; thus we expect these individuals to be less risk tolerant. We use a probit model to assess whether risk attitudes play a role in occupational sorting. Column (3) in Table 4 displays the marginal effects at the mean observation. Risk tolerance is significantly related to self-employment, which is revealed by the positive coefficients on the general willingness to take risk (SG) question, the hypothetical investment question (SI), and the incentivized investment (CI) task. Thus, our results are in line with the findings of Ekelund, Johansson, Jaervelin, and Lichermann (2005), who show similar results on risk attitudes and self-employment using a psychometric measure of harm avoidance as an indicator of propensity to take risk as well as Bonin, Dohmen, Falk, Huffman, and Sunde (2007). On the other hand Holm, Opper, and Nee (2013) show that while entrepreneurs are willing to accept strategic risks, they are unwilling to accept exogenous und uncontrollable risks.

In column (4), we find that the certainty equivalent (CE) experiment significantly predicts occupational sorting into farming activities. The coefficient shows the negative relationship between of risk tolerance and being a farmer at the 1% significance level. This is in line with the finding of Reynaud and Couture (2012).

Financial behavior. Even though poorer farmers do not and cannot hold a market portfolio, the more risk-averse should hold safer portfolios and thus make less risky investments relative to income. Second, planning an investment in the future is embedded in uncertainty about the conditions under which the planned investment may take place. We hypothesize that risk-tolerant rather than risk-averse individuals are more likely to plan considerable investments. Third, borrowing can be generally seen as a decision which entails risk because the borrower has agreed to future repayment without knowing his/her future economic situation. Thus, less risk-averse individuals should be more likely to borrow more.

We find in column (5) that the incentivized investment (CI) task is able to explain significantly whether respondents invest a higher share of their income. Estimating the correlation between risk attitude and planned investment, we find in column (6) that the certainty equivalent (CE) task is able to significantly predict planned investment. For borrowing, we see in column (7) a positive and significant correlation between the probability of borrowing and risk tolerance explained by the financial willingness to take tisk (SF) question.

Risk avoidance. In the absence of formal insurance markets, in theory, risk-averse individuals may choose to implement or undertake more risk-hedging activities (i.e. substitute crops, diversify their agricultural portfolio etc.) than a risk-seeking individual (e.g., Gusio & Paiella, 2005). We find a statistically significant negative relationship between risk tolerance and the implementation of any precautionary measures against shocks and risks (see column 8); this holds for the hypothetical investment question (SI) and the choice set with loss (CSL) risk measure. This result is consistent with findings in the literature by Gusio and Paiella (2005) for Italy or Dercon and Christiaensen (2011) for Ethiopia.

Next, we examine the number of insurance contracts that a household holds. Using a probit regression as shown by column (9), we find that more risk-seeking consumers are less likely to buy private insurances. This holds for the choice set without loss (CS) risk item.

Behavior towards health. Regarding health issues we consider the case, where alongside the free state-provided health insurance, risk tolerant respondents also prefer to have additional health insurance with better coverage. We also compute the BMI of our respondents based on the subjects' own self-reports on weight and height and expect higher BMI of students to be strongly associated with greater risk tolerance. For health insurance, we find a negative relationship between the likelihood of having an additional health insurance and risk tolerance (see column 10). The effect of the hypothetical investment

Table 4
Single and multiple-item risk measures.

	(1) Lottery (Expend/Inc)	(2) Future lottery expenditure	(3) Self-employment	(4) Farming	(5) Investment (Expend/Inc)	(6) Plan to Invest	(7) Borrowing	(8) Risk mitigating	(9) Number of insurance	(10) Health insurance	(11) BMI
SG	0.073**		0.081**								
	(0.03)		(0.04)								
SF							0.237***			−0.049**	
							(0.05)			(0.02)	
SI			0.083**					−0.254***		−0.136***	1.712***
			(0.04)					(0.09)		(0.05)	(0.63)
CE				−0.181***		0.149***					
				(0.05)		(0.05)					
CSL		64.66**						−0.138**			
		(24.99)						(0.06)			
CS	0.065***	43.45**								−0.480***	
	(0.02)	(19.31)								(0.18)	
CI		53.20**	0.084**		0.623***						
		(21.57)	(0.03)		(0.22)						
Observations	711	710	715	710	715	715	708	715	715	715	710
Average of 7 Items	0.026***	12.75***				0.043**	0.043**	−0.064**		−0.022**	
	(0.01)	(4.74)				(0.02)	(0.02)	(0.02)		(0.01)	
Average of 6 Items	0.054***	13.95**	0.026***			0.045**		−0.060**	−0.021**		
	(0.02)	(6.52)	(0.01)			(0.02)		(0.02)	(0.01)		
Observations	709	709	713	709	713	713	713	713	713	713	710
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	Probit	Probit	OLS	Probit	Probit	Probit	OLS	Probit	OLS

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Inc in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total income. Expend/Inc in column (5) is the total amount of household expenses on investment in the last 12 months as a share of total income. See Appendix B for further details. Controls include female, age, height, marital status, household size, education in years, and log per capita income. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis.

** Significance at the 5% level.

*** Significance at the 1% level.

question (SI) is roughly twice the size compared to the financial willingness to take risk (SF) question. In the last column of Table 4 we find that BMI is strongly associated with risk aversion for the hypothetical investment (SI) measure. More risk averse subjects have a lower BMI which corresponds to the results obtained by Sutter et al. (2013) who analyze how risk, ambiguity, and time preferences of children and adolescents relate to various field behaviors concerning decisions including health-related behavior. The elicited risk and ambiguity attitudes are worse predictors of field behavior except with BMI where risk averse students have lower BMI.

5. Predictive ability of multiple-item risk measures

Section 5 reports findings on multiple-item risk measures. First, we describe the creation and performance of the "all-item" risk measure (Section 5.1). Then, we show the efficiency gain in predicting behavior by building random multiple-item measures (Section 5.2). Finally, we search for risk item selection principles for a powerful and parsimonious multiple-item risk measure (Section 5.3).

5.1. All-item risk measure and risky behavior

In this section, we perform the same analysis as in Section 4, but this time using the average of the seven measures to explain behavior. Averaging facilitates interpretation of results because it ensures that all variables contribute evenly to a scale when items are added together. We proceed in two steps. First, the mean of a specific risk item is subtracted from the value of each item, resulting in a mean of zero. Second, these different values are divided by the standard deviation of each item - resulting in a standard deviation of one.

Regarding the "all-item" risk measure, we only report core results (Table 4, bottom) while fully specified regression results are provided in Appendix D. We find that the all-item measure explains more risky behavior than any single-item measure. While the best item in Table 4 the hypothetical investment question (SI) is able to predict risky behavior in four cases, our multiple-item risk measure is able to explain them in six out of eleven cases. This result holds qualitatively if we neglect the financial willingness to take risk (SF) question in the average, i.e. covering only the remaining six risk measures, because financial willingness to take risk (SF) question is intended to be a domain-specific risk measure and thus differs inherently from the other measures which are applied more broadly and generally. Thus, the all-item measure appears to be more robust than any single-item measure, although for some specific forms of risky behavior some specific single-item measures may predict behavior better (which we do not analyze here).

Thus, the all-item measure appears to be more robust than any single-item measure, although for some specific forms of risky behavior some specific single-item measures may predict behavior better. While we do not analyze such horse races here, in the robustness section we provide some further evidence in this direction.

For practicality reasons, it would be interesting to see whether we can reduce the number of items considered and still keep superior explanatory power relative to single-item risk measures. As an exploratory step in this direction we run a factor analysis which is documented in detail in Appendix E. The first factor seems to explain four behaviors, the second factor three behaviors (two of which are explained by factor one, too) and the third factor none. Unfortunately, factors can only be extracted if the information from seven risk measures were available, which seems very impractical. Thus, we now test the power of any multiple-item risk measure in explaining risky behavior, thus obviating the need for input from more than two or three single-item risk measures.

5.2. Efficiency gain from creating random multiple-item risk measures

As a consequence of the last section, we now examine the average gain to be expected by moving from a single-item to a two-item risk measure. Thus, we assume the viewpoint of someone who does not know ex ante which measure may best explain a certain type of behavior but has a pool of seven risk measures from which she/he can select.

Regarding the single-item risk measures, we know that they can explain between 1 and 4 kinds of risky behavior out of 11 cases. We are now interested to see the outcome if we combine - without any prior restriction - single-item measures together. Table 5 shows the result: The general willingness to take risk (SG) question, for example, can explain 2 kinds of risky behavior. Combining the general willingness to take risk (SG) with the financial willingness to take risk (SF) question worsens the outcome since only 1 kind of risky behavior can be explained, combining the general willingness to take risk (SG) with the hypothetical investment (SI) question leads to 5 successes, combining the general willingness to take risk (SG) with certainty equivalent (CE) task leads to 2 successes etc. On average, one can expect an improvement from explaining 2 kinds (for the general willingness to take risk measure) to 2.66 kinds of risky behavior (for any combination of the general willingness to take risk with a second single-item risk measure), albeit within a range of 1–5. Continuing this exercise for the other six single-item risk measures shows the average efficiency gain from taking two items instead of one: this move will improve the explanatory power from 2.6 to 3.2 cases, i.e. by about 20%.

In a further analysis, we conduct the same procedure as above but this time combining any three risk items to a multiple-item risk measure. We find that our "any three-item" risk measure is able to predict 4.1 risky behaviors on average (results in Appendix D). Compared to the "any two-item" risk measure, this signifies a further increase in predictability by about 30%.

Table 5
Average of any two single-item risk measures.

	SF	SI	CE	CSL	CS	CI	Average of 2 items	Average of single-items
SG	1	5	2	3	2	3	2.66	2
SF		4	3	2	2	5	2.83	2
SI			2	5	5	4	4.16	3
CE				2	3	2	2.33	3
CSL					4	4	3.33	4
CS						4	3.16	1
CI							3.66	3
Average							3.16	2.60
N: 760								

Notes: The table reports significant results for any two multiple-item risk measure in explaining risky behavior. We follow the same procedure as in Table 1. We employ the subsample with age of 17–79. Average denotes the average power of any two-multiple risk item in explaining a number of risky behavior.

The analyses above demonstrate the gain one may expect when applying any multiple-item, i.e. here two or three-item, risk measure. Gains can be, of course, much higher if one knows ex ante the predictive power of specific measures and how these relate to one another.

5.3. Principles for building multiple-item risk measures

It is our ambition to create multiple-item risk measures which have high explanatory power in predicting risky behavior. Below, we consider three characteristics of our risk measures and analyze their impact on the performance of multiple-item risk measures.

Similar elicitation method. The first characteristic we investigate is the effect of combining heterogeneous elicitation methods in explaining field behavior. We find that diversification of risk measures by using different elicitation methods (i.e. surveys, choice lists and choice sets) enhances predictive power compared to using, for instance, the same elicitation method (only surveys).

The seven single-item risk measures include two cases where risk attitudes are elicited in a similar way. First, we have the case of the two choice sets which use the same method and presentation but differ regarding the payoff structure, in particular since one experiment considers potential losses. Second, there are the two self-assessment questions, the general willingness to take risk (SG) and the financial willingness to take risk (SF) which use identical methods but refer to different domains. We investigate both cases now by combining similarly presented risk elicitation methods and use the two single-item risk measures in the same way as described in Section 5.1. Using the new measures in predicting risky behavior, we see that these multiple-item risk measures perform disappointingly (Table 6, Panel A). The combined choice set measure is able to explain four risky behaviors, compared to 2 for the choice set with loss (CSL) and 3 for the choice set without loss (CS); we can thus clearly infer that there is no real advantage. The combined general willingness to take risk (SG) and financial willingness to take risk (SF) measure performs even worse than the single-items since the latter explain 2 behaviors each but the combination of the latter succeeds only once. Overall, our data suggest that using multiple-item risk measures with the same elicitation method does lead to a rather weak multiple-item risk measure.

Repetition. The second characteristic we analyze is the reliability of responses over time for the same measure. For this purpose, we rely on the fact that our households are part of a long-term panel household survey. Hence, they were visited and asked in the past starting in 2007, then again in 2008, 2010, 2013 and 2016. Regarding our purpose, the general willingness to take risk (SG) task had been conducted with our subjects just a few months before the experimental risk survey in August 2013. This provides us with two observations of the general willingness to take risk (SG) task with the same individuals at two different points in time. We find that creating a multiple-item risk measure with this repeatedly asked risk item is able to explain 1 kind of behavior (lottery expenditure), whereas the non-repeated general willingness to take risk (SG) can explain 2 behavioral items (see Table 6, Panel B). It becomes obvious from this analysis that the reduction of noise by repeating the same risk experiments does not seem to be crucial.

Survey vs. experiments. Despite the preference of economists for eliciting risk preferences by incentivized experiments, some studies find that simple survey items perform equally well in predicting risky behavior (Dohmen et al., 2011). We contribute to this debate by using a broader database than before. We have three survey items which predict on average 2.33 out of 11 behaviors, while the four experimental items predict 2.75 behaviors. Thus, incentivized experiments do not seem to generate a major advantage.

Looking at any two-item risk measures from Table 5, we see that the three two-item risk measures which can be constructed from our survey items predict on average 3.33 behaviors. This good result is driven by the combined measures including the hypothetical investment (SI) task. If we assess the six two-item risk measures built on the experimental items, they explain on average 3.0 behaviors. Again, we see that two-item risk measures tend to outperform single-item risk measures. In this case, survey questions perform even slightly better than experimental items.

Table 6
Multiple-item risk measures and risky behavior (similar elicitation, repetition).

	(1) Lottery (Expend/Inc)	(2) Future lottery expenditure	(3) Self-employment	(4) Farming	(5) Investment (Expend/Inc)	(6) Plan to Invest	(7) Borrowing	(8) Risk mitigating	(9) Number of insurance	(10) Health insurance	(11) BMI
A: Heterogenous elicitation methods											
CS*CSL	0.020**	24.581***						−0.047**	−0.163**		
	(0.01)	(9.47)						(0.02)	(0.05)		
SG*SF								0.043**			
								(0.02)			
B: Repeated elicitation methods											
SG (Apr)*SG (Aug)	0.042***										
	(0.02)										
SI (Apr)*SI (Aug)	0.029**			0.038**		0.049**				−0.024**	
	(0.01)			(0.02)		(0.02)				(0.01)	
Observations	709	709	713	709	713	713	713	713	713	713	710
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	Probit	Probit	OLS	Probit	Probit	Probit	OLS	Probit	OLS

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Inc in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total income. Expend/Inc in column (5) is the total amount of household expenses on investment in the last 12 months as a share of total income. See Appendix B for further details. Controls include female, age, height, marital status, household size, education in years, and log per capita income. Apr denotes the item from the spring survey while Aug is the survey conducted in the summer. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis.

** Significance at the 5% level.

*** Significance at the 1% level.

Summarizing the analysis of this section, the most important principle for building a powerful multiple-item risk measure is using items with different elicitation methods, in other words using combinations between survey questions, incentivized choice sets and choice lists. We do not find evidence that reducing noise by averaging over time or that applying experimental instead of survey items contribute to an overall improvement using our data.

6. Robustness

In this section we briefly introduce five kinds of robustness tests we have employed and which are documented in detail in Appendix F. They all show that changing certain characteristics of our research does not qualitatively change the findings.

Effect size. In addition to providing the significance levels in Table 4, we use standardized coefficients of each single-item risk measure in order to assess their predictive power in explaining behavior. Standardized coefficients provide a means of comparing the effect of variables measured in different metrics. In our case, however, comparing directly magnitudes of the single-item risk measures coefficients is difficult because risky behavioral variables differ by construction and, therefore, the predictive power of each risk measure cannot be exactly compared.

Extension of risky behavior. We acknowledge that our eleven kinds of risky behavior are ultimately arbitrary and that some definitions used could also be altered. Accordingly, we define another eight kinds of risky behavior and repeat our analysis. We see that multiple-item risk measures are still superior as, for instance, the seven-item risk measure explains 4 kinds of behavior compared to 2.1 for the average of the seven single-item measures. However, the incentivized investment (CI) task is now performing best in this exercise (along with the choice set with loss task) and the relative performance of single-item risk measures sometimes changes.

Cognitive ability. Second, another concern is that the explanatory power of risk measures may be hampered by a lack of understanding. Thus, we test for sub-samples and investigate whether having higher cognitive ability results in more consistent answers. However, we do not find much change in this direction.

Further analysis of general willingess to take risk item. As one may be skeptical about the high level of risk tolerance in the general willingess to take risk (SG) item in our data, we alternatively use the responses to the same item from an earlier survey wave (see Section 5.3). Again, this does not qualitatively change the results.

Heads of household. Finally, we respond to the concern that the most important decision maker in the rural households may be the head of the household. If we restrict the sample to these respondents, observations go down from 710 to 392 individuals. The smaller group is more homogeneous in terms of individual characteristics than the full sample, which may explain why the level of single-item explanatory power remains almost stable (the average of explained behaviors goes down from 2.6 to 2.0) while the advantages of diversification seem to decline relative to the full sample (the number of explained behaviors goes down from 6 to 3).

7. Conclusion

For researchers attempting to use a risk elicitation method as an explanatory variable, in household surveys for instance, it is important to know ex ante which risk item to choose, particularly given the high cost involved in the data collection process. Unfortunately, the few available studies converge towards the insight that risk elicitation methods do not capture exactly the same. Their results, however, are related to each other to such a limited degree that the choice of any measure can lead to divergent conclusions. Our paper attempts to address this issue.

This study is uniquely broad regarding its comprehensive external validation of seven risk elicitation methods. We show in our study that risk measures are not only different but that they also differ in their explanatory power. They have specific abilities in explaining particular forms of risky behavior. Some measures seem to perform generally better than others, at least with respect to our sample population and overall design. We find that a large part of observed heterogeneity seems to come from noise in measurement, and that one way to reduce this is by taking an average across risk elicitation methods.

Our resulting multiple-item risk measures - using the average of two or three risk items - offer a behaviorally meaningful alternative in revealing preferences in a reliable way. Our finding shows that such multiple-item risk measures perform better than single-item risk measures. In many detailed analyses we find support for this finding. Our results also suggest that employing risk tasks based on different elicitation methods increases the predictive ability of the multiple-item risk measure. Therefore, our study not only informs us about the behavioral validity of each item but also offers an alternative for a reliable and behaviorally valid risk measure. This also contributes, for instance, to the improvement of practical techniques aimed at the accurate elicitation of risk attitude in surveys.

Nevertheless, this is just a single study, and it would be interesting to learn from additional research whether this main finding largely holds and how it could be improved. For all types of applications simple and at the same time reliable measures of risk attitude urgently need to be revised and improved upon.

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Appendix A. Information about risk elicitation methods

A.1. Implementation of risk eliciation tasks

The study was carried out by local enumerators with one of the research fellows being present at all times to ensure compliance. Some enumerators were different from those conducting the household survey but had extensive interviewer skills acquired in other surveys. We do not find any systematic interviewer fixed effects. The survey was translated from English into Thai and back and was cross-checked by a Thai economics professor to avoid semantic difficulties. The interviewer training lasted for a total of five days. During these five days, a pilot study was conducted in three villages. We interviewed 830 individuals in total.

In general, enumerators were instructed to select the household member (usually the household head) who was previously interviewed in the household survey to participate in the experimental study. In case that person was not available, enumerators selected the closest family member present. In 44 cases we interviewed households which had not participated at the household survey, as we therefore lack baseline information about these households (and its members), we drop them from our current analysis. Further, we restrict our sample to respondents aged between 17 and 79 years. It is assumed that respondents with age over 80 or under 17 may have more difficulties in understanding the experiments. Hence, we drop another 26 observations. Ultimately, this leaves us with 760 observations to work with.

Implementation of the risk elicitation methods contained two village visits per day, one in the morning and one in the afternoon. The possibility that information had spread between villages seems unlikely because most of the distance between villages (18 km on average). The experimental sessions were conducted in the village town hall. To avoid observation, we made sure that respondents were separated across the town hall. Furthermore, decision spillovers are unlikely because individuals responded at different pace levels. Of course, we cannot exclude the possibility of observation altogether.

Upon arrival, the experimenter reminded participants of the confidentiality of the data. In order to ensure incentive compatibility, subjects were informed that, after the experiment, a random device would determine which experiment would be played out depending on their decision. Care was taken to ensure that subjects understood the decisions they were to make. Once all seven choices were made, one decision was randomly chosen from the incentivized part for payment. The respondents had to pick a number from a non-transparent bag to determine which experiment would be played out and a coin was used to determine the outcome of the risk game. Average earnings were 150 Thai Baht (THB), i.e. approximately 4 Euros, or slightly less than a one-day salary of an unskilled worker. The show-up fee was 50 THB (approx. 1 Euro). The choice set with loss (CSL) task included a negative outcome (−30 THB). We, however, avoided negative payoff by providing an initial fee of 30 THB equal to the maximum loss that could be incurred due to ethical reasons in a manner similar to the Hey and Orme (1994) replication exercise done in Harrison et al. (2007). However, there is little evidence that the house money effect is likely to change the result when we compare the baseline study of Eckel and Grossman (2008) and our results. Each session included exactly the same set of instructions and was implemented in the same order. While the risk experiments took half an hour, the entire risk survey from the beginning to the final payoff took approximately two hours to complete.

A.2. Sampling procedure of the household survey

Our risk survey is administered as part of a larger household survey which collects data from approximately 2200 households in three provinces in Thailand. The household selection process follows a three-stage stratified sampling procedure where provinces constitute strata and the primary sampling units are sub-districts.

Within each province, we exclude the urban area around the provincial capital city and confine the sample to the remaining rural areas. Within each sub-district, two villages are chosen at random. In the third stage, a systematic random sample of ten households was drawn from household lists of the rural census ordered by household size. Overall, the sampled households are representative for the rural areas in the considered provinces. Compared to the household survey which ran in three provinces, our risk survey was conducted in the province of Ubon Ratchathani, the largest of the three provinces in Northeastern Thailand.

A.3. Description of risk elicitation methods

In our data collection process for the experiment, we tried to keep the enumerator instructions as short and simple as possible in order to facilitate understanding.

1. Self-reported risk attitude: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risk? (Please choose a number on a scale from 0 to 10).
2. Attitudes towards risk in different situations. When thinking about investing and borrowing are you a person who is fully prepared to take risk or do you try and avoid taking risk? (Please choose a number on a scale from 0 to 10).
3. Hypothetical investment question: Imagine you just won 100,000 Baht in a lottery and you can invest this money in a business. There is a 50% chance that the business is successful. If the business is successful you double the amount invested after one year. If it is not successful you will lose half the amount you invested. How much of the 100,000 Baht would you invest in the business?
4. Certainty equivalent experiment: This is game 1. It has 20 rows. In each row a decision has to be made. In each row we would like you to choose option A or option B. Option A is a certain amount of THB. It starts with 0 and goes up by 10 THB in every row. Option B is a lottery where a coin is thrown. If 'King' falls you win 300 Baht. If 'Palace' falls you get nothing. *(Enumerator shows the coin)*. Please make your choice of Option A or B for each row. If this game is selected to be played with real money, you will be asked to draw a number from a bag. The bag contains the numbers 1 to 20 for the 20 rows. We will play with real money according to your choice. For example: If you draw the number X (Enumerator ID) from the bag, we play the game at this row for money. That means: If you chose option A you will receive (THB). If you chose option B we will toss a coin. If 'King' you win 300 Baht. If 'Palace' you win nothing (see Table A1).
5. This is game 2. There are 5 options. Please choose the one option that you would like to play the most. In each of the five options we flip a coin to determine the real money payoff. *(Enumerator shows coin)*. Please see the table on the showcard:
   In option 1 you win 50 Baht if King falls and 50 Baht if Palace falls.
   In option 2 you win 90 Baht if King falls and 30 Baht if Palace falls.
   In option 3 you win 130 Baht if King falls and 10 Baht if Palace falls.
   In option 4 you win 170 Baht if King falls and −10 Baht if Palace falls.
   In option 5 you win 210 Baht if King falls and −30 Baht if Palace falls.
   Now we ask you to make your decision. Which of these 5 options do you prefer? *(Enumerator: Please tick box!)* (see Table A2).
6. This is game 3. There are 5 options. Please choose the one option that you would like to play the most. In each of the five options we flip a coin to determine the real money payoff. *(Enumerator shows coin)*. Please see the table on the showcard:
   In option 1 you win 80 Baht if King falls and 80 Baht if Palace falls.
   In option 2 you win 120 Baht if King falls and 60 Baht if Palace falls.
   In option 3 you win 160 Baht if King falls and 40 Baht if Palace falls.
   In option 4 you win 200 Baht if King falls and 20 Baht if Palace falls.
   In option 5 you win 240 Baht if King falls and get nothing if Palace falls.
   Now we ask you to make your decision *(Enumerator: Please tick box!)*. Which of these 5 options do you prefer? (see Table A3).
7. This is game 4. We offer you 100 Baht. There are two options for this money: you can keep money for certain or you can use money to play a game. We ask you to decide how much of the 100 Baht you want to use for these two options each. You can split the money in any way between these two options.

Table A1
Certainty equivalent task.

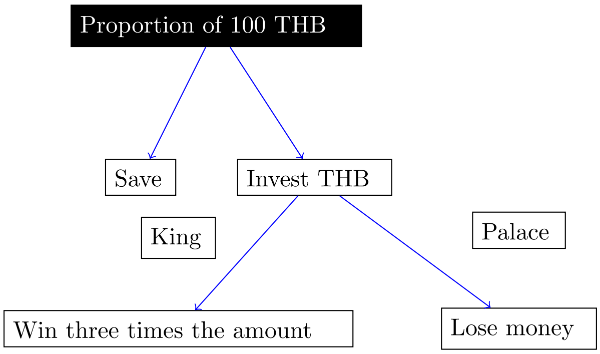
Row	Option A	Tick box	Tick box	Option B
1	0			300: 0
2	10			300: 0
3	20			300: 0
4	30			300: 0
5	40			300: 0
6	50			300: 0
7	60			300: 0
8	70			300: 0
9	80			300: 0
10	90			300: 0
11	100			300: 0
12	110			300: 0
13	120			300: 0
14	130			300: 0
15	140			300: 0
16	150			300: 0
17	160			300: 0
18	170			300: 0
19	180			300: 0
20	190			300: 0

Table A2
Eckel-Grossman with loss option.

	Choice	Coin	Stakes	Tick option
Option	1	King	50	
		Palace	50	
Option	2	King	90	
		Palace	30	
Option	3	King	130	
		Palace	10	
Option	4	King	170	
		Palace	−10	
Option	5	King	210	
		Palace	−30	

Table A3
Eckel-Grossman without loss option.

	Choice	Coin	Stakes	Tick option
Option	1	King	80	
		Palace	80	
Option	2	King	120	
		Palace	60	
Option	3	King	160	
		Palace	40	
Option	4	King	200	
		Palace	20	
Option	5	King	240	
		Palace	0	



Appendix B. Description of variables

This section displays details of the variables we use in our regression.

B.1. Individual characteristics

Female takes the value 1 for female and 0 for male.
Age is the respondents' age in years.
Height is respondents' height in cm.
Years of schooling is denoted as years in eduation.
Marital status takes the value 1 if married and 0 otherwise.
Household size are individuals living in the household for at least 180 days.
Log per capita income is the natural logarithm of household income per day divided by OECD adult equivalents AE (AE = 1 + 0.7*(adults-1) + 0.5*children).

B.2. Behavioral variables

Farmer takes the value 1 for being a farmer and 0 otherwise.

Self-employed takes the value 1 for being self-employed and 0 otherwise.

Lottery expenditure is the total amount of household expenses for lotteries in the last 12 months.

Future lottery expenditure denotes the question: How much money will you spend for the next drawing of the state lottery?

Investment is the total amount of household purchases above 5000 THB and used for longer than a year since 2011.

Planned investment constitutes the question: Do you plan to invest in the next five years in the agricultural/non-agricultural business?

Borrowing takes the value of 1 if the household borrowed since 2011 and 0 otherwise.

Borrowing for business takes the value 1 if respondent applied for a credit for business purposes and 0 otherwise.

Risk-mitigating measures takes the value of 1 if the household has implemented risk measures since 2011 and 0 otherwise.

Number of risk measures is number of actually implemented risk-mitigating measures since 2011.

Number of insurances is the total sum of voluntary insurance policies.

Health insurance takes the value of 1 if the household holds additional health insurance alongside government insurance and 0 otherwise.

Accident insurance takes the value of 1 if the household holds additional accident insurance and 0 otherwise.

Body mass index is computed as weight/height^2.

Overweight takes the value of 1 if the person has a BMI > 25. The WHO definition for BMI is if a person has a BMI greater than or equal to 25.

B.3. Cognitive aptitude

We asked five basic algebra questions and tested their word fluency.

1. What is 45 + 72?
2. You have 4 friends and you want to give each friend 4 sweets. How many sweets do you need?
3. What is 5% of 200?
4. You want to buy a bag of rice that costs 270 Baht, but you only have one 1000 Baht note. How much change will you get back?
5. In a sale, a shop is selling all items at half price. Before the sale, a mattress costs 3000 Baht. How much will the mattress cost in the sale?
6. A second-hand motorbike dealer is selling a motorbike for 12,000 Baht. His is two thirds of what a new motobike costs new. How much did the new motorbike cost?

Word fluency: I would like you to name as many different animals as you can in 60 s *(Enumerator counts with a stopwatch)*.

Appendix C. Risk measures and socio-economic correlates

Table C.1 explores the relationship between various risk elicitation methods and socio-economic correlates. In explaining the individual risk attitude, we rely on a set of seven standard variables which are potential determinants of risk attitude (Dohmen et al., 2011). Noticeable is the reduction of the sample size from 760 to 715 owning to missing observations in terms of schooling and income. Age has an ambiguous relationship with risk attitude. It seems that younger people are more risk seeking in the financial willingness to take risk (SF) as well as the hypothetical investment (SI) question. This is in line with the results found in Dohmen et al. (2011). This result is different in both choice set tasks where older people make more risk-seeking choices. For marital status we find in three cases statistically significant evidence that married people make more risky choices. Furthermore, we find that higher income is positively significant in explaining risk tolerance which is statistically significant in the hypothetical investment (SI) task. Overall, significant relations have the expected signs, the exception being age.

Appendix D. Some fully specified regressions results

Appendix D provides fully specified regression results in two cases and further complementary information in a third case. Table D.1 shows in an exemplary manner the fully specified regression results for the variable "Lottery Expend/Inc" in Table 4. While Table 4 gives only the two statistically significant coefficients for general willingess to take risk (SG) and choice set (CS) tasks, here we show coefficients for all risk measures and also for the control variables. Table D.2 provides the same kind of information for the multiple-item risk measure (with 7 items) which is discussed in Section 5.1 of the main text. Finally, Table D.3 shows the number of risky behaviors that can be explained by the respective combination of three single-item risk measures.

Table C.1
Determinants of risk measures.

	(1) SG	(2) SF	(3) SI	(4) CE	(5) CS	(6) CSL	(7) CI
Female	0.377	−0.008	−3.959	−1.229	−0.102	−0.019	−4.221
	(0.29)	(0.29)	(2.50)	(0.68)	(0.17)	(0.15)	(2.88)
Age	0.010	−0.027**	−0.355***	−0.021	0.013***	0.016***	−0.175
	(0.01)	(0.01)	(0.07)	(0.03)	(0.01)	(0.01)	(0.13)
Height	0.010	−0.010	0.162	−0.079	−0.006	0.006	−0.224
	(0.02)	(0.02)	(0.19)	(0.04)	(0.01)	(0.01)	(0.17)
Years of schooling	0.062	0.023	2.558	0.136	0.035	−0.029	0.513
	(0.04)	(0.05)	(2.53)	(0.11)	(0.02)	(0.02)	(0.40)
Marital status	0.815***	0.932***	6.320***	0.694	0.099	−0.040	3.187
	(0.36)	(0.39)	(2.28)	(0.78)	(0.16)	(0.15)	(3.36)
Household size	0.003	0.107	3.110	0.092	−0.027	0.021	0.030
	(0.07)	(0.07)	(4.31)	(0.17)	(0.03)	(0.03)	(0.69)
LPCI	−0.039	−0.005	1.893***	0.006	0.040	0.105	−0.402
	(0.13)	(0.12)	(0.82)	(0.30)	(0.07)	(0.06)	(1.27)
Constant	3.779	8.235***	24.361	20.594***	3.022	0.467	81.491***
	(3.44)	(3.41)	(21.43)	(7.95)	(2.14)	(1.60)	(30.58)
Observations	715	715	715	715	715	715	715
R-Squared	0.01	0.03	0.09	0.01	0.01	0.03	0.01
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS

Notes: The dependent variables are risk elicitation methods. Columns (1–7) report estimates of least squares estimations. Female is a dummy (1 = yes, 0 = no). Age is age of respondents' in years. Height is in cm reported by the respondent. Marital status is a dummy (1 = yes, 0 = no). LGPI is the log per capita income. It refers to the natural logarithm of household income per day divided by OECD adult equivalents AE (AE = 1 + 0.7*(adults-1) + 0.5*children). We employ the subsample of 17–79 years. Clustered errors on the village level are in parenthesis.
** Significance at the 5% level.
*** Significance at the 1% level.

Appendix E. Factor analysis

In the correlation matrix we saw varying degrees of correlation across risk elicitation methods. We aim now to reduce the number of variables and to detect structure in the relationships between risk items, employing a standard factor analysis. The Kaiser-Meyer-Olkin (KMO) measure verifies the sampling adequacy for the analysis. All KMO values for individual items are above 0.5, supporting retention for the analysis. Factor analysis yields three factors with an eigenvalue of 1.16, 0.87 and 0.70. The first factor accounts for 43% of the variance and the loading is dominated by the hypothetical investment question (SI). The second factor explains 32% of all variance and is dominated by the two choice set tasks. We can see that 75% of the common variance shared by the seven variables can be accounted for by the first two factors. The third factor is dominated by the general willingness to take risk (SG) and to some extent by the financial willingness to take risk (SF) and has the lowest explained variance. After careful examinations of eigenvalues, proportion of variance explained and scree plot criterion, three factors are identified for further use. After rotation, we find a clearer picture of the relevance of each variable in the factor. We drop those variables with a loading smaller than 0.30 (see Table E.1). Based on the a priori classifications, a clear and interpretable underlying structure is identified. We are able to confirm the result described above, in that Factor 1 is mostly defined by the hypothetical investment question (SI), Factor 2 is defined by the two choice set tasks, and Factor 3 is defined by the two survey questions.

E.1. Factor analysis and risky behavior

Next, we consider each factor and its power in explaining the risky behavioral items. We show statistically significant coefficients only, employ the same control variables and report clustered standard-errors. We find that Factor 1 has - as was to be expected - the best explanatory power among the three factors as it explains risky behavior in 4 out of 11 cases. It is, for instance, able to explain risk-mitigating activities and the demand for health insurance policies at the 1% significance level. Factor 2, which captures the two choice set items, is able to explain risky behavior in another area than Factor 1. Factor 3, relying on the two survey items, is unable to predict any behavior. Using factor analysis, we find that we can reduce our seven risk items to three factors (see Fig. E.1 and Table E.2).

Appendix F. Robustness tests

Robustness tests cover five issues. First, we report estimates on the effect sizes of the coefficients of the single-item and multiple-item risk measures. Second, we use further extensions of the behavioral items, including variations of consumption and income definitions (Section F.2). Motivation and results of three other robustness exercises are described in Sections F.3, F.4, and F.5.

Table D.1
Single-item risk measures and risky behavior.

	(1) Lottery Expend/Inc	(2) Lottery Expend/Inc	(3) Lottery Expend/Inc	(4) Lottery Expend/Inc	(5) Lottery Expend/Inc	(6) Lottery Expend/Inc	(7) Lottery Expend/Inc
SG	0.073**						
	(0.03)						
SF		−0.012					
		(0.03)					
SI			0.107				
			(0.069)				
CE				−0.033			
				(0.031)			
CSL					0.022		
					(0.036)		
CS						0.065***	
						(0.025)	
CI							0.071*
							(0.037)
Female	−0.070**	−0.068**	−0.063**	−0.069**	−0.067**	−0.066**	−0.065**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Age	−0.001	−0.001	−0.001	−0.001	−0.002	−0.002	−0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Height	−0.000	−0.000	−0.001	−0.001	−0.000	−0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Years of Schooling	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Marital Status	0.012	0.019	0.011	0.020	0.018	0.016	0.015
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Household Size	0.003	0.003	0.002	0.003	0.003	0.003	0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
LPCI	0.004	0.004	0.002	0.003	0.003	0.003	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	710	710	710	710	710	710	710
R-Squared	0.04	0.03	0.03	0.03	0.03	0.04	0.03

Notes: The dependent variable is the lottery expenditure as a share of income. Columns [1–7] report estimates of least square estimations. Female is a dummy (1 = yes, 0 = no). Age is age of respondents' in years. Marital Status is a dummy (1 = yes if married, 0 = not). LGPI is the log per capita income. It refers to the natural logarithm of household income per day divided by OECD adult equivalents AE (AE = 1 + 0.7*(adults-1) + 0.5*children). We employ the subsample of 17–79 years. Clustered errors on the village level are in parenthesis.
** Significance at the 5% level.
*** Significance at the 1% level.

F.1. Effect size

In order to facilitate the interpretation of the coefficients of the single-item risk measures in Table 4, we standardized variables following Long and Freese (2014). They argue that using standardized coefficients provides a means for comparing the effect of variables measured in different metrics. Table F.1 produces the standardized coefficients' output of the risk measures on risky behavioral variables. Overall, we find that the range of the magnitude of risk items explaining risky behavior varies from 0.021 to 0.365, holding all other covariates constant. In column (1), the bStdX presents standardized values of the explanatory variable on the outcome variable.

In column (1), we find that a one standard deviation increase in the normalized general willingness to take risk (SG) question produces, on average, a 0.021 increase in the % share of income spent on gambling whereas a one standard deviation increase in choice set without loss (CS) results in an increase of 0.025, holding other variables constant. In the second column, we follow the same procedure. We find that a one standard deviation increase in the choice set with loss (CSL) item (std.dev. 0.371) increases, on average, future spending on lotteries by 24.113 which has a higher impact compared to the incentivized investment (CI) and choice set without loss (CS) item. In column (3) a one standard deviation increase in incentivized investment (CI) item results, on average, in an increase in the probability of being self-employed by 0.194. This effect is reduced slightly using the hypothetical investment (0.130) and the general willingness to take risk question (0.180). In column (4), we find a similar magnitude of the certainty equivalent (CE) item on the probability of being a farmer compared to the general willingness to take risk (SG) item. Concerning financial behavior, in column 5–7 we find that the one standard deviation increase in the incentivized investment (CI), certainty equivalent (CE) and financial willingness to take risk (SF) increases the probability of risky financial behavior by 0.190, 0.149, and 0.237, respectively. In contrast, in column (8) we find that a one standard deviation increase in the hypothetical (SI) question (0.216) from the mean (0.503), decreases, on average, the probability of planning substantial investments in the future by 0.135. In the last column, we find that a one standard deviation increase in the hypothetical investment (SI) question increases the variation of the BMI measure by

Table D.2
Multiple-item risk measures and risky behavior.

	(1) Lottery (Expend/Inc)	(2) Future lottery expenditure	(3) Self-employment	(4) Farming	(5) Investment (Expend/Inc)	(6) Plan to invest	(7) Borrowing	(8) Risk mitigating	(9) Number of insurance	(10) Health insurance	(11) BMI
Average of 7 items	0.026***	12.753***	0.021*	−0.039*	0.117*	0.043**	0.043**	−0.064**	−0.091	−0.022**	0.187
	(0.01)	(4.75)	(0.01)	(0.02)	(0.07)	(0.02)	(0.02)	(0.02)	(0.07)	(0.01)	(0.15)
Female	−0.064**	−14.495	−0.004	−0.329***	0.106	−0.005	−0.228	−0.226*	−0.019	0.069	0.175
	(0.03)	(12.71)	(0.18)	(0.13)	(0.14)	(0.13)	(0.14)	(0.14)	(0.16)	(0.18)	(0.30)
Age	−0.001	−1.480	0.005	−0.018***	0.002	−0.008*	−0.017***	−0.010**	0.006	0.014**	−0.031**
	(0.00)	(1.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Height	−0.000	0.054	0.023**	−0.006	0.012	−0.003	−0.001	−0.015**	−0.010	−0.000	−0.085***
	(0.00)	(0.48)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Years of schooling	0.008	−1.303	0.024	−0.057***	−0.007	0.032*	−0.021	0.012	0.056**	0.045*	−0.062
	(0.01)	(1.67)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)
Marital status	0.010	5.007	−0.746***	0.553***	0.308*	0.161	0.213	0.062	0.540***	−0.043	1.334***
	(0.02)	(6.45)	(0.18)	(0.16)	(0.16)	(0.17)	(0.15)	(0.15)	(0.17)	(0.19)	(0.45)
Household size	0.002	4.344	0.041	0.026	−0.057	0.139***	0.060**	0.040	0.197***	0.032	0.060
	(0.01)	(4.17)	(0.05)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.05)	(0.08)
LPCI	0.002	−3.498	0.073	−0.006	0.097*	0.165***	0.069	0.079*	0.258***	0.135	0.229*
	(0.01)	(7.84)	(0.08)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)	(0.08)	(0.09)	(0.13)
Constant	0.156	119.76	−5.681***	2.327	−2.284	−1.249	0.941	2.154	−0.275	−3.793*	35.351***
	(0.23)	(161.19)	(2.00)	(1.50)	(1.46)	(1.53)	(1.53)	(1.34)	(2.02)	(2.15)	(3.75)
Observations	688	688	692	689	692	692	692	692	692	692	688
Estimator	OLS	OLS	Probit	Probit	OLS	Probit	Probit	Probit	OLS	Probit	OLS

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Inc in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total income. Expend/Inc in column (5) is the total amount of household expenses on investment in the last 12 months as a share of total income. See Appendix B for details. Controls include Female, Age, Height, marital status, household size, education in years, and log per capita income. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis.

** Significance at the 5% level.

*** Significance at the 1% level.

Table D.3
Average of any 'three' single-item risk measure.

Team sheet	
SG*SF*SI	3
SG*SF*CI	4
SG*SF*CE	3
SG*SF*CS	3
SG*SF*CSL	2
SG*SI*CI	6
SG*SI*CE	3
SG*SI*CS	7
SG*SI*CSL	6
SG*CI*CE	3
SG*CI*CS	4
SG*CI*CSL	5
SG*CE*CS	2
SG*CE*CSL	3
SG*CS*CSL	3
SF*SI*CI	7
SF*SI*CE	3
SF*SI*CS	4
SF*SI*CSL	4
SF*CI*CE	3
SF*CI*CSL	4
SF*CI*CS	5
SF*CS*CSL	4
SF*CE*CSL	3
SF*CE*CS	3
SI*CI*CE	4
SI*CI*CSL	6
SI*CI*CS	4
SI*CE*CSL	4
SI*CE*CS	4
SI*CS*CSL	6
CI*CE*CSL	4
CI*CE*CS	4
CI*CSL*CS	4
CE*CSL*CS	4
Average of 3 items	4.1

Table E.1
Factor analysis.

Variable	Factor 1	Factor 2	Factor 3
SG			0.7548
SF			0.4852
SI	0.9591		
CE			
CSL		0.6216	
CS		0.7085	
CI			

Notes: Factor analysis pattern matrix. Rotation method is promax with Kaiser normalization. Table shows for each risk elicitation method the factor loadings that are greater than 0.3.

0.365, holding other items constant. However, one needs to be careful in interpretation and comparing magnitudes of the risk items because risky behavioral variables differ by construction and therefore cannot be directly compared. As for the multiple-item risk measures with six or seven items, we find that standardized coefficients are similar to the beta values in Table 4, as values for the latter are standardized.

F.2. Extension of risky behavior

Since any set of risky behavior is arbitrary, here we document either slight variations of already used measures or alternatives which are available from the household questionnaire. Overall, we present results for a further eight risky behavioral items.

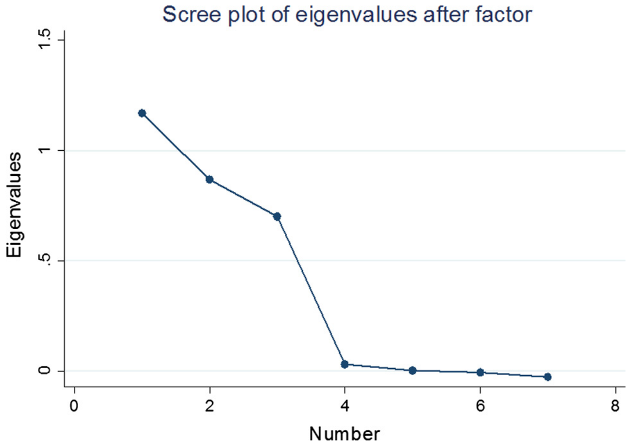


Fig. E.1. Screeplot.

(1) We use the share of past lottery expenditure as part of consumption instead of income. (2) We use the log of investment in our robustness section (instead of investment quota). This seems reasonable because we have a large share of respondents whose investments were substantial while others abstained altogether. Hence, in order to reduce the variation caused by extreme values, we take the log of investment and test whether the results are robust. In Column (3) we use the total amount of investment while in column (4) we use the share of household investment as part of their consumption. We use variations of the investment variable to show that the relation between risk and investment is not random. (5) In addition to borrowing, we use borrowing for business. The household survey not only asks whether they took out any loans in the last two years but also for which purpose, be it to repay outstanding loans, to pay for medical bills or school fees, but also for business purposes, among other things. (6) The number of risk-mitigating measures instead of the indicator variable. (7) We also consider accident insurance (as opposed to health insurance). (8) As another proxy for BMI, we will only consider those who are overweight according to the WHO definition.

Table F.2 shows results which replicate the former Table 4, the difference being that we take the alternative variables. At first glance, we see that in 15 out of 56 cases a single-item risk measure is able to explain behavior. Hence, the main picture drawn from Table 4 has not changed. Taking the total amount of investment, we still find that the incentivized investment (CI) task is significant. This also holds if we take household's investment over total consumption. The incentivized investment (CI) task is statistically significant for all of investment variables. Hence, variations of the investment variable shows that the previously significant risk items remain constant. For the indicator variable of borrowing in general, we found that the financial willingness to take risk (SF) was successful in revealing borrowing behavior. This time, however, we find a significant and positive relationship using the hypothetical investment (SI) and incentivized investment (CI) tasks at the 1% level in addition to the choice set task with loss. To conclude, we can say that, even with new variables or an alternative structure thereof, using a single-item risk measure is still unreliable as we succeed in only 15 out of 56 cases.

In the next step we test whether the average of seven items is still superior to the single-item risk measure. In four out of eight cases, our multiple-risk item measure is successful (Table F.2, bottom). Further, for all four behavioral items, our multiple-item risk measure is significant at the 1% level. Regarding factor analysis, Factor 1 is most relevant (Table F.3). The multiple-item risk measure with average of three and two risk methods can explain four to five behavioral items (Table F.3, bottom). Hence, we conclude that our main findings – in particular the robustness of the explanatory power of various multiple-item risk measures over single-item risk measures – also hold if we add eight more risky behavioral items.

F.3. Role of cognitive ability

We examine whether correlation among risk measures is higher for those individuals in our sample with more years of formal education and higher cognitive abilities. Dohmen, Falk, Huffman, and Sunde (2010) measure risk (and time) preferences using a representative sample of 1,000 German adults. They find that people with low cognitive ability are more risk averse. Similar findings are found by Benjamin, Brown, and Shapiro (2013) in a sample of Chilean high school graduates. These results, however, do not take into account the relationship between risk aversion, cognitive ability, and noise. Andersson, Tyran, Wengström, and Holm (2016) use a representative sample of the Danish population and two standard risk-elicitation tasks - one producing a positive correlation, and the other a negative correlation, between risk aversion and cognitive ability. They found no significant relation between risk aversion and cognitive ability. Instead, cognitive ability is negatively correlated to the amount of noise. We test the assumption whether cognitive ability leads to less noise and therefore improved correlation across elicitation methods. We hypothesize that highly skilled individuals should be making fewer errors and thus produce more consistent results across tasks.

Table E.2
Factor analysis and multiple-item risk measures.

	(1) Lottery (Expend/Inc)	(2) Future lottery expenditure	(3) Self-employment	(4) Farming	(5) Investment (Expend/Inc)	(6) Plan to invest	(7) Borrowing	(8) Risk mitigating	(9) Number of insurance	(10) Health insurance	(11) BMI
Factor 1			0.019**					−0.056***		−0.031***	0.387**
			(0.01)					(0.02)		(0.01)	(0.14)
Factor 2		29.320**						−0.062**	−0.202**		
		(12.44)						(0.03)	(0.08)		
Factor 3											
Observations	709	709	713	713	713	713	713	713	713	713	709
Average of 3 Items	0.030**	16.954***						−0.081***		−0.019**	0.351***
	(0.01)	(6.04)						(0.02)		(0.01)	(0.13)
Average of 2 Items		28.08**						−0.073***	−0.118**	−0.021**	0.316**
		(12.36)						(0.02)	(0.06)	(0.01)	(0.13)
Observations	711	711	715	715	715	713	715	715	715	715	710
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	Probit	Probit	OLS	Probit	Probit	Probit	OLS	Probit	OLS

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Inc in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total income. Expend/Inc in column (5) is the total amount of household expenses on investment in the last 12 months as a share of total income. See Appendix B for further details. Controls include Female, Age, Height, Marital status, Household size, education in years, and log per capita income. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis.

** Significance at the 5% level.

*** Significance at the 1% level.

Table F.1
Effect size estimates.

	(1) Lottery (Expend/Inc) bstdX	(2) Future lottery expenditure bstdX	(3) Self-employment bstdX	(4) Farming bstdX	(5) Investment (Expend/Inc) bstdX	(6) Plan to invest bstdX	(7) Borrowing bstdX	(8) Risk mitigating bstdX	(9) Number of insurance bstdX	(10) Health insurance bstdX	(11) BMI bstdX
SG	0.021		0.180								
SF							0.237			−0.147	
SI			0.131					−0.135		−0.281	0.365
CE				−0.189		0.149					
CSL		24.113						−0.129			
CS	0.025	10.004							−0.188		
GP		16.293	0.194		0.190						
Observations	392	392	396	394	396	396	396	396	396	396	396
Average of 7 items	0.026	12.751				0.104	0.127	−0.1554		−0.1975	
Average of 6 items	0.054	13.952	0.196			0.111		−0.1471		−0.1871	
Estimator	OLS	OLS	Probit	Probit	OLS	Probit	Probit	Probit	OLS	Probit	OLS

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Inc in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total income. Expend/Inc in column (5) is the total amount of household expenses on investment in the last 12 months as a share of total income. See Appendix B for details. Controls include Female, Age, Height, marital status, Household size, education in years, and log per capita income. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis. *** and ** denote significance at the 1% and 5% levels.

Table F.2
Extensions of risky behavior.

	(1) Lottery (Expend/Cons)	(2) Log investment	(3) Total investment	(4) Investment (Expend/Cons)	(5) Borrowing (business)	(6) Number of risk-mitigating	(7) Accident insurance	(8) Over-weight
SG	0.011**				−0.027**			
	(0.00)				(0.01)			
SF								
SI		0.010***			0.001***			0.000***
		(0.00)			(0.00)			(0.00)
CE								
CSL	0.016**				0.013**		−0.013**	0.025**
	(0.00)				(0.01)		(0.01)	(0.01)
CS							−0.016***	
							(0.01)	
CI		0.010***	35.508**	1.226***	0.001***	−0.003**		
		(0.00)	(15.56)	(0.46)	(0.00)	(0.00)		
Observations	711	390	715	715	715	715	715	715
Average of 7 Items	0.026***	0.194***			0.037***	−0.156***		
	(0.01)	(0.07)			(0.01)	(0.04)		
Observations	709	389	713	713	713	713	713	713
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	OLS	Probit	OLS	Probit	Probit

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Cons in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total consumption. Expend/Cons in column (4) is the total amount of household expenses on investment in the last 12 months as a share of total consumption. See Appendix B for details. Controls include Female, Age, Height, Marital status, Household size, education in years and log per capita income. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis.
** Significance at the 1% and 5% levels.
*** Significance at the 1% level.

Table F.3
Factor analysis and multiple-risk item measures (robustness).

	(1) Lottery (Expend/Cons)	(2) Log investment	(3) Total investment	(4) Investment (Expend/Cons)	(5) Borrowing (business)	(6) Number of risk-mitigating	(7) Accident insurance	(8) Over-weight
Factor 1		0.227***			0.030***			0.045**
		(0.07)			(0.01)			(0.02)
Factor 2							−0.034***	
							(0.01)	
Factor 3	0.035							
	(0.02)							
Observations	709	389	713	713	713	713	713	713
Average of 3 Items	0.047**	0.148***			0.030***	−0.130**		
	(0.02)	(0.07)			(0.01)	(0.04)		
Average of 2 Items		0.176***			0.026***	−0.027**	−0.227***	0.044**
		(0.07)			(0.01)	(0.05)	(0.01)	(0.02)
Observations	711	390	713	713	715	715	715	713
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	OLS	Probit	OLS	Probit	Probit

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Cons in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total consumption. Expend/Cons in column (4) is the total amount of household expenses on investment in the last 12 months as a share of total consumption. See Appendix B for details. Controls include Female, Age, Height, Marital status, household size, education in years and log per capita income. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis.
** Significance at the 5% levels.
*** Significance at the 1% level.

After conducting the risk survey, we asked the respondents six mathematical questions, comrising addition, multiplication, and percentage calculation. We also additionally tested for word fluency by asking them to verbally list as many animals as they could in 60 s (Appendix B.3). The correlation between the two cognitive ability measures is 0.355 (Spearman; $p < 0.001$). Thus, the two tests capture a similar underlying trait but also distinct aspects of cognitive ability. We follow the same procedure as Dohmen et al. (2010) and use a single combined measure of cognitive ability using a principal component analysis. Table F.4 shows that better education and higher cognitive ability improve the correlation coefficients slightly but not dramatically compared to the coefficients for the full sample in Table 4. We find increased correlation between the survey items and between both investment tasks. The largest improvement can be seen between the choice set tasks. Essentially, from the results above we can infer that education slightly improves correlation between the experimental measures where probabilities are part of the task. Hence, understanding seems to play a role, yet it is not the decisive factor explaining low correlations.

F.4. Further analysis of general willingness to take risk (SG) item

The responses of our sample population to the general willingness to take risk (SG) item indicate an unusually high degree of risk-taking willingness, compared to most other surveys using the same item. Thus we check whether this outcome may distort our findings. As a first step, we replace the general willingness to take risk (SG) item from the risk survey with the same item from the household panel survey which was conducted only few months earlier (April 2013). It must be noted, however, that we lose observations because we did not manage to repeat the experiment with the same subjects in August. Ultimately, we have 512 observations that could be matched. The average response in the household panel survey is 4.51 which compared to the average response in our risk survey of 6.86 comes closer to the findings of Dohmen et al. (2010) and Hardeweg et al. (2013). Using the general willingness to take risk (SG) item from the spring of 2013, we find that it is unable to explain any behavioral items. Using the average of all seven risk items with the general willingness to take risk (SG) item of the household survey; it still significantly explains 7 out of 11 items. We conclude that the high level of risk tolerance in our risk survey does not reduce the explanatory power of this item. In the next step, we compile an average of the general willingness to take risk (SG) from the spring and summer of 2013 to see whether the results hold in Table 4. Table F.5, Panel B reports results. We find that taking the average of both survey questions from the household panel survey and risk survey does not change the results. The average is still able to explain the share of lottery expenditure at the 5% level.

F.5. Restricting the sample to the household head

Table F.6 replicates the results of Table 4; however, this time it confines the respondents to the head of households as respondents. Using household heads reduces the observation to around 400 subjects. Out of these 400 subjects, 303 are male respondents. Household heads seem to be less risk tolerant than the spouse, who often is a woman. The difference in risk attitude between men and women, therefore, goes back to the long-standing debate about gender differences in preferences (Croson & Gneezy, 2009). According to them, one major reason for gender differences in risk-taking is that women's emotional reaction to uncertain situations differs from men, resulting in differences in risk taking.

Overall, our single-risk items are able to explain 14 out of 77 risky behavioral items. We do also find significant heterogeneity in terms of the strength of various risk items. While the investment questions were able to explain four and three behavioral items in Table 4, other single-item risk measure in Table F.6 like the general willingness to take risk (SG) and choice set with loss (CSL) are now able to explain up to three items. Hence, it is more equally balanced. Except with the general willingness to take risk (SG) in column (7), all significant results have the expected signs.

Table F.4
Spearman's rank correlations for subsample.

	SG	SF	SI	CE	CS	CSL	CI
SG	1.000						
SF	(a) 0.381*** (b) 0.401***	1.000					
SI	(a) 0.128** (b) 0.033	(a) 0.041 (b) 0.092	1.000				
CE	(a) −0.005 (b) 0.115	(a) 0.070 (b) 0.006	(a)0.027 (b) 0.054	1.000			
SL	(a) 0.126** (b) 0.149***	(a) 0.009 (b) 0.035	(a) 0.031 (b) −0.028	(a) 0.146** (b) 0.161***	1.000		
CS	(a) 0.070 (b) 0.065	(a) 0.015 (b) 0.007	(a) −0.041 (b) −0.048	(a) 0.095 (b) 0.099	(a) 0.364*** (b) 0.405***	1.000	
CI	(a) 0.075 (b) 0.056	(a) 0.045 (b) 0.017	(a) 0.245*** (b) 0.261***	(a) 0.014 (b) −0.011	(a) 0.103 (b) 0.125**	(a) 0.171*** (b) 0.107**	1.000
N: 760							

Notes: The table reports pairwise Spearman rank correlation coefficients for a subsample with age of 17–79 and (a) Having high education (more than 5 years), (N = 288) (b) Having above average cognitive ability, (N = 367) Statistical significance is in parenthesis.
** Significance at the 5% level.
*** Significance at the 1% level.

Table F.5
SG variations and risky behavior.

	(1) Lottery (Expend/Inc)	(2) Future lottery expenditure	(3) Self-employment	(4) Farming	(5) Investment (Expend/Inc)	(6) Plan to invest	(7) Borrowing	(8) Risk mitigating	(9) Number of insurance	(10) Health insurance	(11) BMI
A: SG replacement											
SG											
Average of 7 Items	0.030***	10.013***			0.208***	0.062**	0.065**	−0.054**		−0.026**	
	(0.01)	(4.91)			(0.08)	(0.02)	(0.03)	(0.02)		(0.02)	
Observations	477	481	482	485	485	485	485	485	485	485	482
B: SG over time											
SG (HH survey)	0.039**										
	(0.02)										
Observations	477	481	482	485	485	485	485	485	485	485	482
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	Probit	Probit	OLS	Probit	Probit	Probit	OLS	Probit	OLS

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Inc. in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total income. Expend/Inc in column (5) is the total amount of household expenses on investment in the last 12 months as a share of total income. See Appendix B for details. Controls include Female, Age, Height, Marital status, household size, education in years and log per capita income. We employ the subsample of 17–79. Clustered errors on the village level are in parenthesis.

** Significance at the 5% level.

*** Significance at the 1% level.

Table F.6
Household head and risky behavior.

	(1) Lottery (Expend/Inc)	(2) Future lottery expenditure	(3) Self-employment	(4) Farming	(5) Investment (Expend/Inc)	(6) Plan to invest	(7) Borrowing	(8) Risk mitigating	(9) Number of insurance	(10) Health insurance	(11) BMI
SG	0.008**		0.012**				−0.014**				
	(0.00)		(0.01)				(0.01)				
SF							0.020**	−0.017**			
							(0.01)	(0.01)			
SI										0.001**	
										(0.00)	
CE				−0.011**							
				(0.00)							
CSL	0.019**								−0.140**	−0.020***	
	(0.01)								(0.05)	(0.01)	
CS		13.052***						−0.044***			
		(5.65)						(0.02)			
GP					0.011***			−0.002**			
					(0.00)			(0.00)			
Observations	392	392	396	394	396	396	396	396	396	396	396
Average of 7 Items			0.032**					−0.090***		−0.037**	
			(0.02)					(0.03)		(0.01)	
Observations	391	391	395	395	395	395	395	395	395	395	395
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	Probit	Probit	OLS	Probit	Probit	Probit	OLS	Probit	OLS

Notes: The dependent variables are the behavioral variables from the household survey. Expend/Inc in column (1) is the total amount of household expenses on buying lottery tickets in the last 12 months as a share of total income. Expend/Inc in column (5) is the total amount of household expenses on investment in the last 12 months as a share of total income. See Appendix B for details. Controls include Female, Age, Height, marital status, household size, education in years, and log per capita income. We employ the subsample with age of 17–79. Clustered errors on the village level are in parenthesis.
** Significance at the 5% level.
*** Significance at the 1% level.

References

Abdellaoui, M., Baillon, A., Placido, L., & Wakker, P. (2011). The rich domain of uncertainty: Source functions and their experimental implementation. *American Economic Review, 101*(2), 695–723.

Andersson, O., Tyran, J.-R., Wengström, E., & Holm, H. J. (2016). Risk aversion relates to cognitive ability: Preference or noise? *Journal of the European Economic Association, 14*(5), 1129–1154.

Barsky, R. B., Juster, T. F., Kimball, M. S., & Shapiro, M. D. (1997). Preference parameters and behavioral heterogeneity: An experimental approach in the health and retirement study. *Quarterly Journal of Economics, 112*(2), 537–579.

Benjamin, D. J., Brown, S. A., & Shapiro, J. M. (2013). Who is 'behavioral'? Cognitive ability and anomalous preferences. *Journal of the European Economic Association, 11*(6), 1231–1255.

Bonin, H., Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2007). Cross-sectional earnings risk and occupational sorting: The role of risk attitudes. *Labour Economics, 14*(6), 926–937.

Bruhin, A., Fehr-Duda, H., & Epper, T. (2010). Risk and rationality: Uncovering heterogeneity in probability distortion. *Econometrica, 78*(4), 1375–1412.

Charness, G., & Viceisza, A. (2012). Comprehension and risk elicitation in the field: Evidence from rural Senegal. Working Paper, UC Santa Barbara.

Charness, G., & Villeval, M. C. (2009). Cooperation and competition in intergenerational experiments in the field and the laboratory. *American Economic Review, 99*(3), 956–978.

Clotfelter, C. T., & Cook, P. J. (1990). On the economics of state lotteries. *Journal of Economic Perspectives, 4*(4), 105–119.

Crosetto, P., & Filippin, A. (2016). A theoretical and experimental appraisal of four elicitation methods. *Experimental Economics, 19*(3), 613–641.

Croson, R., & Gneezy, U. (2009). Gender differences in preferences. *Journal of Economic Literature, 47*(2), 448–474.

Deck, C., Lee, J., Reyes, J. A., & Rosen, C. C. (2013). A failed attempt to explain within subject variation in risk taking behavior using domain specific risk attitudes. *Journal of Economic Behavior and Organization, 87*(3), 1–124.

Dercon, S., & Christiaensen, L. (2011). Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia. *Journal of Development Economics, 96*(2), 159–173.

Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2010). Are risk aversion and impatience related to cognitive ability? *American Economic Review, 100*(3), 1238–1260.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association, 9*(3), 522–550.

Eckel, C. C., & Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and Human Behavior, 23*(4), 281–295.

Eckel, C. C., & Grossman, P. J. (2008). Forecasting risk attitudes: An experimental study using actual and forecast gamble choices. *Journal of Economic Behavior and Organization, 68*(1), 1–17.

Ekelund, J., Johansson, E., Jaervelin, M.-R., & Lichermann, D. (2005). Self-employment and risk-aversion-evidence from psychological test data. *Labour Economics, 12*(5), 649–659.

Gloede, O., Menkhoff, L., & Waibel, H. (2015). Shocks, risk attitude, and vulnerability to poverty among rural households in Thailand and Vietnam. *World Development, 71*(1), 54–78.

Gneezy, U., & Potters, J. (1997). An experiment on risk taking and evaluation periods. *Quarterly Journal of Economics, 112*(2), 631–645.

Gusio, L., & Paiella, M. (2005). The role of risk aversion in predicting individual behavior. Discussion Paper No. 546, Banca D'Italia.

Hardeweg, B., Menkhoff, L., & Waibel, H. (2013). Experimentally validated survey evidence on individual risk attitudes in rural Thailand. *Economic Development and Cultural Change, 61*(4), 859–888.

Harrison, G. W., Lau, M. I., & Rutström, E. E. (2007). Estimating risk attitudes in Denmark: A field experiment. *Scandinavian Journal of Economics, 109*(2), 341–368.

He, P., Veronesi, M., & Engel, S. (2016). Consistency of risk preference measures and the role of ambiguity: An artefactual field experiment from China. University of Verona, Working Paper No.3.

Hey, J. D., & Orme, C. (1994). Investigating generalizations of expected utility theory using experimental data. *Econometrica, 62*(6), 1291–1326.

Holm, H. J., Opper, S., & Nee, V. (2013). Entrepreneurs under uncertainty: An economic experiment in China. *Management Science, 59*(7), 1671–1687.

Isaac, R. M., & James, D. (2000). Just who are you calling risk averse? *Journal of Risk and Uncertainty, 20*(2), 177–187.

Kihlstrom, R. E., & Laffont, J.-J. (1979). A general equilibrium entrepreneurial theory of firm formation based on risk aversion. *Journal of Political Economy, 87*(4), 719–748.

Long, J. S., & Freese, J. (2014). *Regression models for categorical dependent variables using Stata*. Stata Press.

Loomes, G., & Pogrebna, G. (2014). Measuring individual risk attitudes when preferences are imprecise. *Economic Journal, 124*(576), 569–593.

Menkhoff, L., & Sakha, S. (2016). Determinants of risk aversion over time: Experimental evidence. Discussion Paper No. 1582, DIW Berlin.

Nielsen, T., Keil, A., & Zeller, M. (2013). Assessing farmers' risk preferences and their determinants in a marginal upland area of Vietnam: A comparison of multiple elicitation techniques. *Agricultural Economics, 1*(19), 557–571.

Reynaud, A., & Couture, S. (2012). Stability of risk preference measures: Results from a field experiment on french farmers. *Theory and Decision, 73*(2), 203–221.

Sutter, M., Kocher, M. G., Glätzle-Rützler, D., & Trautmann, S. T. (2013). Impatience and uncertainty: Experimental decisions predict adolescents' field behavior. *American Economic Review, 103*(1), 510–531.

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review, 100*(1), 557–571.

Timmermann, A. (2006). Forecast combinations. *Handbook of economic forecasting* (Vol. I).

Vieider, F. M., Lefebvre, M., Bouchouicha, R., Chmura, T., Hakimov, R., Krawczyk, M., et al (2015). Common components of risk and uncertainty attitudes across contexts and domains: Evidence from 30 countries. *Journal of the European Economic Association, 13*(3), 421–452.