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Measuring the risk attitude of decision-makers: are there differences between groups of methods and persons?*

Syster C. Maart-Noelck and Oliver Musshoff†

Many studies quantifying individual risk preferences of test persons show that results of different measuring methods may vary. Additional reservations about the reliability of the results regarding the risk attitude measurement arise from the fact that most studies are based on convenience groups, such as students or businessmen in developing countries. With this in mind, we systematically compare different measuring methods to answer the question how the choice of method affects the results. Moreover, we compare the risk preferences of German farmers with those of students and Kazakhstani farmers to investigate whether farmers' risk preferences can be approximated through those of convenience groups. The methods applied comprise an incentive-compatible Holt-and-Laury-lottery as well as two psychometric methods. Results show that students respond consistently across all three elicitation methods whereas German and Kazakhstani farmers are more inconsistent. Significant differences exist in the responses of German students and German farmers. The comparison of risk preferences between German and Kazakhstani farmers, however, reveals significant similarities with respect to the psychometric methods.

Key words: contextualized statements, Holt-and-Laury-lottery, measuring the risk attitude, self-assessment.

1. Introduction

As do all entrepreneurs, agricultural entrepreneurs have to make decisions under uncertainty. The individual risk attitude is of great relevance as it can influence the order of entrepreneurial action alternatives (AAs) considerably. For example, risk-averse decision-makers possibly might reject an investment with uncertain returns despite a positive expected net present value because their risk premium is not covered (cf. Isik and Khanna 2003). In addition, the risk attitude is relevant for policy impact assessment, which is supposed to predict the adaptive behaviour under changed framework conditions (cf. Harrison *et al*. 2010).

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† Syster C. Maart-Noelck (e-mail: syster.maart@agr.uni-goettingen.de) is at Department of Agricultural Economics and Rural Development, Georg-August-University Goettingen, Goettingen, Germany. Oliver Musshoff, is at Department of Agricultural Economics and Rural Development, Georg-August-University Goettingen, Goettingen, Germany.

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Applying econometric approaches, the individual risk attitude is estimated on the basis of empirically observed data (cf. Antle 1987; Gardebroek 2006). Owing to the complexity of real decisions, there is a danger that the risk attitude is not estimated correctly (cf. Masson 1972; Eswaran and Kotwal 1990). Another barrier in the application of econometric methods is the fact that time series data are mostly only available on an aggregated level and not on a single-farm basis. Therefore, experimental approaches that may also include surveys gain in importance (Wik *et al*. 2004, p. 2443). These approaches focus on the response behaviour gathered in surveys dealing with hypothetical decision situations that are often related to real payments. From the response behaviour, conclusions are drawn regarding the participants' risk attitude (Bardsley and Harris 1987, p. 112). However, previous investigations quantifying the risk attitude using different experimental methods clearly show that results might be method-dependent. Nevertheless, these studies also often use convenience groups, such as students (cf. Deck *et al*. 2008) and households or entrepreneurs in developing countries (cf. Binswanger 1980; Balgah and Buchenrieder 2011). The reason for this is that students are very easy to recruit, constitute a homogenous group and have higher incentive compatibility than entrepreneurs owing to their lower income level. Especially the last-named reason is mentioned with regard to participants in developing countries (cf. Wik *et al*. 2004; Akay *et al*. 2012).

With this in mind, the present study pursues two objectives: First, we analyse how different methods to measure the risk attitude lead to different results. In particular, we investigate whether the risk attitude determined using an incentive-compatible Holt-and-Laury-lottery (HLL; Holt and Laury 2002), which for some years has been widely used in research, differs from the risk attitude estimated using questionnaires based on psychometric methods. Second, we answer the question whether it is acceptable to apply the results of experiments investigating the risk attitude of convenience groups of, for example, students and entrepreneurs in developing countries to entrepreneurs in industrialized countries. The present study analyses, on the one hand, whether the risk attitude determined for German students is indicative of those of German farmers and, on the other hand, whether the risk attitude determined for Kazakhstani farmers is indicative of those of German farmers. To our knowledge, this is the first study that systematically uses the measuring methods mentioned above to compare the risk attitude of students with that of decision-makers in general and of farmers in particular. The same applies to the risk attitude comparison of participants of the same occupational group in two different countries.

The present article is structured as follows: Section 2 presents the relevant literature which serves as the basis for the generation of the research hypotheses. In Section 3, applied methods to measure the risk attitude are explained before the results are described in Section 4. The article ends with conclusions and future research prospects (Section 5).

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2. Relevant literature and generation of hypotheses

A variety of studies compare the results of different methods to measure risk attitudes. For example, Binswanger (1980) compares the response behaviour of Indian farmers in a hypothetical questionnaire with those in an incentive-compatible experiment. As he discovers inconsistencies in the intrapersonal comparison of the two methods, the incentive-compatible experiments have gained in importance. Especially, the HLL constitutes a particularly promising approach for measuring the risk attitude in an incentive-compatible way. For an overview of investigations applying HLL, please refer to Abdellaoui *et al*. (2011). Reynaud and Couture (2010) investigate whether inconsistencies in the participants' risk attitude determined using different measuring methods result from the fact that varying methods address different contexts, so that the risk attitude depends on the situation. For this, the authors carry out an experiment with 30 French farmers. For determining the risk attitude, they use two lotteries (according to Eckel and Grossman 2002; Holt and Laury 2002), a psychometric method that assesses risk taking in five content domains (financial decisions, health/safety, recreational, ethical, and social decisions) as well as a contextual self-assessment. Both applied lotteries are not incentive-compatible. The authors state that participants are assessed to be significantly less risk-averse in the HLL than in the lottery according to Eckel and Grossman (2002). Further results are that the last-named lottery shows stronger and more significant correlations with the two other measuring methods than the HLL, which does not show any significant correlation with any self-assessment area. Dohmen *et al*. (2011) use data from the German socio-economic panel (SOEP) conducted in 2004 as well as from self-collected data which includes a self-assessment question and an incentive-compatible experiment. SOEP is a wide-ranging representative study of private households in Germany which measures among others the risk attitudes over a self-assessment question. Dohmen *et al*. (2011) examine whether the predictions regarding the participants' behaviour in the experiment can be made on the basis of their response behaviour in the self-assessment questionnaire. They find a significant correlation between the experiment and the self-assessment. Furthermore, they show that the investigation of the general risk attitude exhibits correlations with the risk attitudes in the specific contexts. Context-related elicitations of the risk attitude, however, are better suited to explain the behaviour in the respective context.

Thus far, it has not been investigated whether there is a dependency between the risk attitude of a group of farmers that is determined by an incentive-compatible HLL and those determined by self-assessment. Here also, no investigations exist on whether there is a dependency between the behaviour in an incentive-based HLL and the answer to the question about risk attitude elicitation, which is explicitly formulated in a business context. Thus, the following hypotheses are derived:

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H1 (HLL vs. self-assessment): There are significant dependencies between the risk attitude determined by self-assessment and the response behavior in the incentive-compatible HLL.

H2 (HLL vs. statement): There are significant dependencies between the risk attitude determined via the agreement with a business-related, contextualized statement and the response behaviour in the incentive-compatible HLL.

The special relevancy of the question whether it is possible to approximate the individual risk attitude measured by the HLL, using self-assessment and business-related, contextualized statements as it is intended in H1 and H2, can be explained as follows: on the one hand, the two aforementioned methods are easier to include in simple household surveys, which are very frequently conducted for investigating agricultural and food economic problems especially in developing countries, than the HLL (cf. Ecker and Qaim 2011). Furthermore, the HLL is more expensive owing to the incentives that need to be set. On the other hand, during the last decade, the incentive-based HLL has become the most important standard method for the elicitation of the individual risk attitude.

Experimental studies often use convenience groups, such as students or participants from developing countries. Here, the question arises whether it is possible to draw conclusions from the risk attitude of convenience groups that also apply to the risk attitude of other groups. A study from Holm *et al.* (2010) deals with an explicit comparison of the risk attitude of 700 successful Chinese entrepreneurs and a control group of 200 employed Chinese citizens. The results are ambiguous: it is true that both groups do not differ significantly in their response behaviour regarding the performed incentive-compatible HLL. However, on the basis of the results of another lottery, Holm *et al.* (2010) found that entrepreneurs show a higher risk-aversion than the control group if a risk-free alternative in the form of a fix disbursement is available.

Brown and Dietrich (2011) work with panel data from the 'US Panel Study of Income Dynamics' and examine the correlation between the participants' risk attitude and their type of income (self-employed vs. employed participants). The authors come to the conclusion that the willingness to take financial risks is positively correlated with the probability to take up independent work. Barsky *et al.* (1997), who work with the data from the 'Health and Retirement Study', give proof that self-employed participants are more risk tolerant than the employees. Masclet *et al.* (2009) examine the correlation between the risk attitude and the type of income by means of an incentive-compatible HLL. They verify that self-employed persons are more likely to take risks than employees and students. An interesting aspect of the study is that the authors were not able to detect a significant difference between the risk behaviour of employees and students. Akay *et al.* (2012) compare the risk attitudes of Ethiopian small-scale farmers and a Western university student sample, using an incentive-compatible experiment. The results show that the risk-aversion of farmers is stronger than that of the student sample.

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Thus far, it has not been investigated whether the risk attitude determined for convenience groups is indicative for those of German farmers. That is why we will examine the following hypotheses:

H3 (German farmers vs. German students): The risk attitudes determined for German students are suitable for drawing conclusions on the risk attitude of German farmers.

H4 (German farmers vs. Kazakhstani farmers): The risk attitudes determined for Kazakhstani farmers are suitable for drawing conclusions on the risk attitude of German farmers.

Many studies focus on the question of whether the individual risk attitude differs randomly between individuals or whether there are significant influencing factors. Dohmen *et al.* (2011) use the data variety of the SOEP to test the influence of various socio-demographic factors on the individual risk attitude. Participants' age, gender and height are identified as the main influencing factors for the general risk attitude. The risk-aversion increases with increasing age. Moreover, women act in a more risk-averse manner than men, while taller people are more likely to take risks than smaller individuals. Also, the educational background of the parents as well as the individuals' level of education influences the risk attitude to a certain extent. Wik *et al.* (2004) discover that besides gender also the household size plays an important role. Furthermore, an important variable that needs to be tested is the economic condition of participants. Dohmen *et al.* (2011) conclude that participants with high-income levels may have a higher willingness to take risks because they can handle the impact of bad outcomes. Consequently, the fifth hypothesis is as follows:

H5 (socio-demographic variables influence the risk attitude): Socio-demographic variables, such as age or gender, have a significant influence on the risk attitude.

3. Design of the survey

We confront three sample groups with three different methods for measuring their risk attitude: after completing an incentive-compatible HLL, participants are asked to indicate their general willingness to take risks on an 11-point scale. Subsequently, participants are asked to agree with one of three business-related, contextualized statements. Finally, participants' socio-demographic data are collected. In the following, the three different methods for measuring the risk attitude are explained.

3.1. The Holt-and-Laury-lottery

In the HLL, participants are faced with ten decision situations (cf. Table 1) in which they are asked to decide for AA 1 or 2 each time. Both AA are

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Table 1 Disbursement matrix of the Holt-and-Laury-lottery*

Decision situation	Action alternative 1	Action alternative 2	Difference between the expected disbursements
1	With 10% gain of €200 With 90% gain of €160	With 10% gain of €385 With 90% gain of €10	€116.5
2	With 20% gain of €200 With 80% gain of €160	With 20% gain of €385 With 80% gain of €10	€83.0
…	…	…	…
9	With 90% gain of €200 With 10% gain of €160	With 90% gain of €385 With 10% gain of €10	€−151.5
10	With 100% gain of €200 With 0% gain of €160	With 100% gain of €385 With 0% gain of €10	€−185.0

Notes: Author's own figure according to Holt and Laury (2002). *Participants did not see the last column.

characterized by two disbursement amounts. As the possible disbursements in AA 1 (€200/€160) show a lower difference than those in AA 2 (€385/€10), AA 1 is more secure than AA 2. The probabilities of the higher and the lower disbursement are changed systematically from one to the next decision situation. Because of this experimental setting, the expected value of the disbursements for AA 1 and AA 2 varies from one decision situation to another. The HLL aims to identify the decision situation in which the participants switch from AA 1 to AA 2. In situation 5, a risk-neutral decision-maker would switch because he/she prefers the AA with the higher expected value. In other words, in the first four decision situations, he/she only selects the more secure AA 1 and has a HLL-value (number of safe choices) of 4 (Holt and Laury 2002, p. 1645). If a participant switches earlier (HLL-value < 4), he/she shows a risk-seeking behaviour. Whereas if a participant switches later (HLL-value > 4), he/she shows a risk-averse behaviour. According to Holt and Laury (2002), there is one adjustment made in the results of the HLL: the 11-point scale is reduced to a 9-point scale by combining the two expressions 'selected AA 1 never or once' and 'selected AA 1 nine or 10 times' in one expression.

In the HLL, financial incentives are set for 'hard thinking': before the experiment started, German farmers and students are informed that from each group, one of the 100 participants will be randomly selected and receive a disbursement of between €10 and €385 depending on his/her decision.[1] Because of the lower wage level in Kazakhstan, a Kazakhstani participant receives a disbursement of between €1 and €38.50 (converted from the Kazakhstani currency, 'tenge'). The situation relevant for disbursement is

[1] Financial incentives in experiments have been subject to controversial discussions. Camerer and Hogarth (1999) investigated that higher incentives often improve participants' performance during the experiment. Furthermore, they mentioned that it might be more motivating to pay one out of *N* participants if participants overweigh their chances of being selected. Therefore, we decided to pay higher incentives to a fraction of participants.

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determined by the first throw of a 10-sided dice. If here, for example, situation 4 was identified and the participant had selected AA 2 for this situation, he/she would have the chance to win €385 with a probability of 40 per cent and €10 with a probability of 60 per cent. A second throw of the 10-sided dice decided whether €385 or €10 would be realized. This method is clearly explained to all participants, and moreover, it is pointed out that each situation can be relevant. It is therefore recommendable to decide carefully between the AA.

3.2. Self-assessment

In addition, the self-assessment is frequently applied for measuring the individual risk attitude. As shown in Figure 1, we use an 11-point scale and the question wording from the SOEP (cf. Dohmen *et al.* 2011). The self-assessment and the HLL are both based on an 11-point scale. However, the interpretation of both methods is contrary: a HLL-value of 9 implies risk-aversion, while a self-assessment value of 9 implies a willingness to take risks. To counteract misinterpretations, we recoded the self-assessment scale for analysing and testing the hypotheses. Moreover, the results were reduced from an 11-point scale to a 9-point scale analogously to the HLL. Nonetheless, for the HLL a value of 4, and for self-assessment, a value of 5 indicates risk-neutrality.

3.3. Investigating the risk attitude by means of business-related, contextualized statements

Contextualized methods to measure an individual's risk attitude as well as to investigate patterns in decision-making processes have been applied, for example, in Weber *et al.* (2002), Fausti and Gillespie (2006) and Mann *et al.* (1997). Participants could select from the following business-related, contextualized statements:

How do you see yourself: Are you generally a risk-seeking person or do you try to avoid risks? *(Please tick the value on the scale, which best describes your willingness to take risks. On the scale 0 stands for 'not risk seeking at all' and 10 for 'very risk seeking'. Between these two values you can grade your self-assessed risk attitude.)*	☐ 0 (not risk seeking at all) ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 (very risk seeking)

Note: author's own figure according to Dohmen *et al.* (2011).

Figure 1 Elicitation of self-assessment.

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1 'I am willing to spend money on reducing the entrepreneurial risk of success because too high entrepreneurial risks cause me a lot of worry'.
2 'I am not willing to spend money on changing the entrepreneurial risk of success because I do not care about the risk'.
3 'I am willing to spend money on increasing the entrepreneurial risk of success because I like to take on entrepreneurial risks in general'.

Participants are supposed to determine the statement with which they are most likely to agree. In doing so, we are not able to differentiate the decision-makers with respect to the extent of the risk-aversion – as it is done in the HLL and self-assessment – but we can classify them as risk-averse, risk-neutral and risk-seeking. The formulation 'entrepreneurial risk of success', which is included in each of the three statements above, establishes a concrete contextual reference. If the participant agrees with statement (1), it can be concluded that he/she is risk-averse. An agreement with statement (2) implies risk-neutrality, while statement (3) stands for risk-seeking behaviour. Here, the scale is also adjusted in a way that a low value implies risk-seeking behaviour, and a high value stands for risk-aversion.

4. Descriptive statistics

Our survey about the quantification of the individual risk attitude was carried out online between the end of 2010 and the middle of 2011. One hundred and six German farmers, 105 German students and 100 Kazakhstani farmers participated in the survey. The German and Kazakhstani farmers were recruited through the alumni network of the Georg-August-University Goettingen and the S. Seikfullin Kazakh Agrotechnical University in Astana. In addition, participating farmers were asked to inform their colleagues about our survey. Because of the different development levels of the agricultural sectors of the two countries, it was not possible to recruit German and Kazakhstani farmers with completely similar characteristics. Hence, the groups of the participating farmers differed in the share of females and in the individuals' educational backgrounds. Nevertheless, all of them had adequate decision-making competencies. Moreover, 105 students of a German university of who 95 per cent studied agricultural sciences were made aware of and invited to participate in the survey. Apart from the chance to be selected for the cash bonus of the HLL, each participant received a previously announced expense allowance of €10 (or 2000 tenge in Kazakhstan) to increase participation. At the end of the survey, participants were asked to indicate their e-mail addresses to facilitate the coordination of the payment transaction of the expense allowance and the HLL cash bonus. The German farmers and students received the money by bank transfer or in cash. Kazakhstani farmers could choose from bank transfer or a credit on their mobile phone balance. Only two Kazakhstani farmers decided for bank transfer because they did not own a mobile phone.

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Two of the 106 German farmers did not indicate an answer for the business-related, contextualized statements. To carry out an intrapersonal comparison of the various methods to measure the risk attitude, these two participants are not further considered. One of the 105 German students did not participate in the HLL and was therefore removed from the data set. From the 100 Kazakhstani farmers, one participant was removed because he/she did not agree with any of the business-related, contextualized statements so that this group now consists of 99 participants. Table 2 displays the descriptive statistics of the participants. The average age of the German farmers is 30.2 years. At the time of data collection, the youngest participant was 19 years old, while the oldest was 60 years old. The average age of the students is 23.9 years lower than that of the German farmers. The average age of the Kazakhstani farmers is 37.4 years and, therefore, higher than that of their German colleagues; 38.5 per cent of the German farmers, 35.6 per cent of the German students (mainly Bachelor's degree) and 69.7 per cent of the Kazakhstani farmers hold a university degree. On average, the German and Kazakhstani farmers ranked their farm on the upper part of a 100-point scale ranging from 0 (lower performance) to 100 (higher performance) at 63.1 and 71.8 points, respectively.

Table 3 reveals a summary of the results of the different measuring methods of the individual risk attitude.

For all survey methods applied, German farmers appeared to be risk-neutral on average. For the HLL, however, more than 50 per cent were classified as risk-averse. In the self-assessment, 44 per cent of the German farmers described themselves as willing to take risks. This result is consistent with the results of previous studies: Shapiro *et al.* (1992) and Pennings and Garcia (2001) stated that, respectively, 39 per cent of the US-American farmers and 60 per cent of the Dutch farmers were risk-seeking. In our study, on average, students were risk-averse among all survey methods. In the HLL, the behaviour of Kazakhstani farmers is assessed to be risk-seeking, whereas they are classified as risk-neutral or risk-averse when using the two other methods. In contrast to the results of Holt and Laury (2002) (6–8 per cent of the participants showed risk-seeking behaviour), Kazakhstani and German

Table 2 Descriptive statistic of socio-demographic variables*

	German farmers with $n = 104$	German students with $n = 104$	Kazakhstani farmers with $n = 99$
Average age	30.2 (10.4)	23.9 (2.9)	37.4 (11.1)
Average number of household members	3.9 (1.5)	3.1 (1.5)	4.0 (2.0)
Percentage of female participants (%)	20.2	46.2	53.5
University degree (%)	38.5	35.6	69.7
Farm performance†	63.1 points (29.0)	—	71.8 points (22.7)

Notes: *Standard deviation is indicated in brackets. †Scale from 0 to 100 points.

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Table 3 Response behaviour of the participants regarding their risk attitude*

	German farmers with $n = 104$	German students with $n = 104$	Kazakhstani farmers with $n = 99$
HLL (1–3 = risk-seeking, 4 = risk-neutral, 5–9 = risk-averse)			
Mean	4.4 (2.4)	5.8 (1.8)	3.3 (3.1)
Percentage of risk-seeking participants (%)	37.5	10.6	68.7
Percentage of risk-neutral participants (%)	11.5	22.1	2.0
Percentage of risk-averse participants (%)	51.0	67.3	29.3
Self-assessment (1–4 = risk-seeking, 5 = risk-neutral, 6–9 = risk-averse)			
Mean	4.9 (2.1)	5.7 (1.8)	5.3 (2.3)
Percentage of risk-seeking participants (%)	44.2	27.9	30.3
Percentage of risk-neutral participants (%)	16.3	15.4	28.3
Percentage of risk-averse participants (%)	39.4	56.7	41.4
Contextualized statements (1 = risk-seeking, 2 = risk-neutral, 3 = risk-averse)			
Mean	2.1 (0.9)	2.7 (0.7)	2.1 (0.8)
Percentage of risk-seeking participants (%)	35.6	11.5	24.2
Percentage of risk-neutral participants (%)	20.2	10.6	37.4
Percentage of risk-averse participants (%)	44.2	77.9	38.4

Notes: *Standard deviation is indicated in brackets. HLL, Holt-and-Laury-lottery.

farmers indicate a much higher proportion of risk-seeking behaviour. The results of the German students, however, are consistent with those of Holt and Laury (2002), who also carried out the experiment with students. In the literature, a distinction is made between the attitude towards perceived risk and risk perception, that is, the characteristic that differentiates entrepreneurs from others is not a greater preference for risk but an optimistic perception of the risks involved (cf. Weber *et al*. 2002). Entrepreneurs feel confident that they can control and manage a risky decision; hence, the perception of the riskiness is reduced; that is, a risk-seeking decision is driven by the perception that risk is manageable and, thus, involves a low level of risk. Furthermore, Holt and Laury (2002) reported that incentive-compatible lotteries result in subjects revealing a higher level of risk-aversion than hypothetical lotteries.

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In contrast, Kazakhstani farmers are more risk-averse using psychometric elicitation procedures than using the incentive-compatible HLL. A possible explanation is that Kazakhstani farmers understand the HLL differently than German farmers and students owing to their different cultural background. This might indicate that the mean of 3.3 for Kazakhstani farmers using the HLL is not as reliable as the one for the other groups. For the analysis of the individual response consistency across elicitation methods, we summarize the different extents of risk-seeking and risk-averse behaviour of the HLL and the self-assessment questionnaire. In doing so, we obtain three categories (risk-seeking, risk-neutral and risk-averse behaviour) that are consistent with those of the business-related, contextualized statements.

Table 4 indicates the absolute and relative consistency for the merged data set and for all three groups separately. For the merged data set, participants respond consistently in around 50 per cent of the cases. It is conspicuous that the German students respond relatively consistently over all elicitation methods compared to the other groups. Kazakhstani farmers indicate the lowest response consistency in the HLL compared with the self-assessment as well as with the statement. The consistency between self-assessment and statement is above 50 per cent in all groups.

5. Validity test of hypotheses

For the verification of H1 'HLL vs. self-assessment' and H2 'HLL vs. statement', the three data sets of the 104 German farmers, the 104 German students and the 99 Kazakhstani farmers are analysed separately. Due to the fact that all participants are confronted with three different measuring methods, it is possible to make an intrapersonal comparison (within-subject design). For verifying H3 'German farmers vs. German students' and of H4 'German farmers vs. Kazakhstani farmers', the data sets of the German farmers and students and of the Kazakhstani farmers are analysed comparatively (interpersonal comparison or between-subjects design). To verify H5 'socio-demographic variables influence the risk attitude', all data sets of the three groups of participants are pooled.

Table 4 Individual response consistency across the risk-attitude-measuring elicitation methods*

	All with $n = 307$	German farmers with $n = 104$	German students with $n = 104$	Kazakhstani farmers with $n = 99$
HLL and self-assessment	48% (147)	52% (54)	51% (53)	40% (40)
HLL and statement	47% (143)	44% (46)	67% (70)	27% (27)
Self-assessment and statement	56% (171)	51% (53)	64% (67)	52% (51)

Notes: *Cases of consistent decisions are indicated in brackets. HLL, Holt-and-Laury-lottery.

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5.1. Test H1 'HLL vs. self-assessment' and H2 'HLL vs. statement'

To test whether there is a relationship between the response behaviour in the HLL, the self-assessment and the business-related, contextualized statement, we conduct a chi-square test. The results of the chi-square test are indicated in Table 5. For the German farmers, a statistically significant relationship between HLL and self-assessment is observable (P-value = 0.043). The same holds for the German students (P-value = 0.059). For the Kazakhstani farmers, no statistically significant relationship between both elicitation methods is observable (P-value = 0.320). Thus, H1 is confirmed for the German farmers and students, whereas it is rejected for the Kazakhstani farmers. Between HLL and business-related, contextualized statements, a statistically significant relationship can be observed for the German students (P-value = 0.005), whereas there is no statistically significant relationship evident for farmers. Thus, H2 is confirmed for the German students, while it is rejected for the German and Kazakhstani farmers. All in all, results suggest that the response behaviour in the incentive-compatible HLL can be approximated to the two other measuring methods only to a limited extent. Especially the results of the Kazakhstani farmers differ considerably depending on the method applied. It is interesting to note that the distribution between the risk attitude measured by self-assessment and those determined by business-related, contextualized statements indicate a high, statistically significant relationship for all three groups of participants.

5.2. Test H3 'German farmers vs. German students' and H4 'German farmers vs. Kazakhstani farmers'

When looking at Table 3 and comparing the response behaviour between the German famers and the German students, it is apparent that, in all three measuring methods, the behaviour of the students is more risk-averse than that of the German farmers. To test whether the difference in the response behaviour of German students and German farmers is significant, it is verified whether the distributions of the risk attitudes of both groups vary. As the prerequisite of the chi-square test that the expected frequency is lower than 5 in less than 20 per cent of the cells is not fulfilled, we use the Kolmogorov–Smirnov test to compare the distributions (Mitchell 1971). The results in

Table 5 P-values of the chi-square tests across elicitation methods

	German farmers with $n = 104$	German students with $n = 104$	Kazakhstani farmers with $n = 99$
HLL and self-assessment	0.043**	0.059*	0.320
HLL and statement	0.278	0.005**	0.320
Self-assessment and statement	0.009***	<0.001***	<0.001***

Notes: Means *P-value < 0.10 (**P-value < 0.05, ***P-value < 0.01). HLL, Holt-and-Laury-lottery.

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Table 6 indicate that the distributions of the groups 'German farmers' and 'German students' differ significantly for all three measuring methods. Thus, H3 is rejected. It, therefore, is not possible to make any conclusion about the risk attitudes of the German farmers from those of the German students. Hence, when estimating, for example, farmers' willingness to participate in agri-environmental schemes, which has an effect on the income risk, on the basis of the risk attitude distribution of students, inapplicable results can be expected. For all different risk-attitude-measuring methods except for the HLL, the response behaviour of the Kazakhstani and German farmers is similar (see Table 3). The Kolmogorov–Smirnov test shows that the distributions of both groups in the HLL are significantly different (P-value < 0.001). For the remaining two elicitation methods, the equality of the distributions cannot be rejected ($P > 0.100$). With regard to the HLL, H4 is consequently rejected. For the other two measuring methods, H4 is confirmed.[2]

5.3. Test H5 'socio-demographic variables influence the risk attitude'

Table 7 depicts the results of three ordered probit regressions. In the first model, the HLL-value, in the second model, the value selected in the self-assessment method and in the third model, the response behaviour regarding the business-related, contextualized statements is the dependent variable. A higher HLL-, self-assessment- and business-related-contextualized-statement-value is followed by risk-averse behaviour. In each model, the explanatory variables are a student-dummy, a country-dummy, age, the number of household members, gender and whether or not a participant has a university degree.

In the model of the response behaviour of the HLL, the student-dummy, the country-dummy and the gender influence are significant. For the HLL, the students show a more significant risk-averse behaviour than the (German and Kazakhstani) farmers, while the Kazakhstani participants significantly show a more risk-seeking behaviour than the German participants (farmers and students). Female participants show a more significant risk-averse behaviour than male participants. Older participants do not act in a more risk-averse manner than younger participants, and a university degree is not imperatively accompanied by a more risk-seeking behaviour. If the risk attitudes determined by the other measuring methods are used as dependent variables, the student-dummy and the gender are systematically significant. Apart from the age, which is only significant in the self-assessment, the

[2] Despite the results of the hypothesis tests, researchers should be careful to draw conclusions from the risk attitude of convenience groups because the survey conducted is not representative. When assuming that Kazakhstani farmers are wealthier and German farmers are less wealthy than the average farmer in the specific country, Kazakhstani farmers might consider the returns in the HLL as 'play money' resulting in a greater risk-seeking behavior, while German farmers would show a more risk-averse behavior (cf. Dohmen *et al*. 2011).

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Table 6 *P*-values of the Kolmogorov–Smirnov tests across the participation groups

	HLL-values	Self-assessment	Business-related, contextualized statements
German farmers vs. German students	<0.001***	0.089*	<0.001***
German farmers vs. Kazakhstani farmers	<0.001***	0.279	0.532

Notes: Means *P-value < 0.10 (**P-value < 0.05, ***P-value < 0.01). HLL, Holt-and-Laury-lottery.

Table 7 Results of the ordered probit regression of all three models (n = 307)[a]

Dependent variable	HLL-value	Self-assessment-value	Business-related-contextualized-statement-value
Students (0 = no, 1 = yes)	0.372 (0.017)**	0.321 (0.037)**	0.852 (<0.001)***
Kazakhstani nationality (0 = no, 1 = yes)	−0.648 (< 0.001)***	−0.055 (0.734)	−0.162 (0.391)
Age in years	−0.004 (0.538)	0.013 (0.045)**	0.007 (0.359)
Number of household members	−0.058 (0.109)	−0.020 (0.568)	−0.036 (0.387)
Female gender (0 = no, 1 = yes)	0.423 (0.001)***	0.468 (<0.001)***	0.411 (0.007)***
University degree (0 = no, 1 = yes)	0.195 (0.127)	−0.141 (0.565)	0.084 (0.569)
Chi-square	56.965 (<0.001)***	25.339 (<0.001)***	43.558 (<0.001)***
Correct predictions (%)	29.4	21.9	54.2

Notes: [a]*P*-values are indicated in brackets. Means **P*-value < 0.10 (***P*-value < 0.05, ****P*-value < 0.01). HLL, Holt-and-Laury-lottery.

direction in which the variables influence the individual risk attitude remains steady for all measuring methods.

To test the influence of the economic condition on the response behaviour, we run a further ordered probit model with the additional independent variable 'farm performance'. Because the students could not answer the question regarding farm performance, this model is based on the farmer's data set. The results reveal that farm performance has no significant influence on the willingness to take risk in all three elicitation methods.

6. Conclusions and future research

The individual risk attitude influences the decisions of entrepreneurs. Hence, the knowledge about the risk attitude of decision-makers is essential for an adequate single-farm decision support as well as for an appropriate policy impact assessment. The present study assesses the risk attitude of German farmers, German students and Kazakhstani farmers in three different ways. We carried out an intrapersonal method comparison for the three sample groups to examine whether the risk attitude determined by self-assessment or

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by agreeing and disagreeing with business-related, contextualized statements allows conclusions about the decision-making behaviour in incentive-compatible Holt-and-Laury-lotteries (HLL). Moreover, the determined risk attitude of German farmers is compared interpersonally with those of German students and Kazakhstani farmers. This is to investigate whether it is possible to make conclusions about the risk attitudes of German farmers from the risk attitude of convenience groups.

Results can be summarized as follows: (i) The risk preferences which were quantified using an incentive-compatible HLL and a self-assessment questionnaire indicate a statistically significant relationship for the German students and farmers. A statistically significant relationship between the risk preferences estimated with the HLL and the business-related, contextualized statements is only observable for the German students. (ii) Students are not a suitable convenience group for making conclusions about the risk attitude of German farmers. This applies independently from the selected measuring method. (iii) The response behaviour in the self-assessment and regarding the business-related, contextualized statements does not vary significantly between German and Kazakhstani farmers. For the HLL, however, a significantly different risk attitude arises. The response behaviour in the self-assessment and regarding the business-related, contextualized statements, therefore, does not vary significantly among the members of one occupational group from different countries (German farmers vs. Kazakhstani farmers). In contrast, the same response behaviour varies significantly among the members of two different occupational groups from one country (German farmers vs. German students). (iv) The socio-demographic factors, student-dummy and gender, were found to influence the participants' risk attitude independently from the measuring method. Students are more risk-averse than farmers, and according to the investigation of Wik *et al*. (2004) and Dohmen *et al*. (2011), women are more risk-averse than men. In contrast to the results of Dohmen *et al*. (2011, p. 528), older participants do not act in a more risk-averse manner than younger participants in the HLL. The results of the comparison of the risk attitude of farmers and students are in line with the results of Masclet *et al*. (2009) who indicate that self-employed participants tend to be significantly less risk-averse than students. Contrary to our results, Akay *et al*. (2012) find that Ethiopian small-scale farmers are more risk-averse than the participants of a sample of students from a Western university. The fact that the risk preferences estimated with the incentive-compatible HLL are more consistent with those of the self-assessment questionnaire is in line with the conclusions of Fausti and Gillespie (2006). They conclude that if survey resources are scarce, the best mechanism for the elicitation of risk preferences is the simplest. In our study, the HLL has an incentive-compatible design and the self-assessment questionnaire is easier to understand than the business-related, contextualized statements. In accordance with Fausti and Gillespie (2006), it is not surprising that the results of the HLL are more consistent with those of the self-assessment questionnaire

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than the results of the HLL with the business-related, contextualized statements. Dohmen *et al*. (2011) also find a significant correlation between the experiment and the self-assessment and conclude that a general risk measure can predict real-stakes lottery choices in a field experiment. Their results are based on a larger sample size than those of the present study with a representative survey of 22,000 and a complementary experiment with 450 participants. Nevertheless, our between-groups and within-groups comparisons weakened the latter finding of Dohmen *et al*. (2011) that general risk measures can be used to predict real-stakes lottery choices in a field experiment for every sample group.

An extension of the present study regarding the sample size by including more sample groups and using other measuring methods might further verify the validity of our results. In addition, it might be interesting to examine whether the different effects of the amount of disbursement on the risk attitude of students (stake-size effect), which were found by Holt and Laury (2002), vary among different sample groups. As our investigation suggests that differences in the risk attitude rather result from the participants' affiliation to different occupational groups than from their different nationalities, it might be conceivable that other occupational groups react differently to varying amounts of disbursement than students.

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