Bounded rationality and the adoption of weather index insurance

Evidence from an extra-laboratory experiment with farmers in Germany

Received 10 February 2017
Revised 27 May 2017
27 July 2017
Accepted 21 August 2017

Oliver Mußhoff
Department for Agricultural Economics and Rural Development, University of Göttingen, Göttingen, Germany
Norbert Hirschauer and Sven Grüner
Institute of Agricultural and Nutrition Sciences, Martin Luther University Halle-Wittenberg, Halle, Germany, and
Stefan Pielsticker
Department for Agricultural Economics and Rural Development, University of Göttingen, Göttingen, Germany

Abstract

Purpose – The purpose of this paper is to check which role-bounded rationality might play as an explanation for farmers' missing willingness to adopt weather index insurance (WII). WII is an innovative risk management instrument that causes low administration and regulation costs. Moreover, index insurance is plagued neither by moral hazard nor by adverse selection. Nonetheless, WII has been little used to date in agriculture.

Design/methodology/approach – An extra-laboratory experiment in the form of a multi-period, single-person business simulation game is conducted with farmers as experimental subjects to investigate the reasons for the low willingness to adopt WII.

Findings – First, the demand for WII decreases as the premium loading increases. Second, a transparent communication of the loading reduces demand, indicating that farmers refrain from transactions if they feel that the other party earns (too) much money. Third, communicating to farmers that the index insurance has been subsidized raises demand even though insurance costs in terms of loading are kept constant. This can be taken as an indication that farmers interpret subsidies as a signal for profitable action.

Originality/value – Using an experimental approach and going beyond observational research, this study investigates the prominent question of farmers' risk management and innovation adoption behavior, and, in particular, the behavioral effect of subsidies. Using a randomized controlled trial, the real behavior of real subjects with real incentives is studied under controlled experimental conditions. Compared to prior studies, the external validity of the experiment is improved by recruiting farmers instead of a convenience group of students.

Keywords Bounded rationality, Business simulation games, Extra-laboratory experiment, Subsidization, Weather index insurance

Paper type Research paper

1. Introduction

It has been frequently noted that insurance for adverse weather events with a high probability of occurrence is not very widespread in the agricultural sector. Goodwin and Smith (2013), for instance, point out that the demand for farm-level yield insurance in the USA had been low before considerable subsidization was introduced. This is easy to understand from an economic perspective. Yield insurance (multi-peril crop insurance) causes high costs for the insurance provider who passes them on to the insurance holder

Agricultural Finance Review
Vol. 78 No. 1, 2018
pp. 116-134

0002-1466
DOI 10.1108/AFR-02-2017-0008

through the loading (Antón *et al.*, 2013). Several features of farm-level yield insurance are responsible for their high costs: first, administration and regulation costs are high as, compared to conventional insurance against extreme weather events such as hail, insured events occur frequently. Second, regulation costs are further increased by the fact that the extent of damage is often controversial. Third, farm-level yield insurance is plagued by moral hazard and adverse selection problems.

Weather index insurance (WII) has been discussed as a innovative management instrument for weather-related volumetric risks since the end of the 1990s (Richards *et al.*, 2004; Berg and Schmitz, 2008; Mußhoff *et al.*, 2008; Norton *et al.*, 2013). In contrast to farm-level damage insurance, risk is hedged by payments that are contingent on a contractually specified weather index (e.g. precipitation sums, temperature sums, etc.) that are objectively measured at a reference weather station. Thus, WII has the advantage of low regulation costs and little to none moral hazard and adverse selection problems[1]. Assuming an efficient market, the buyers of WII should benefit from this cost advantage. Nevertheless, the market for WII in the agricultural sector remains rather small (Glauber, 2004; Bielza *et al.*, 2007; Xu *et al.*, 2008; Smith and Watts, 2009; Mahul and Stutley, 2010; Kapphan, 2012).

There are two fundamentally different explanatory approaches for the low adoption[2] of WII: First, the risk-reducing effect of WII is possibly so low that farmers, given their respective risk attitudes, are not prepared to bear the costs of insurance. In other words, WII does not increase the expected utility of rational and risk averse farmers. Several studies (Stoppa and Hess, 2003; Vedenov and Barnett, 2004; Mußhoff *et al.*, 2011) show that the basis risk of WII can indeed be very high. A "geographic basis risk" is caused by the fact that the reference weather station is usually not situated at the place of production. Therefore, the weather at the weather station can differ from the weather on the farm. In addition, a "basis risk of production" arises from the fact that the economic success of farming is never exclusively determined by the weather variable used as an index but depends on a wide variety of other factors (Woodard and Garcia, 2008; World Bank, 2011).

A second explanation for the low adoption of weather insurance could be that farmers, due to bounded rationality (Simon, 1957), do not fully understand the relative competitiveness of this novel instrument. Bounded rationality means that individuals make suboptimal decisions due to lacking information and/or cognitive constraints. Farmers may ignore the fact, for instance, that insurance premiums include not only the costs of insurance (loading) but also the fair premium (= expectation value of the indemnity payment). If the fair premium is very low – as in the case of conventional insurance for rarely occurring damage events – equating the insurance premium with the costs of insurance is only a minor mistake. This does not apply to WII, however. Being familiar with conventional insurance, farmers may nonetheless continue to interpret the complete insurance premium as the costs of insurance (Xu *et al.*, 2008). Being used to beneficial subsidies for many decades, farmers may furthermore take subsidization as a signal indicating profitable courses of action without carrying out explicit cost benefit assessments. In other words, they may use the simple heuristic that it is beneficial to perform actions which are subsidized by the government.

With this in mind, the present study focuses on the question of whether bounded rationality may explain farmers' missing willingness to adopt this type of insurance. While comparing the behavior of experimental subjects with a rational choice benchmark would be adequate to assess the extent of bounded rationality, our research interest is both more specific and more moderate: we specifically aim to understand how costs, cost transparency, and a subsidization framing affect farmers' choice to purchase WII or not. For this purpose, we conducted an extra-laboratory experiment (Charness *et al.*, 2013) in the form of an internet-based, multi-period, single-person business simulation game with farmers. In a closely related business simulation game, Musshoff *et al.* (2014) recruited students to analyze the demand for WII in an experimental setting. The present study builds on and goes beyond this preliminary study from which it differs in two significant ways: first, the present study uses a panel data model to better exploit the informational content of the data provided by the choices of the experimental subjects in consecutive production periods. Second, and even more important, we recruit farmers (i.e. representatives of the social group of interest) as subjects instead of students in order to increase the external validity of our findings.

In the experiment, the participating farmers run a virtual arable farm and have to decide about the use of WII. While the costs of the insurance are kept constant throughout the game, we use different framings to inform the experimental subjects about these costs. The experiment is supposed to answer three central questions: first, does the demand for WII change ceteris paribus with an increasing loading? Second, does demand change if farmers are explicitly informed about the loading? Third, does demand change if the participating farmers are notified that the insurance had been subsidized? To our knowledge, no studies have been carried out to date that investigate how a transparent communication of the loading of WII (net insurance costs) affects the demand of farmers for WII. No studies investigating the question of whether farmers take the subsidization of insurance as a signal indicating "good insurance" are available either.

The remainder of this paper is organized as follows: In Section 2, we develop the research hypotheses. In Section 3, the experimental design and the framing variants are explained. Subsequently, the socio-demographic and socio-economic characteristics of the experimental subjects are described (Section 4), and the hypotheses are examined (Section 5). The paper ends with conclusions and suggestions for future research (Section 6).

2. Generation of hypotheses

Mainstream economics rests on the rational-choice approach to analyze and predict the behavior of economic actors. According to the rationality assumption, the price for goods and services, such as insurance, affects demand. This leads to the following hypothesis that is not only a statement of the law of demand (Gollier, 2003) but also serves as a check whether the subjects understood the game:

H1. With an increasing loading, the demand for WII decreases ceteris paribus.

The influence of the presentation of information (framing) on individual behavior has been studied in previous papers (e.g. Tversky and Kahneman, 1986). In a survey, Xu *et al.* (2008) found that farmers' mean willingness to pay for weather index drought insurance and multi-risk insurance is considerably lower than the fair premium. They speculate that farmers might have equated the total premium with the loading. Explicitly communicating the fair premium and the loading might help to solve this problem. However, the explicit communication of the loading that accrues to the insurance company may also have a negative impact on demand. This will be the case if farmers feel that they are treated unfairly after knowing what the insurance provider "earns." Such feelings can be associated with people being averse to inequity (Kahneman *et al.*, 1986; Fehr and Schmidt, 1999; Charness and Rabin, 2002; Tricomi *et al.*, 2010). In our case this means that farmers refrain from buying the insurance – even if it were beneficial to them – if they have the feeling that the other party earns (too much) money. Against this background, we tackle the following hypothesis:

H2. The transparent communication of the loading influences the demand for WII compared to only communicating the total premium.

The communication of the loading increases (decreases) the volume of demand if the demand-reducing effect of a feeling of being treated unfairly or aversion to inequity is lower (higher) than the demand-increasing effect caused by learning that insurance costs are only a fraction of the insurance premium. If both effects are either zero or identical, no effect will be observed.

Boundedly rational actors, having limited information and/or limited information processing capacities, often rely on simple heuristics for decision making (Plous, 1993; Gigerenzer and Gaissmaier, 2011). Agricultural subsidies, for instance, playing an important role for the profitability of farm businesses (Kumbhakar and Lien, 2010), may be interpreted by farmers as a signal that indicates profitable actions and substitutes an explicit analysis of their economic competitiveness. In other decision-making contexts, indications for similar heuristics have been found (Nash, 2006). The perception that subsidized actions make *per se* sense represents a bounded rational heuristic. Thus, we will examine the following hypothesis:

H3. Communicating that WII is subsidized increases demand even if insurance costs are kept constant.

3. Experimental design

We carried out an internet-based experiment consisting of two parts: an incentivized business simulation game and an incentivized procedure described by Holt and Laury (2002) to elicit the risk attitude of the experimental subjects (cf. the appendix for more detailed information about the experimental instructions). Complementing the experimental data, we additionally collected socio-demographic and farm-specific data of the subjects.

3.1 Design of the business simulation game

3.1.1 Basic design. In the business simulation game, each experimental subject runs a virtual crop farm with an acreage of 200 ha for eight production periods in a marginal and drought-threatened area. Arable land is the only scarce production factor. In each period, two choices are to be made:

(1) Arable land must be allocated for the production of Winter wheat, Winter canola, Winter rye, and silage maize.

(2) A decision must be made regarding the number of WII contracts that are to be purchased.

At the beginning of the game, each experimental subject has an initial capital of €200,000. To cover the assumed costs of living, obligatory €40,000 are extracted from the virtual business at the beginning of each period. The interest rate of an eventual bank deposit is 0 percent. Liquidity is not endangered at any time as an interest-free credit is automatically provided if a player is not able to comply with payment obligations. A repayment of borrowed capital is automatically effected as soon as liquidity exceeds the obligatory extraction of €40,000 at the end of a period.

All farmland has to be cultivated and a minimum share of 5 percent and a maximum share of 70 percent of arable land must be allocated to each of the four crops. Acreage-based subsidies of 300 €/ha and crop-specific variable costs (cf. Table I) are pre-defined and deterministic parameters for all players. The price of each crop, in contrast, is a function of its price in the previous period and a volatile price index. Starting from a value of 1, the price index follows a binomial geometric Brownian motion without drift and with a standard deviation of 8 percent per period. Starting from the price of the previous period, each crop's price can take on only two values: it either rises to a 1.08 multiple or falls to a 1/1.08 multiple. Both developments occur with a probability of 50 percent (see the modeling of Brownian motion by Jarrow and Rudd, 1983: Chapter 13). Using one price index for all four crops implies a perfect correlation between all prices. While the prices at the beginning of the first period are predetermined and identical for all players (cf. Table I), the price developments in subsequent periods differ between players as different random realizations of the geometric Brownian motion occur. Storage facilities are not available in the game and the complete production is automatically sold at the end of each period.

The yield of each crop is a deterministic function of precipitation between April and June (cf. Table I). Precipitation is volatile and shows the following discrete uniform distribution $P(60\text{ mm}) = P(160\text{ mm}) = P(260\text{ mm}) = 33.33$ percent. Modeling all crop yields as a deterministic function of the same uncertain precipitation implies a perfect correlation between crop yields.

The experimental subjects can buy WII contracts that are based on the precipitation between April and June. As yield is modeled as a deterministic function of precipitation, and as the reference weather station is assumed to be located on each player's farm, there is neither a basis risk of production nor a geographical basis risk regarding yield. The contract is construed as a put option and guarantees a payment of €3 for each millimeter by which precipitation falls short of the long-term mean of 160 mm. With a probability of 33.33 percent, it results in a payment of €300, and with a probability of 66.67 percent in a payment of €0. The fair premium thus amounts to €100.

After having described the business simulation game to the experimental subjects, we use control questions to ensure that they have understood their task. Subsequently, the business simulation game starts. The decisions regarding the production program and the number of insurance contracts are to be made at the beginning of each period. At the beginning of the next period, the subjects are informed about the prices and weather developments as well as the profit earned and the resulting bank balance in the previous period. We technically ensured that the experimental subjects cannot break the rules of the game (e.g. crop rotation restrictions).

3.1.2 Framing variants for the price of WII. One half of the subjects can purchase a WII with a loading of 10 percent. For the other half, the loading is 40 percent. In both groups, sub-groups are formed for which the price of the insurance is framed differently. The following wordings are used to describe the WII in the respective framings (the formulation refers to a variant with a loading of 40 percent):

> Framing 1 (Communication of total premium): You can hedge your farming risk by purchasing a weather index insurance. A weather station is located in your direct neighborhood. For buying the insurance, you have to spend €140. Insurance payments of €3 are effected per mm precipitation shortfall compared to the benchmark (long-term mean) of 160 mm measured from April to June.
>
> Framing 2 (Communication of loading): […] [as in framing variant 1]. In addition, you know that you can expect, on average, insurance payments of €100 per contract and year (= fair premium). The costs of the risk management instrument "weather index insurance" thus amount to €40 (i.e. 40% of the fair premium).

Table I. Assumptions regarding the production activities

Crop	Yield (dt/ha) for … 60 mm $P = 33.33\%$	160 mm $P = 33.33\%$	260 mm $P = 33.33\%$	Product price (€/dt) at the beginning of the first period	Variable costs (€/ha)
Winter wheat	50	65	80	21.00	850
Winter canola	25	30	35	40.00	850
Winter rye	55	60	65	20.00	700
Silage maize	300	330	360	3.30	750

Note: Participating farmers can be expected to be familiar with the yield levels that reflect overall conditions in Germany
Source: Bundesministerium für Ernährung und Landwirtschaft (BMEL) (2017)

Framing 3 (Communication of a cost-neutral subsidy): […] [as in framing variant 2]. The insurance representative informs you that each insurance contract is subsidized with €40. Without this subsidy, the total premium would be €180.

To facilitate easy comparability between the six groups (10 and 40 percent loading in three framing variants, respectively), we formed sextets of experimental subjects: In each of the six groups, one experimental subject faces the same price and weather development as the other five members of the sextet in the other five groups.

3.1.3 Monetary incentives. Monetary incentives are supposed to motivate experimental subjects to "make an effort" in order to generate a decision-making behavior that is as close to reality as possible and, therefore, increases external validity (Camerer and Hogarth, 1999; Duersch *et al.*, 2009). To enhance motivation, we provided the information at the beginning of the game that a random selection of 20 percent of players will win a performance-dependent premium. From the random winners, the player with the highest second-lowest profit in a period receives €200. The other random winners receive a proportion of €200 corresponding to their second lowest profit in a period.

3.2 Design and monetary incentives of the Holt and Laury procedure

After the business simulation game, we elicited the individual risk attitude of the experimental subjects. Following the Holt and Laury-procedure (HL-procedure; Holt and Laury, 2002), the subjects had to decide between a "safer" lottery A and a "less safe" lottery B in different lottery doublets. They could always win €200 or €160 in lottery A, and €385 or €10 in lottery B. However, by systematically varying the probabilities ten different lottery doublets were generated. The expected payoff increased from one lottery doublet to the next. From doublet 1 to 4, the expected payoff of lottery A was higher than that of lottery B. From doublet 5 onwards, the expected payoff of lottery B was higher. Based on the observation of up to which lottery doublet subjects chose the "safer" lottery A, the so-called "number of safe choices" can be determined. They can range from 1 to 10: values from 1 to 3 reflect a decreasing risk-seeking attitude, a value of 4 stands for risk-neutrality, and values above 4 reflect an increasing risk aversion.

Experimental subjects are informed that one out of ten wins a prize money in the HL-procedure, the amount of which is determined by two casts with a ten-sided dice. The first cast determines which of the ten lottery doublets is used, while the second cast determines the prize money for the lottery chosen by the farmer.

4. Descriptive statistics

We recruited representatives of the social group of interest (farmers) through social networks, personal contact, and the distribution of over 500 postcards. A sample of 114 German farmers, facilitating the formation of 19 sextets, participated. In the sample, 51 persons were farm managers and 53 farm successors. Five experimental subjects had an administrative position and five did not provide information regarding their professional position. The socio-demographic and socio-economic characteristics of the subjects and their farms are depicted in Table II.

All experimental subjects are male[3] and, on average, about 35-years old. The youngest subject is 18 and the oldest 84 years old. On average, the farmers have approximately 14 years of education and training. With an average number of safe choice of 4.7, the subjects can be classified as slightly risk averse.

The average farm size is 290 ha (median: 106 ha), with acreage ranging from 6 to 7,500 ha. The average soil quality is 51 soil points (according to the German soil quality scale ranging from zero to 100 points). Average annual precipitation is 686 mm. More than 95 percent ($n = 109$) of the farms are engaged in crop farming.

Table II.
Descriptive statistics of the experimental subjects

	Min.	Max.	Mean	Median	SD
Share of male participants (%)	–	–	100	100	–
Age (years)	18	84	34.7	29	13.0
Years of education[a]	8	18	13.9	13	3.0
Risk attitude (number of safe choices)	0	10	4.7	5	2.8
Arable land (ha)	6	7,500	289.7	106	807.9
Soil quality (on a scale from 0 to 100)	20	90	50.8	47	19.1
Annual precipitation (mm)	150	1,200	686.0	665	151.7
Time needed for the business simulation game (minutes)	2.5	184.6	14.2	10.8	17.7
Fun to participate[b]	0	3	2.1	2	0.7

Notes: $n = 114$. [a]Measured according to the Organisation for Economic Co-operation and Development approach (1999); [b]measured on a scale ranging from 0 (= disagree completely) to 3 (= agree completely)

Experimental subjects needed approximately 14 minutes to complete the business simulation game. Using a four-level scale from 1 (agree completely) to 4 (disagree completely), we measured if the subjects enjoyed the game. The mean of 2.1 indicates that the farmers, on average, enjoyed participating in the experiment. To generate comparable groups, the subjects were randomly assigned to one of the framing variants (randomization; Fisher, 1935). The H-test according to Kruskal and Wallis reveals that no statistically significant difference exists between the subjects in the six groups with regard to the characteristics listed in Table II.

Table III provides an overview of the individual average demand volume (number of contracts) over all periods.

Each experimental subject made program decisions over eight periods regarding the acreage used for each crop and the purchase volume of WII contracts. We thus have a total of 912 observations for the number of purchased insurance contracts. Experimental subjects in group 1a (10 percent loading + communication of total premium) purchased, on average, most contracts per period (70.6). Experimental subjects in group 2a who faced a higher loading of 40 percent concluded considerably less contracts (27.8). The demand effect caused by the communication of the loading (net contract costs) and the subsidization are ambiguous at first view.

5. Estimation model and results

5.1 Estimation model

The dependent variable Y (number of contracts purchased per period and experimental subject) only takes on non-negative integer values ($Y \in \{0, 1, 2, 3, \ldots, n\}$). In other words, we are facing count data[4] for which a normal distribution cannot be assumed. This implies that we cannot use the ordinary least squares (OLS) estimator (Wooldridge, 2002) for several reasons:

(1) OLS regressions are based on the restrictive assumption that the average error term is zero ($E(u) = 0$) and that no systematic link exists between the dependent variable and the error term ($E(u|X) = 0$).

Table III.
Weather index insurance contracts purchased per period and experimental subject

Six groups ($n = 19$, respectively)	Mean	SD
1a: 10% loading + communication of total premium	70.6	79.5
1b: 10% loading + communication of loading	33.0	94.1
1c: 10% loading + communication of loading+ cost-neutral subsidization of loading	55.2	79.5
2a: 40% loading + communication of total premium	27.8	43.9
2b: 40% loading + communication of loading	33.9	44.3
2c: 40% loading + communication of loading+ cost-neutral subsidization of loading	30.5	69.6
Total ($n = 114$)	41.8	72.5

(2) Count data are positive ($Y \geqslant 0$). While negative estimates for Y are nonsensical, they could occur when drawing on the correlation found in an OLS regression (Wooldridge, 2002).

For non-negative variables, the homoscedasticity assumption often is not met (Winkelmann and Boes, 2009). If the homoscedasticity requirement is disregarded, the hypothesis tests (*t*-test, *F*-test) lose validity.

We use count data models to account for the dependent variable taking on non-negative integer values. In addition, we observe experimental subjects to purchase zero contracts in 34.76 percent of all decision situations – another argument in favor of count models instead of linear models estimated by OLS (Wooldridge, 2002). In our sample, we moreover found a statistically significant overdispersion: The variance of the number of contracts is 125 times higher than the mean. We resort to negative binomial regression with corrected standard errors (Agresti, 1996; Hilbe, 2011) to account for the strong deviation from equidispersion. We furthermore face panel data since experimental subjects made decisions over several periods. The count data structure in conjunction with the panel data structure requires the application of a non-linear panel model (Wooldridge, 2002; Cameron and Trivedi, 2013). To be precise, we use a negative binomial random effects panel model for the following reason: a likelihood ratio test revealed that the consideration of the temporal structure produces results that differ statistically significantly from those of a pooled regression model (p-value < 0.001). An educated guess would be that learning effects occurred.

The dummy variables for the variation of the loading (*H1*), the varying communication of the net contract costs (*H2*), and the cost-neutral subsidization of the WII (*H3*) are used as independent variables. Selected socio-demographic and socio-economic variables are used to control for potentially confounding influences.

5.2 Results

The estimates of the negative binomial random effects panel regression are depicted in Table IV.

	Coefficient	SE	p-value
Loading (0 = 40% loading; 1 = 10% loading)	0.508	0.179	0.005
Communication of loading (0 = no; 1 = yes)	−0.818	0.175	0.000
Subsidization of loading (0 = no; 1 = yes)	0.494	0.184	0.007
Age (years)	−0.019	0.005	0.001
Years of education	−0.057	0.024	0.019
Risk attitude (number of safe choices)	0.152	0.022	0.000
Arable land (ha)	< 0.001	< 0.001	0.038
Soil quality (on a scale from 0 to 100)	−0.004	0.001	0.000
Annual precipitation (mm)	−0.002	< 0.001	0.000
Time needed for completion of the business simulation game (minutes)	< 0.001	< 0.001	0.845
Period 2	0.254	0.137	0.064
Period 3	0.282	0.137	0.040
Period 4	0.386	0.136	0.005
Period 5	0.316	0.139	0.023
Period 6	0.383	0.136	0.005
Period 7	0.381	0.138	0.006
Period 8	0.407	0.137	0.003
Constant	1.703	0.547	0.002

Notes: $n = 904$. The null hypothesis of all coefficients being zero in the regression model (except the coefficient of the constant) is rejected by a Wald-χ^2-test ($p < 0.001$)

Table IV. Estimation results of the negative binomial regression for the explanation of purchased contracts

The main results concerning our hypotheses can be summarized as follows:

(1) The variation of the loading (10 vs 40 percent of the fair premium) had a statistically significant effect on the number of purchased contracts in the simulation game (p-value = 0.005). Because dummy = 0 had been attributed to the loading of 40 percent, the positive sign of the coefficient (0.508) means that a reduction of the loading from 40 to 10 percent of the fair premium increased the demand volume.

(2) The communication of net contract costs had a statistically significant but negative effect on demand (p-value = 0.000). Demand volume was lower when the loading was explicitly communicated compared to the communication of the total premium (the coefficient is −0.818). This means that the demand-decreasing effect due to a feeling of being treated unfairly was higher than the demand-increasing effect due to learning that insurance costs were only a fraction of the insurance premium. This is an indication that farmers refrained even from beneficial transactions if they have the feeling that the other party earns (too much) money.

(3) Communicating to the farmers that the WII had been subsidized stimulated demand, even though insurance costs had been kept constant for farmers. In the subsidization setting, demand volume increased (the coefficient is 0.494, p-value = 0.007). In other words, we found evidence indicating that farmers take subsidies as signaling profitable courses of actions without carrying out a profitability analysis.

In brief, we may summarize that the respective null hypotheses of no effect can be rejected in all three cases at the conventional 0.05 threshold of significance. This holds even if we adjust for multiple testing. In our case, we simultaneously test for $m = 3$ hypotheses. Using the Bonferroni correction (Holm, 1979) which is usually considered as a too rigorous (conservative) approach, implies using an adjusted threshold of $0.05/m = 0.05/3 = 0.0167$ for our three tests of statistical significance. All three p-values are below this adjusted level.

There are many reasons why students and professionals may behave differently in experimental settings. For example, professionals usually have more experience in the field of interest where choices must be made according to the experimental design. They are also likely to have higher opportunity costs (Fréchette, 2015). An additional specificity of our experiment is that the participating professionals were all male. While this is a reflection of the overall predominance of male farmers in Germany (with only 10 percent of farm managers being female), it is in contrast to many experiments that resort to convenience groups of students in which gender is often quite balanced. It is thence particularly interesting to compare the results of the present study with the preliminary study by Musshoff *et al.* (2014) that was carried out along similar lines but with students as experimental subjects. There are some interesting commonalities and differences to be found between the two studies: Agricultural students as well as farmers seem to interpret subsidies as signaling a profitable course of entrepreneurial action. In contrast, the communication of the loading (net costs of the WII) had a statistically significant but negative effect on demand in the experiment with the farmers, whereas it was positively correlated with demand in the experiments with students. This is in accordance with Henrich *et al.* (2010), who in general find a higher "unfairness aversion" and more pro-social preferences in experimental studies with farmers compared to students.

5.2.1 Further results. Berry (2016), Halsey *et al.* (2015), Head *et al.* (2015), and many others note that, to avoid the inflation of unsubstantiated significance claims, the exploratory search for interesting new hypotheses must not be presented as hypotheses testing after results are known (HARKing; Kerr, 1998). In other words, confirmatory analysis with the testing of predefined hypotheses must be clearly separated from an exploratory search for potentially interesting correlations within a data set that might be worth investigating with new data in the future. Following this advice, we complement our confirmatory analysis with an exploratory search for interesting features that can be found in the control variables. We find a negative relation between age and education, on the one hand, and experimental demand for WII, on the other hand. Both relationships might be worth investigating further. As might be expected, an increasing risk aversion was positively correlated with demand. The same holds for the variable "arable land." This implies that the experimental subjects coming from large farms purchased more insurance contracts than those from smaller farms. A first speculative interpretation would be that this is because large-scale farmers have a more professional market-based perspective. Furthermore, the higher the soil quality and the higher the annual precipitation on the experimental subjects' own farms, the less precipitation-related WII was purchased. We might similarly speculate that the experimental subjects who are not familiar with drought problems do not fully realize the problem in the experimental setting.

6. Conclusions and suggestions for further research

The present study experimentally investigated the demand for WII depending on its loading (net costs of insurance), the separate disclosure of the loading (cost transparency), and the notification of an insurance subsidy (at constant net insurance costs for farmers). For this purpose, an extra-laboratory experiment was carried out with farmers who managed a virtual arable farm.

Two findings are especially noteworthy: first, the group of experimental subjects who were transparently informed about the loading (net cost of insurance) bought less insurance contracts than those who were not. This finding can be related to aversion to being unfairly treated and may be taken as evidence that farmers reduce demand if they feel surcharged. Second, the group of farmers who were notified that the insurance was subsidized bought more contracts than those who were not. This indicates that farmers, without individually analyzing costs and benefits, consider subsidies as a heuristic that signals an economically advantageous course of action. Our findings are not only interesting for behavioral economists but also for insurance economists, regulatory theorists, and policy makers who should bear in mind that individuals are not fully rational, but often rely on simple decision heuristics. It is the challenge for policy makers and regulators to account for typical behavioral patterns when designing measures to steer people's behavior.

However, experimental results must be cautiously interpreted regarding their external validity. Roe and Just (2009) note that the results of experimental approaches including extra-laboratory experiments such as internet-based business simulation games can only be generalized to a limited extent: reality is much more complex than what could be modeled into an experiment. In the real-world decision context we are interested in, a very wide range of risk management instruments, for example, is available to farmers besides diversification and WII. Furthermore, despite all efforts to incentivize experiments, the incentives provided in experiments such as ours are regularly less vigorous than in real life due to budgetary constraints. Hence, future studies should investigate whether incentive levels can be reduced without loss of external validity when subjects genuinely enjoy participating in an experiment such as a business simulation game.

Further research should also investigate the differences between students and the social group of interest in economic experiments. For example, Druckman and Kam (2011) criticize that the few studies dealing with such comparisons only insufficiently explain possible differences. Our study provides a first step in this direction. A concrete step ahead would be to carry out replications that investigate whether the identified differences between the convenience group of students and the farmers can be robustly attributed to differences between these two social groups or whether they are merely artifacts of slightly different study designs.

Notes

1. Low transaction costs may be a feature that favors the use and the adoption of index insurance in developing countries (Miranda and Farrin, 2012).
2. Only two individuals (out of 114 participants) stated that they use weather index insurance in real life. Crop hail insurance ($N=86$), and commodity features ($N=73$) are far more popular risk management measures.
3. Lehberger and Hirschauer (2014) point out that approximately 50 percent of those who receive their university degree in agricultural and nutritional sciences in Germany are female. In stark contrast to that, only 10 percent of farm managers are female.
4. Count data are referred to as positive integer values without an upper limit (Agresti, 1996; Cameron and Trivedi, 2013).

References

Agresti, A. (1996), *An Introduction to Categorical Data Analysis*, Department of Statistics University of Florida, Gainesville, FL.

Antón, J., Cattaneo, A., Kimura, S. and Lankoski, J. (2013), "Agricultural risk management policies under climate uncertainty", *Global Environmental Change*, Vol. 23 No. 6, pp. 1726-1736.

Berg, E. and Schmitz, B. (2008), "Weather-based instruments in the context of whole-farm risk management", *Agricultural Finance Review*, Vol. 68 No. 1, pp. 119-133.

Berry, D.A. (2016), "P-values are not what they're cracked up to be online discussion: ASA statement on statistical significance and P-values", *The American Statistician*, Vol. 70 No. 2, pp. 1-2.

Bielza, M., Stroblmair, J., Conte, C., Dittmann and Gallego, J. (2007), "Agricultural Risk Management in Europe", 101st European Association of Agricultural Economists (EAAE) Seminar, Berlin, July 5-6, 2008.

Bundesministerium für Ernährung und Landwirtschaft (BMEL) (2017), Die wirtschaftliche Lage der landwirtschaftlichen Betriebe Buchführungsergebnisse der Testbetriebe Wirtschaftsjahr 2015/16, available at: www.bmel-statistik.de//fileadmin/user_upload/monatsberichte/BFB-0111001-2016.pdf (accessed July 25, 2016).

Camerer, C.F. and Hogarth, R.M. (1999), "The effects of financial incentives in experiments: a review and capital-labor-production framework", *Journal of Risk and Uncertainty*, Vol. 19 Nos 1-3, pp. 7-42.

Cameron, A.C. and Trivedi, P.K. (2013), *Regression Analysis of Count*, Cambridge University Press, Cambridge.

Charness, G., Gneezy, U. and Kuhn, M.A. (2013), "Experimental methods: extra-laboratory experiments – extending the reach of experimental economics", *Journal of Economic Behavior & Organization*, Vol. 91, pp. 93-100.

Charness, G. and Rabin, M. (2002), "Understanding social preferences with simple tests", *Quarterly Journal of Economics*, Vol. 117 No. 3, pp. 817-869.

Druckman, J.N. and Kam, C.D. (2011), "Students as experimental participants: a defense of the 'narrow data base'", in Druckman, J.N., Green, D.P., Kuklinski, J.H. and Lupia, A. (Eds), *Cambridge Handbook of Experimental Political Science*, Cambridge University Press, Cambridge, pp. 41-57.

Duersch, P., Oechssler, J. and Schipper, B.C. (2009), "Incentives for subjects in internet experiments", *Economics Letters*, Vol. 105 No. 1, pp. 120-122.

Fehr, E. and Schmidt, K.M. (1999), "A theory of fairness, competition, and cooperation", *The Quarterly Journal of Economics*, Vol. 114 No. 3, pp. 817-868.

Fisher, R.A. (1935), *The Design of Experiments*, Oliver & Boyd, Edinburgh.

Fréchette, G.R. (2015), "Laboratory experiments: professionals versus students", in Fréchette, G.R. and Schotter, A. (Eds), *Handbook of Experimental Economic Methodology*, Oxford University Press, Oxford, pp. 360-390.

Gigerenzer, G. and Gaissmaier, W. (2011), “Heuristic decision making”, *Annual Review of Psychology*, Vol. 62, pp. 451-482.

Glauber, J.W. (2004), “Crop insurance reconsidered”, *American Journal of Agricultural Economics*, Vol. 86 No. 5, pp. 1179-1195.

Gollier, C. (2003), “To insure or not to insure? An insurance puzzle”, *The Geneva Papers on Risk and Insurance Theory*, Vol. 28, pp. 5-24.

Goodwin, B.K. and Smith, V.H. (2013), “What harm is done by subsidizing crop insurance?”, *American Journal of Agricultural Economics*, Vol. 95 No. 2, pp. 489-497.

Halsey, L.G., Curran-Everett, D., Vowler, S.L. and Drummond, B. (2015), “The fickle P value generates irreproducible results”, *Nature Methods*, Vol. 12 No. 3, pp. 179-185.

Head, M.L., Holman, L., Lanfear, R., Kahn, A.T. and Jennions, M.D. (2015), “The extent and consequences of P-hacking in science”, *PLoS Biology*, Vol. 13 No. 3, doi: 10.1371/journal.pbio.1002106.

Henrich, J., Heine, S.J. and Norenzayan, A. (2010), “The weirdest people in the world?”, *Behavioral and Brain Sciences*, Vol. 33, pp. 61-83.

Hilbe, J.M. (2011), *Negative Binomial Regression*, Cambridge University Press, Cambridge.

Holm, S. (1979), “A simple sequentially rejective multiple test procedure”, *Scandinavian Journal of Statistics*, Vol. 6 No. 2, pp. 65-70.

Holt, C.A. and Laury, S.K. (2002), “Risk aversion and incentive effects”, *American Economic Review*, Vol. 92 No. 5, pp. 1644-1655.

Jarrow, R. and Rudd, A. (1983), *Option Pricing*, Dow Jones-Irwin Publishing, Homewood, IL.

Kahneman, D., Knetsch, J.L. and Thaler, R. (1986), “Fairness as a constraint on profit seeking: entitlements in the market”, *The American Economic Review*, Vol. 76 No. 4, pp. 728-741.

Kapphan, I. (2012), *Weather Risk Management in Light of Climate Change Using Financial Derivatives*, ETH Zürich, Zürich.

Kerr, N.L. (1998), “HARKing: hypothesizing after the results are known”, *Personality and Social Psychology Review*, Vol. 2 No. 3, pp. 196-217.

Kumbhakar, S.C. and Lien, G. (2010), “Impacts of subsidies on farm productivity and efficiency”, in Ball, E., Fanfani, R. and Gutierrez, L. (Eds), *The Economic Impact of Public Support to Agriculture: An International Perspective*, Springer, New York, NY, pp. 109-124.

Lehberger, M. and Hirschauer, N. (2014), “What causes the low share of female farm managers? An explorative study from Eastern Germany”, *ÖGA-Jahrbuch*, Vol. 23, pp. 111-120.

Mahul, O. and Stutley, C.J. (2010), *Government Support to Agricultural Insurance: Challenges and Options for Developing Countries*, The World Bank, Washington, DC.

Miranda, M.J. and Farrin, K. (2012), “Index insurance for developing countries”, *Applied Economic Perspectives and Policy*, Vol. 34 No. 3, pp. 391-427.

Musshoff, O., Grüner, S. and Hirschauer, N. (2014), “Do we need to consider bounded rationality and heuristic decision making when trying to understand the weak development of weather-index insurance markets in agriculture? An exploratory investigation based on an extra-laboratory experiment”, *German Journal of Agricultural Economics*, Vol. 63 No. 2, pp. 67-80.

Mußhoff, O., Hirschauer, N. and Odening, M. (2008), “Portfolio effects and the willingness to pay for weather insurances”, *Agricultural Finance Review*, Vol. 68 No. 1, pp. 83-97.

Mußhoff, O., Odening, M. and Xu, W. (2011), “Management of climate risks in agriculture – will weather derivatives permeate?”, *Applied Economics*, Vol. 43 No. 9, pp. 1067-1077.

Nash, J.R. (2006), “Framing effects and regulatory choice”, *Notre Dame Law Review*, Vol. 82 No. 1, pp. 313-372.

Norton, M., Osgood, D. and Turvey, C.G. (2013), “Quantifying spatial basis risk for weather index insurance”, *The Journal of Risk Finance*, Vol. 14 No. 1, pp. 20-34.

Organisation for Economic Co-operation and Development (1999), "Classifying educational programmes: manual for ISCED-97 implementation in OECD Countries", OECD.

Plous, S. (1993), *The Psychology of Judgment and Decision Making*, McGraw-Hill, New York, NY.

Richards, T.J., Manfredo, M.R. and Sanders, D.R. (2004), "Pricing weather derivatives", *American Journal of Agricultural Economics*, Vol. 86 No. 4, pp. 1005-1017.

Roe, B.E. and Just, D.R. (2009), "Internal and external validity in economics research: tradeoffs between experiments, field experiments, natural experiments, and field data", *American Journal of Agricultural Economics*, Vol. 91 No. 5, pp. 1266-1271.

Simon, H.A. (1957), *Models of Man: Social and Rational*, Wiley, New York, NY.

Smith, V.H. and Watts, M. (2009), "Index based agricultural insurance in developing countries: feasibility", Scalability and Sustainability, available at: http://agecon.ucdavis.edu/research/seminars/files/vsmith-index-insurance.pdf (accessed July 25, 2016).

Stoppa, A. and Hess, U. (2003), "Design and use of weather derivatives in agricultural policies: the case of rainfall index insurance in Morocco", paper presented at the International Conference: Agricultural Policy Reform and the WTO, Where are we Heading, Capri.

Tricomi, E., Rangel, A., Camerer, C.F. and O'Doherty, J.P. (2010), "Neural evidence for inequality-averse social preferences", *Nature*, Vol. 463 No. 7284, pp. 1089-1091.

Tversky, A. and Kahneman, D. (1986), "Rational choice and the framing of decisions", *The Journal of Business*, Vol. 59 No. 4, pp. S251-S278.

Vedenov, D.V. and Barnett, B.J. (2004), "Efficiency of weather derivatives as primary crop insurance instruments", *Journal of Agricultural and Resource Economics*, Vol. 29 No. 3, pp. 387-403.

Winkelmann, R. and Boes, S. (2009), *Analysis of Microdata*, Springer, Berlin.

Woodard, J. and Garcia, P. (2008), "Basis risk and weather hedging effectiveness", *Special Issue of the Agricultural Finance Review*, Vol. 68 No. 1, pp. 111-124.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge.

World Bank (2011), "Weather index insurance for agriculture: guidance for development practitioners", Discussion Paper No. 50, Agriculture and Rural Development, Washington, DC.

Xu, W., Weber, R., Odening, M. and Mußhoff, O. (2008), "Optimal design of weather bonds for reinsuring drought risk", 108th European Association of Agricultural Economists (EAAE) Seminar, Warsaw, February 8-9.

Appendix. Experimental Instructions (supplementary material available online)

General Information

[…] The participation includes three experimental parts: (1) Your decisions in the business simulation game (2) Your decisions for lottery selection, and (3) Personal and farm data. You have the chance to win some prize money. Therefore, please carefully read the instructions as your prize money depends on your decisions.

You can participate in the game until February 28, 2014. In the business simulation game, every fifth participant wins prize money of up to €200. The prize money is determined depending on the second lowest prize that you achieved in a certain production period. In the lottery selection, one out of 100 farmers wins prize money of up to €385. If you won prize money, you will be informed by e-mail by March 30, 2014.

The completion of the experiment will take approximately 40 minutes of your time (including reading the instructions). Your data will, of course, be treated confidentially and will be analyzed anonymously […].

Good luck!

Part 1 *(Instructions: Business Simulation Game)*

In the business simulation game, you manage a farm with 200 ha farmland at a weak and drought-threatened location over a period of 8 years (= 8 game periods). The whole agricultural area is rented for the long-term. You can select from four different production activities, the yield of which is uncertain as it is directly coupled with the weather development. Even the product prices are uncertain.

You have a starting capital of €200,000 available. Every year, you use €40,000 to cover your living expenses as well as the costs for rent, buildings, and machinery.

At the beginning of each period, you need to decide for one cultivation program:

(1) Selection of the cultivation program: How much arable land should be used for the production of winter wheat, winter canola, winter rye, and silage maize?

In addition to the cultivation program, you also need to decide about taking out weather index insurance:

(2) Taking out weather index insurance: How many weather index insurance contracts do you want to purchase for hedging your farm?

Decision 1: Selection of the cultivation program

For the cultivation of your arable land, you can chose from four production activities:

(1) Winter wheat cultivation

(2) Winter canola cultivation

(3) Winter rye cultivation

(4) Silage maize cultivation

You must comply with the following regulations:

(1) You are allowed to cultivate a maximum of 140 ha of each crop.

(2) You must cultivate at least 10 ha of each crop.

(3) The total farmland has to be tilled. Hence, it is not possible to set land aside.

Yields and costs of the production activities

The costs arising for the cultivation of the crops are independent from the weather and structured as follows:

(1) Winter wheat cultivation: €850

(2) Winter canola cultivation: €850

(3) Winter rye cultivation: €700

(4) Silage maize cultivation: €750

On the contrary, the yields of the production activities depend on the amount of precipitation between April and June. You do not know about the weather before a production period starts. However, you do know that the following three weather conditions are possible: above-average (260 mm of precipitation), average (160 mm of precipitation) and below-average (60 mm of precipitation). The probability for each weather condition is 33.33 percent. Table AI summarizes the yields for different precipitation conditions.

Product prices

The market prices of the four production activities fluctuate. The prices rise or fall with a probability of 50 percent in each period. From one period to another, all prices rise or fall (Table AII).

Production activity	Yield for 60 mm (with a probability of occurrence of 33.33%)	Yield for 160 mm (with a probability of occurrence of 33.33%)	Yield for 260 mm (with a probability of occurrence of 33.33%)
Winter wheat	50	65	80
Winter canola	25	30	35
Winter rye	55	60	65
Silage maize	300	330	360

Table AI. Yields for different precipitation conditions (dt/ha)

At the beginning of the game, the market price of silage maize, for example, is 3.30 €/dt and rises or falls by 0.30 €/dt in each period. The product prices that are observed before the start of the first production period are different for the individual crops. The vegetable products are automatically sold at the end of the respective production period for the price observed at that time. This means that there is no possibility to store the products (Table AIII).

In each production period, you receive an acreage premium of 300 €/ha of farmland, meaning 200 ha x €300 = €60,000. You receive this premium independently from your production decisions.

Decision 2: Taking out weather index insurance:

You have the additional chance to take out weather index insurance as a risk management instrument. You need to make a decision about how many weather index-base insurance contracts you want to pursue.

The principle of these insurance contracts is as follows: The accumulated precipitation from April to June is measured at a reference weather station that is directly situated at the production location. If the measured precipitation falls below the expected precipitation (long-term mean), the insurance holder receives a payout of €3 per mm that the precipitation falls short. The costs for weather index insurance are independent of the production activities and amount to €110 per insurance contract purchased.

(*This indication differs in the individual framing variants. Here a loading of 10% is illustratively observed.*)

Liquidity

Your Liquidity is not threatened at any time in the game. If you do not meet your payments on the basis of your own funds, you have an interest-free loan available. This is automatically taken out and amortized.

Overview of the course of the game

You make your production decisions and determine the number of weather index insurance contracts purchased. After the end of a production period, you automatically receive an overview of your decisions made, the weather and price developments that occur, as well as of your current bank account balance.

Prize money to be won

How can you achieve some prize money in the business simulation game "risk or hedge"?

Out of all participants, 20 percent can receive a maximum payout of €200. The prize money depends on the second lowest profit in one game period.

Now, the game starts […]

After you read the instructions, you can start with the game. During the whole game, you have all important information available that you will need for making your decisions. Furthermore, you can always open up the instructions in a new browser window by clicking on the button "instructions."

To prevent technical problems during the game, do not use the "back" button.

Table AII. Prices and price fluctuations

Production activities	Price at the beginning of the game (€/dt)	Value by which the prices rise or fall from period to period (€/dt)
Winter wheat	21.00	1.70
Winter canola	40.00	3.20
Winter rye	20.00	1.60
Silage maize	3.30	0.30

Table AIII. Illustrative product price change for the production activity "silage maize"

Current product price (period 0)	Uncertain product price in the next production period (period 1)
3.30 €/dt	3.60 €/dt with a probability of 50% 3.00 €/dt with a probability of 50%

Before we start the investment game, we would like to ask you to answer some control questions. This is to make sure that you understand the rules of the investment game.

1.	How many ha of farmland do you have available for the different production activities?	100	o
		200	o
		300	o

2.	What is your starting capital?	€200,000	o
		€500,000	o
		€40,000	o

3.	What is the probability of occurrence for the different weather conditions?	33.33% - 33.33% - 33.33%	o
		30.00% - 40.00% - 30.00%	o
		20.00% - 60.00% - 20.00%	o

4.	Which production activity cannot be selected?	Winter rye	o
		Silage maize	o
		Winter wheat	o
		Sugar beet	o

5.	Which insurance benefit does each player receive per mm in case of below-average precipitation?	5 €/mm	o
		4 €/mm	o
		3 €/mm	o

Description of the weather index insurance

You have the chance to hedge the risk of your farm by purchasing weather index insurance. There is one weather station that is located in your direct neighborhood. To sign a contract, you have to pay an amount of €110 for a weather index insurance. The insurance benefit corresponds with a payment of €3 per mm that the precipitation measured from April to June is below the long-term mean of 160 mm.

(*The following indications differ between the individual framing variants with respect to the price for weather index insurance. Framing variant 3 (Communication of cost-neutral subsidization) is exemplarily described.)*

In addition, it is known that you will benefit from the weather index insurance by a payment of €100 per contract on average over the years (= fair premium). The costs of the risk management instrument "weather index insurance" thus amount to €10 or 10 percent of the so-called fair premium.

Your insurance agent informs you that this instrument will be subsidized with €10. Without this subsidy, the total premium would be €120.

The business simulation game starts

Starting situation

Bank account statement

Your current account balance	€200,000.00

Your decisions in production period 1

Weather-index insurance

How many insurance contracts do you want to purchase? Please indicate integer numbers (a minimum of 0)	

Winter wheat cultivation

Costs		Yields		
850 €/ha		Weather conditions and their probabilities of occurrence		
		below-average 33%	average 33%	above-average 33%
		50 dt/ha	65 dt/ha	80 dt/ha
Price development		Your decision		
Current product price (period 0)	Uncertain product price in the next production period (period 1)	Minimum cultivation scale 10 ha Maximum cultivation scale 140 ha		
21.00 €/dt	22.70 €/dt with a probability of 50%	I cultivate ____ ha of winter wheat		
	19.30 €/dt with a probability of 50%			

Winter canola cultivation

Costs		Yields		
850 €/ha		Weather conditions and their probabilities of occurrence		
		below-average 33%	average 33%	above-average 33%
		25 dt/ha	30 dt/ha	35 dt/ha
Price development		Your decision		
Current product price (period 0)	Uncertain product price in the next production period (period 1)	Minimum cultivation scale 10 ha Maximum cultivation scale 140 ha		
40.00 €/dt	43.20 €/dt with a probability of 50%	I cultivate ____ ha of winter canola		
	36.80 €/dt with a probability of 50%			

Winter rye cultivation

Costs		Yields		
700 €/ha		Weather conditions and their probabilities of occurrence		
		below-average 33%	average 33%	above-average 33%
		55 dt/ha	60 dt/ha	65 dt/ha
Price development		Your decision		
Current product price (period 0)	Uncertain product price in the next production period (period 1)	Minimum cultivation scale 10 ha Maximum cultivation scale 140 ha		
20.00 €/dt	21.60 €/dt with a probability of 50%	I cultivate ______ ha of winter rye		
	18.40 €/dt with a probability of 50%			

Silage maize cultivation

Costs		Yields		
750 €/ha		Weather conditions and their probabilities of occurrence		
		below-average 33%	average 33%	above-average 33%
		300 dt/ha	330 dt/ha	360 dt/ha
Price development		Your decision		
Current product price (period 0)	Uncertain product price in the next production period (period 1)	Minimum cultivation scale 10 ha Maximum cultivation scale 140 ha		
3.30 €/dt	3.60 €/dt with a probability of 50%	I cultivate ______ ha of silage maize		
	3.00 €/dt with a probability of 50%			

[…]

Part 2 (Instructions according to Holt und Laury 2002)

[…] In the lottery presented here, another participant is randomly selected and receives a money prize. Here, the amount of the money prize also depends on your own decisions and coincidence.

We now offer you ten selection alternatives where you are asked to decide between two lotteries: lottery A and lottery B. You can win €200 or €160 in lottery A and €385 or €10 in lottery with certain probabilities. These probabilities are systematically varied resulting in ten different starting situations. Please decide for one lottery each time.

The following figure shows an excerpt of the selection alternatives between lottery A and B, emphasizing selection alternative four. You need to decide between lottery A, where you can win €200 with a probability of 40 percent or €160 with a probability of 60 percent, and lottery B, where you can win €385 with a probability of 40 percent or €10 with a probability of 60 percent.

	Lottery 1 (A_1)	Decision for A_1	Decision for A_2	Lottery 2 (A_2)
1	with 10% gain of € 200	o	o	with 10% gain of € 385
	with 90% gain of € 160			with 90% gain of € 10
2	with 20% gain of € 200	o	o	with 20% gain of € 385
	with 80% gain of € 160			with 80% gain of € 10
3	with 30% gain of € 200	o	o	with 30% gain of € 385
	with 70% gain of € 160			with 70% gain of € 10
4	with 40% gain of € 200	o	o	with 40% gain of € 385
	with 60% gain of € 160			with 60% gain of € 10
5	with 50% gain of € 200	o	o	with 50% gain of € 385
	with 50% gain of € 160			with 50% gain of € 10
…	…			…

Your prize money will be calculated as follows: A ten-sided dice determines:

(1) Cast: […] which of the ten lottery pairs is finally decisive. If, for example, a 4 results, the fourth lottery pair is decisive.

(2) Cast: […] which amount of money from the decisive lottery will count for your money prize. If you for example have decided for option A of the fourth lottery pair (40 percent; €200; 60 percent: €160), and the dice shows a number between 1 and 4, you win €200. If the number of points on the dice is higher than four, you receive €160.

Please consider your decisions carefully as each lottery pair and each amount of money could be drawn by lot for your money prize.

Now, we would like to ask you to decide in each of the ten lines for one of the two lotteries A and B. At the end of the game, one of the ten decisions is randomly selected to be relevant for payout.

	Lottery 1 (A_1)	Decision for A_1	Decision for A_2	Lottery 2 (A_2)
1	with **10%** gain of **€ 200**	o	o	with **10%** gain of **€ 385**
	with **90%** gain of **€ 160**			with **90%** gain of **€ 10**
2	with **20%** gain of **€ 200**	o	o	with **20%** gain of **€ 385**
	with **80%** gain of **€ 160**			with **80%** gain of **€ 10**
…	…			…
9	with **90%** gain of **€ 200**	o	o	with **90%** gain of **€ 385**
	with **10%** gain of **€ 160**			with **10%** gain of **€ 10**
10	with **100%** gain of **€ 200**	o	o	with **100%** gain of **€ 385**
	with **0%** gain of **€ 160**			with **0%** gain of **€ 10**

Corresponding author
Oliver Mußhoff can be contacted at: Oliver.Musshoff@agr.uni-goettingen.de