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Measuring farmers' time preference – A comparison of methods

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– A comparison of methods

Abstract

The discount rate is of great importance for all decisions in an intertemporal context, such as the decision of how much a society invests in environmental preservation, or the financial decision-making on the individual level. This study experimentally investigates the time preferences of farmers by comparing two different methods: One method is based on the measurement of time preference and risk attitude that are elicited in two parts of an experiment. Afterwards, the discount rate is adjusted using the risk attitude. The other method uses a one-parameter approach without the necessity of separately eliciting the individual risk attitude and without an assumption regarding the form of the utility function. The results reveal that, contrary to previous research, the ascertained discount rates of both methods are different. Furthermore, only the method based on the measurement of time preference and risk attitude separately reveals sensitivities regarding the prospective payout.

Keywords

Discount rate, experimental economics, intertemporal decision making, magnitude effect, risk attitude

1. Introduction

The understanding of many economic decisions is decisively depending on the exchange ratio between future and current consumption. On the individual farm level, investment projects with uncertain future returns have to be related with the associated investment costs in the present (Ahlbrecht and Weber 1997). On a social level, the weighting between future and current consumption determine e.g. the investment in environmental preservation (Laury et al. 2012). In both cases, the time preference of the decision-makers determine the intertemporal exchange between present and future consumption (Anderhub et al. 2001; Frederick 2003). The investigation of time preference is therefore of great interest for the individual farmers' decision-making, the agricultural advice as well as for the support of policy recommendations (Anderson and Stafford 2009; Laury et al. 2012; Liebenehm and Waibel 2014).

Due to the relevance for entrepreneurial decisions, the time preference is investigated in many research studies (Andreoni and Sprenger 2012; Coble and Lusk 2010; Ahlbrecht and Weber 1997), whereby the quantification of the time preference is always expressed by the discount rate (Bocquého et al. 2013; Benhabib et al. 2010; Andersen et al. 2008; Onay and Öncüler 2007; Coller and Williams 1999). Frederick et al. (2002) provide an overview of various studies investigating time preference and reveal a range of discount rates from negative six per cent to basically infinity. An explanation for these differences in the stated discount rate – besides different time preferences – is the range of methodological approaches used to measure discount rates. Possible approaches are the determination of discount rates based on field data (Lence 2000) or on experimentally obtained data (Bocquého et al. 2013; Duquette et al. 2012; Pender 1996). In addition, the differences may originate from the so-called 'magnitude effect', i.e. the use of different amounts of money for eliciting the discount rate (Bocquého et al. 2013; Frederick et al. 2002; Pender 1996).

In addition to the aforementioned factors, recent discount rate research focuses on the assumption of linear preferences in wealth. This assumption is important for earlier elicitation methods of time preference, for example by Coller and Williams (1999). However, this basic assumption implies directly risk-neutral decision-makers that is especially critical since it is frequently found that people do not show risk-neutral behaviour (Coble and Lusk 2010; Andersen et al. 2006; Holt and Laury 2002), which holds also true for farmers (Maart-Noelck and Musshoff 2014). Andersen et al. (2008) indicate that there may be an erroneous determination of discount rates if a risk-neutral decision-maker is assumed a priori. Therefore, Andersen et al. (2008) measure the discount rates by the method of Coller and Williams (1999), as well as the risk attitude according to Holt and Laury (2002) and estimate the individual discount rate and the risk attitude of the experiment participants. Another experimental method for the determination of discount rates has been shown by Laury et al. (2012). They do not elicit the risk attitude of the participants separately. The risk attitude is implicitly included in the discount rate elicitation. The discount rate has been elicited using a single experimental task. Thus, the elicitation of discount rates is simplified and possible sources of errors e.g. the assumption regarding the curvature of a utility function can be avoided. Laury et al. (2012) find no difference between the discount rate elicited with their method and the discount rate estimated with the method of Andersen et al. (2008). As usual in economic experiments (Coble and Lusk 2010; Anderson and Stafford 2009; Onay and Öncüler 2007; Anderhub et al. 2001; Coller and Williams 1999), Laury et al. (2012) serve students as experiment participants.

With this in mind, the present study aims to clarify whether the methods of time preference elicitation and estimation by Andersen et al. (2008) and by Laury et al. (2012) lead to comparable results when they are applied to farmers. We focus on farmers, since farmers are exposed to many risks in their daily work. For instance, weather risk, the attack of plants by diseases or pests, price risks, technological, and political risks play a considerable role in agriculture (Herberich and List 2012; Moschini and Hennessy 2001, p. 89f.). Furthermore, farmers make decisions with long maturities and with a high proportion of sunk costs (e.g. the cultivation of perennial crops or the use of specific livestock buildings) (Lambson and Jensen 1995). Furthermore, we examine a potential 'magnitude effect' by using different amounts of money to elicit the discount rate. For this purpose, the discount rates of farmers are elicited experimentally and afterwards estimated using structural maximum likelihood methods. Therefore, the present study is an extension of the existing literature with regard to three aspects: First, we measure discount rates of farmers, taking into account the possibility of non-linear utility over wealth with two methods, namely the method of Andersen et al. (2008) and the method of Laury et al. (2012). Most of the previous studies measure discount rates of farmers without considering the risk attitude (Bocquého et al. 2013; Duquette et al. 2012). One of the few research studies that take into account the risk attitude was conducted by Liebenehm and Waibel (2014) to estimate discount rates of small-scale farmers in Africa. Second, the results of both methods tested regarding their equality for farmers. Third, we investigate a 'magnitude effect' for both methods with farmers as experiment participants.

In the following section 2, hypotheses are derived from the existing literature, while the experimental design is presented in section 3. Subsequently, section 4 contains the theoretical considerations of the data analysis. In section 5, descriptive statistics is presented and the validity of the hypotheses is tested. The article ends with conclusions and future research perspectives, provided in section 6.

2. Hypotheses

As mentioned, Laury et al. (2012) compare the discount rate estimated with their own method and the discount rate estimated with the method according to Andersen et al. (2008). They reveal that the estimated discount rates of both methods show similar results in a within subject experiment with 103 students. However, a transfer of this method comparison and the discount rate of students to entrepreneurs in general and farmers in particular is not easily possible. Barr and Hitt (1986) illustrate that the validity of experiments with students in behavioural research is controversial and show that managers act systematically different than students in selection decisions. One possible reason for these differences is provided by Andersen et al. (2010) describing the characteristics of the group of students, including age and level of education, as more homogeneous compared to entrepreneurs. Harrison and List (2008) and Khera and Benson (1970) point out that due to different experiences (e.g. in the management of companies) of students and entrepreneurs, the behaviour of students cannot be generalized. These differences in the decision behaviour also hold true for farmers and students as Maart-Noelck and Musshoff (2014) reveal with regard to the risk attitude. Thus, it can be stated that, in general, results derived with students are not directly applicable to entrepreneurs or farmers. We check if results of Laury et al. (2012) obtained with students also hold true for farmers. Thus, our first hypothesis is formulated as follows:

H1: For farmers, the discount rate estimates do not differ between the two methods of Andersen et al. (2008) and Laury et al. (2012).

Benzion et al. (1989) and Thaler (1981) elicit the discount rates of students and find a significant influence of the used amount of money on the discount rate. In the literature, this coherent effect is described as the so-called 'magnitude effect' and indicates that the discount rate decreases with increasing amounts of experimentally offered goods (Frederick et al. 2002). Andersen et al. (2013) provide an extensive overview regarding previous findings of the 'magnitude effect'. They also find a 'magnitude effect' in a time preference measurement for the Danish population. In relation to farmers, Pender (1996) confirm these results and show for farmers and agricultural workers in India that the discount rate decreases with a larger expected quantity of rice. In detail, he found that the median discount rate of 50 per cent decreases with a higher proportion of rice offered to the experiment participants. However, Bocquého et al. (2013) note a reverse 'magnitude effect' for French farmers, whose discount rate increase with increasing payouts. Based on these varying results, we examine the 'magnitude effect' when using both methods of time preference measurement for farmers and test the following hypothesis:

H2: *The discount rates of farmers decrease when the used amount of money for the elicitation increases, independent of the elicitation method.*

3. Methodology

The aforementioned hypotheses will be tested using a computer-based within-subject experiment that is carried out with farmers. The experiment consists of a lottery and a choice part with three sub-experiments and a questionnaire.

3.1 Design of the experiment

In the lottery and choice part, different lotteries and choices are used to measure the discount rate. In the following, we describe the elicitation of the discount rates according to Coller and Williams (1999) (CW task). Afterwards, the Holt and Laury task (HL task; Holt and Laury 2002), used to measure the risk attitude, is described. With the results of both tasks, we can estimate the time preference according to the Andersen et al. (2008) procedure. Subsequently, the probability discounting task (p task) according to Laury et al. (2012) is explained. Following the lottery and choice part, some general information about the managed farm as well as socio-demographic data of the farmers are collected. The structure of each sub-experiment is described in detail below.

Structure of sub-experiment CW task according to Coller and Williams (1999)

In this section of the experiment, participants are confronted with 20 decision situations. In each decision situation, a participant has to choose between a secure amount of money A that will be received in three weeks[1] and a secure amount of money B that will be paid out in twelve weeks.[2] The respective times of the payouts in three and twelve weeks are visually illustrated by calendar sheets (see Appendix I). In option A, the amount of money is fixed at €100 in each decision situation (Table 1). For option B, the amount of money increases from €100 in decision situation one to €129.48 in decision situation 20. As additional information, the participants see the annual discount rate and the annual effective discount rate they have to assume to equalize the two delayed amounts A and B. However, the last column of Table 1, revealing the implied range of discount rates, is not presented to the participants. Using the switching point from choosing the amount A to choosing the amount B in the CW task, we can identify the individual discount rate of participants under the assumption of risk neutrality.

[1] To exclude influence of quasi-hyperbolic discounting (Benhabib et al. 2010), we have carried out the experiment with a so-called front-end delay, i.e. both payment options are paid out delayed. Thus, we can assume a constant discount rate that is not distorted by a present bias (Andersen et al. 2008; Laury et al. 2012).

[2] We choose the time period of nine weeks between the two payouts in order to avoid different background consumption or different transaction costs between the two time points (Laury et al. 2012).

Table 1: Decision situations for the measurement of time preference according to Coller and Williams (1999)

Row	Payment option A in 3 weeks	Please choose payment option A or B	Payment option B in 12 weeks	Annual interest rate	Annual Effective interest rate[a)]	Implied discount rate if switching in this row[b)]
1	€100.00	A ○ ○ B	€100.00	0.00%	0.00%	$\delta \leq 0.00\%$
2	€100.00	A ○ ○ B	€100.17	1.00%	1.01%	$0.00\% \leq \delta \leq 1.01\%$
3	€100.00	A ○ ○ B	€100.35	2.00%	2.02%	$1.01\% \leq \delta \leq 2.02\%$
…	…	…	…	…	…	…
18	€100.00	A ○ ○ B	€113.81	75.00%	111.54%	$64.82\% \leq \delta \leq 111.54\%$
19	€100.00	A ○ ○ B	€118.81	100.00%	171.46%	$111.54\% \leq \delta \leq 171.46\%$
20	€100.00	A ○ ○ B	€129.48	150.00%	346.79%	$171.46\% \leq \delta \leq 346.79\%$

[a)] The annual effective interest rate from 0.00% to 346.79% results from the calculation of the daily interest for the 63 days between the two payment options, extrapolated to one year.
[b)] This column was not shown to the participants.

Source: Authors own illustrations according to Laury et al. (2012)

To investigate the sensitivity of the method to varying amounts of underlying monetary amounts, the task is not only carried out with €100 as payment option A (€100 treatment). In a second design of this experimental task, we use three times the amounts (€300 treatment) of the illustrated one (€300 in payment option A and €300 to €388.45 in payment option B), however, the shown implied discount rates remain constant in each row (see details in Appendix I).

Structure of the sub-experiment HL task according to Holt and Laury (2002)

To measure the risk attitude, participants are asked to choose between two lotteries in 20 decision situations (see Table 2). In lottery A, the payouts can be €180 or €144, while, in lottery B, the payouts can be €346.50 or €9. In both lotteries (A and B), the probabilities vary systematically in each row. The chance to receive the higher payout of €180 in lottery A or €346.50 in lottery B is five per cent in row one and increases in steps of five per cent to 100 per cent in row 20. The probability to receive the lower payouts in row one is therefore 95 per cent and decreases in each subsequent row by five per cent. Lottery B is more risky than lottery A as the difference of possible payouts is greater in lottery B. Furthermore, the payout range of the HL task is chosen in such a way that a reliable statement regarding the observed risk aversion coefficient is possible for both payout treatments (€100 and €300) of the CW task.

Table 2: Decision situations for the measurement of risk attitude according to Holt and Laury (2002)

Row	Lottery A Chance of		Please choose Lottery A or B	Lottery B Chance of		Difference of the expected values (A-B)[a)]	Range of constant relative risk aversion coefficient if switching in this row[a) b)]
	€180.00	€144.00		€346.50	€9.00		
1	5%	95%	A ○ ○ B	5%	95%	€119.93	r ≤ -2.48
2	10%	90%	A ○ ○ B	10%	90%	€104.85	-2.48 ≤ r ≤ -1.71
3	15%	85%	A ○ ○ B	15%	85%	€89.78	-1.71 ≤ r ≤ -1.27
…	…	…	…	…	…	…	…
18	90%	10%	A ○ ○ B	90%	10%	-€136.35	1.15 ≤ r ≤ 1.37
19	95%	5%	A ○ ○ B	95%	5%	-€151.43	1.37 ≤ r ≤ 1.68
20	100%	0%	A ○ ○ B	100%	0%	-€166.50	1.68 ≤ r ≤ 2.25

a) Columns were not shown to the participants.

b) A power utility function of the form $u(x) = \frac{x^{(1-r)}}{(1-r)}$ is assumed.

Source: Authors own illustrations according to Laury et al. (2012)

Observing the row in which a participant switches from choosing the safer lottery A to choosing the more risky lottery B allows conclusions regarding his/her risk attitude. The expected values of lottery A are up to row eight higher than those of lottery B. Starting from row nine, the expected values of lottery B exceed the expected values of lottery A.

Structure of sub-experiment p task according to Laury et al. (2012)

In order to measure the discount rates according to Laury et al. (2012), participants have to choose between two lotteries with a potential payout of €0 or €100 (€100 treatment) in 20 rows. In lottery A, the probability to receive €100 remains constant at 50 per cent over the 20 rows (Table 3). Accordingly, the probability of receiving €0 in lottery A is 50 per cent in each row. However, in lottery B, the probability to receive the payout of €100 increases from 50 per cent in row one to 64.7 per cent in row 20. The payout of a possible payment in lottery A is three weeks delayed to the time of processing the experiment. Participants receive the potential payout of lottery B twelve weeks after they carry out the experiment. The timing of a potential payment is – as in the CW task – displayed on calendar pages (see Appendix I). The switching point, from choosing lottery B instead of lottery A, directly expresses the individual discount rate of a participant, independent of his/her risk attitude. In contrast to Coller and Williams (1999), Laury et al. (2012) decide not to display the annual interest rates.

Table 3: Decision situations for the measurement of time preference according to Laury et al. (2012)

Row	Lottery A Chance of €100 in 3 weeks	Please choose Lottery A or B	Lottery B Chance of €100 in 12 weeks	Annual interest rate[a)]	Annual effective interest rate[a) b)]	Implied discount rate if switching in this row[a)]
1	50%	A ○ ○ B	50.00%	0.00%	0.00%	δ ≤ 0.00%
2	50%	A ○ ○ B	50.10%	1.00%	1.01%	0.00% ≤ δ ≤ 1.01%
3	50%	A ○ ○ B	50.20%	2.00%	2.02%	1.01% ≤ δ ≤ 2.02%
…	…	…	…	…	…	…
18	50%	A ○ ○ B	56.90%	75.00%	111.54%	64.82% ≤ δ ≤ 111.54%
19	50%	A ○ ○ B	59.40%	100.00%	171.46%	111.54% ≤ δ ≤ 171.46%
20	50%	A ○ ○ B	64.70%	150.00%	346.79%	171.46% ≤ δ ≤ 346.79%

[a)] Columns were not shown to the subjects (according to Laury et al. (2012)).
[b)] The annual effective interest rate 0.00% to 346.79% result from the calculation of the daily interest for the 63 days between the two payment options extrapolated to one year.

Source: Authors own illustrations according to Laury et al. (2012)

In order to examine the sensitivity of the method regarding the used money amount, the p task is also carried out with three times higher payouts (€300 treatment). The probabilities in each row and the discount rates remain equivalent in both payout treatments (see details in Appendix I).

3.2 Conducting the experiment

The experiment was carried out online in January and February 2014. Through various agricultural associations and organizations, farmers were invited to participate in the experiment. The experiment was completed by 111 farmers. At the start of the experiment, we indicated that there is no ‘right’ or ‘wrong’ in the decisions since individual preferences of the participants should be investigated through intuitive decision behaviour. The time to complete the experiment was on average 26 minutes.

The order of the different tasks for the elicitation of time preference according to Coller and Williams (1999) and Laury et al. (2012), as well as the order of the payout treatments (€100 and €300) within the two methods is randomized. For the elicitation of the risk attitude according to Holt and Laury (2002), we use the same procedure as Laury et al. (2012) and always carry out the HL task in the middle as the third task out of five tasks in the experiment. More specifically, before a participant can process the HL task, he/she has to complete once the CW task and the p task in a random order, however, both in the same random determined payout treatment (€100 or €300). The remaining payout treatment is carried out in the same order of the CW task and the p task as in the first treatment after the HL task i.e. there are four possible orders. This randomization is used to avoid order effects and increases the internal validity and reliability of the results (Harrison et al. 2009).

To increase the motivation of farmers to participate and also to represent real decision situations, all sub-experiments are linked to monetary incentives. Each participant has the chance to gain a cash premium with a probability of 10 per cent in a random selected task.[3] For each random selected winner of the cash premium, a random decision out of the lotteries and choice decisions is paid out. The HL task is paid out immediately after the lottery drawing and the determination of the winner. The individual payout time in the CW task and the p task depends on the participation

[3] Andersen et al. (2011) conducted an experiment and varied the payment probabilities from 10 per cent to 100 per cent. However, the authors reveal no significant differences in discount rate treatment responses with different payment probabilities.

date of the participant. The possible cash premium and payout time therefore depends on the choices of the participant.

4. Methodology of data analysis

In the following section, we describe the analysis procedure of the collected experimental data. As Andersen et al. (2008) and Laury et al. (2012), we use structural maximum likelihood methods for analyzing the data. First, we describe the estimation of the risk attitude and the time preference according to Andersen et al. (2008). They estimate the risk attitude and the discount rate jointly which is described in this section. Second, we show the derivation of the likelihood function of the probability discount method according to Laury et al. (2012).

4.1 General theoretical considerations

Following the expected utility theory (EUT), we assume exponential discounting when estimating the discount rates.[4] It can be generally considered that the utility values of two alternatives at time t are equal if

$$
\begin{aligned}
&p_t U\left(\omega + \frac{M_t}{\lambda}\right) + (1 - p_t)U(\omega) + \left(\frac{1}{1+\delta}\right)^{\tau} U(\omega) = \\
&U(\omega) + \left(\frac{1}{1+\delta}\right)^{\tau} \left[p_{t+\tau} U\left(\omega + \frac{M_{t+\tau}}{\lambda}\right) + (1 - p_{t+\tau})U(\omega)\right],
\end{aligned} \tag{1}
$$

where $U(\cdot)$ is the expected utility per period, which is a function of ω – representing the background consumption[5] – and the payouts M_t and $M_{t+\tau}$ at time t and $t+\tau$ (Andersen et al. 2008). The probability to obtain an utility that is greater than the utility of the background consumption,

[4] According to Andersen et al. (2008) and Laury et al. (2012), we can assume constant discount rates without present bias due to the use of a front-end delay in our experiment.
[5] According to Andersen et al. (2008, p. 583), background consumption is ‘the optimized consumption stream based on wealth and income that is perfectly anticipated before allowing for the effects of the money offered in the experimental tasks’. Therefore, we use the spending of German farmer households for food, beverages and tobacco from the year 2008 (€13,23; Federal Statistical Office 2011) inflation-adjusted to January 2014 (Federal Statistical Office 2014) amounting €14.89.

depends on the probabilities p_t or $p_{t+\tau}$ that a payout M_t or $M_{t+\tau}$ occurs at time t or $t+\tau$. Payouts received at time $t+\tau$ as well as the background consumption at time $t+\tau$ are discounted over the time period τ with the discount rate δ (Laury et al. 2012). The time period over which the payouts M_t and $M_{t+\tau}$ are integrated in the consumption is described by the parameter λ (Andersen et al. 2008). In other words, λ specifies the number of days needed by a participant to spend the potentially received payout of the CW task. Andersen et al. (2008) and Laury et al. (2012) set the parameter λ equal to one in their calculations.

4.2 Joint estimation of risk attitude and discount rate (Andersen et al. 2008)

In order to specify a likelihood function for the joint estimation of the risk parameter and the discount rate according to Andersen et al. (2008), we have to make an assumption regarding the parametric form of the utility function. Following Andersen et al. (2008) and (Laury et al. 2012), we choose the power utility function of the form

$$U(M) = \frac{(\omega + M)^{(1-r)}}{(1-r)} \tag{2}$$

with a constant relative risk aversion (CRRA) coefficient r (Holt and Laury 2002; Andersen et al. 2008; Laury et al. 2012). Table 2 shows for each row of the HL task the choice between two lotteries with two possible payouts each. For every lottery i, we define the payout j as M_{ij} and the probability of the payout as $p(M_{ij})$ and take into account equation (2), which leads to an equation for the choice in lottery i (Laury et al. 2012):

$$EU_i = \sum_{j=1,2} p(M_{ij}) \times \frac{\left(\omega + \frac{M_{ij}}{\eta}\right)^{(1-r)}}{(1-r)} = \sum_{j=1,2} p(M_{ij}) \times \frac{\left(\omega + M_{ij}\right)^{(1-r)}}{(1-r)}. \tag{3}$$

As the λ parameter in equation (1), η is the integration time of M_{ij} in the consumption. According to Andersen et al. (2008), we simplify the equation by dropping the symbol η, since per definition $\eta = 1$. Then, we introduce the probabilistic choice function $Pr_i^{HL}(A)$ as the probability of a participant choosing lottery A instead of lottery B in choice situation i of the HL task and define this probability as

$$Pr_i^{HL}(A) = \frac{EU_A^{1/\mu}}{EU_A^{1/\mu} + EU_B^{1/\mu}}, \tag{4}$$

where μ is a structural noise parameter used to allow for errors from the deterministic EUT model (Andersen et al. 2008). It follows a conditional log-likelihood of the form:

$$\ln L^{HL}(r, \mu; y, \omega, \boldsymbol{X}) = \tag{5}$$
$$\sum_i \left(\left(\ln(Pr_i^R(A) \middle| y_i = A \right) + \left(\ln(1 - Pr_i^R(A) \middle| y_i = B \right) \right),$$

where $y_i = j$ describe selection of lottery j in observation i and $\boldsymbol{X}$ is a vector of individual characteristics (Andersen et al. 2008).

A comparable likelihood function can be derived for the discount rate measured with the CW task. Table 1 shows that the farmers have the choice between the payout M_A in time t and the equal or larger payout M_B at time $t + \tau$ in each decision situation i (Andersen et al. 2008).[6] Assuming the power utility function of equation (2) and fixed probabilities with $p_t = p_{t+\tau} = 1$, which results from the secure payouts of the task (Table 1), we derive from equation (1) the following present values of the two options:

[6] We use M_A and M_B instead of M_t and $M_{t+\tau}$ since the discounting choices are labeled with A and B.

$$PV_A = \sum_{k=[t,\dots,t+\lambda-1]} \left(\frac{1}{1+\delta}\right)^k \times \frac{\left(\omega + \frac{M_A}{\lambda}\right)^{(1-r)}}{(1-r)} + \sum_{k=[t+\tau,\dots,t+\tau+\lambda-1]} \left(\frac{1}{1+\delta}\right)^k \times \frac{\omega^{(1-r)}}{(1-r)} \tag{6}$$

and

$$PV_B = \sum_{k=[t,\dots,t+\lambda-1]} \left(\frac{1}{1+\delta}\right)^k \times \frac{\omega^{(1-r)}}{(1-r)} + \sum_{k=[t+\tau,\dots,t+\tau+\lambda-1]} \left(\frac{1}{1+\delta}\right)^k \times \frac{\left(\omega + \frac{M_B}{\lambda}\right)^{(1-r)}}{(1-r)}. \tag{7}$$

We define the probability that a participant prefers payout A over payout B in decision situation i of the CW task, as

$$Pr_i^{CW}(A) = \frac{PV_A^{1/\nu}}{PV_A^{1/\nu} + PV_B^{1/\nu}}. \tag{8}$$

Here, ν is a structural error term, comparable to μ from equation (4) (Andersen et al. 2008). However, it should be noted that there is no condition for the equivalence of the error terms μ and ν.[7] Now, we define the conditional log-likelihood as

$$\ln L\,(\delta, r, \mu, \nu; y, \omega, \lambda, \boldsymbol{X}, \boldsymbol{T}) = \sum_i \left(\left(\ln(Pr_i^{CW}(A)\middle|y_i = A\right) + \left(\ln(1 - Pr_i^{CW}(A)\middle|y_i = B\right)\right), \tag{9}$$

where $y_i = j$ describe selection of lottery j in decision situation i (Andersen et al. 2008) and $\boldsymbol{T}$ is the treatment variable coming into play when the discount rate is estimated.

[7] Based on the higher complexity of the HL task, it is to expect that $\mu > \nu$ (Andersen et al. 2008).

The equations (5) and (9) are summarized and therefore jointly estimated:

$$\ln L\,(\delta, r, \mu, \nu; y, \omega, \lambda, \boldsymbol{X}, \boldsymbol{T}) = \ln L^{\mathrm{HL}} + L^{\mathrm{CW}}\,. \tag{10}$$

4.3 Probability based discount rate estimation (Laury et al. 2012)

Starting from the general formula of equation (1) according to Laury et al. (2012) by equating the payouts M_t and $M_{t+\tau}$ (see table 2) and with $U(w)$= 0 and $U(w+M)$= 1, we can rewrite equation (1) as

$$p_t = \left(\frac{1}{1+\delta}\right)^{\tau} p_{t+\tau}\,. \tag{11}$$

To define the likelihood function for the probability based p task, first, we have to describe the present value NPV of both choices A and B (Laury et al. 2012) as:

$$NPV_A = \left(\frac{1}{1+\delta}\right)^{t} \times p_A \tag{12}$$

and

$$NPV_B = \left(\frac{1}{1+\delta}\right)^{t+\tau} \times p_B\,. \tag{13}$$

We define the probability of choosing payoff A over payoff B in choice *i* of the p task as $Pr_i^P(A)$ and express this as

$$Pr_i^P(A) = \frac{NPV_A^{1/\xi}}{NPV_A^{1/\xi} + NPV_B^{1/\xi}}\,, \tag{14}$$

where ξ denotes a structural error term comparable to μ in equation (4) and ν in equation (8) (Laury et al. 2012). The conditional log-likelihood function for discounting decision is therefore:

$$\ln L^P(\delta, \xi; y, \boldsymbol{X}) = \sum_i \left(\left(\ln(Pr_i^P(A) \middle| y_i = A \right) + \left(\ln(1 - Pr_i^P(A) \middle| y_i = B \right) \right), \tag{15}$$

where $y_i = j$ describes the selection of lottery j in observation i (Laury et al. 2012).

5. Descriptive statistics and results

Initially, we describe the sample of farmers and, subsequently, we show the results of the maximum likelihood estimations to answer the derived hypotheses.

5.1 Descriptive statistics

The socio-demographic characteristics of the 111 farmers as well as the structure of their farms are shown in Table 4.

Table 4: Descriptive statistics (n=111)

	Average	Standard deviation
Age in years	38.30	12.69
Female participants in %	9.00	-
Years of education[a)] in years	14.17	3.29
Agricultural education[b)] in %	34.00	-
HL task value[c)]	10.69	4.38
Self-assessment of asset situation[d)]	5.46	1.40
Average size of farmland in ha	189.71	416.03
Farm is main source of income in %	78.38	-
Organic farmers in %	4.51	-
Multiswitchers [e)] in CW task and HL task	27	-
Multiswitchers [e)] in p task	17	-

[a)] Without vocational school; according to the conversion factor of the OECD (1999)
[b)] An agricultural education includes everything from a rich agricultural apprenticeship to a study of agricultural sciences.
[c)] Number of A choices; values from 0 to 20 are possible; risk-neutral=8; the 19 multiple switching participants are taken into account by counting their A choices
[d)] Values from 0 to 10 are possible; 0-4 = below average, 5 = average, 6-10 = above average
[e)] Multiswitchers are participants switching more than once from option A to option B

Source: Authors own calculations

With an average age of 38 years, the farmers are relatively young, which is possibly a result of the online execution of the experiment. The youngest participant is 20 years and the oldest participant is 78 years old. Overall, the farmers can be described as slightly risk averse according to their HL task value of 10.69 (number of A choices). On average, the farmers cultivate 190 ha agricultural land. On the smallest farm, five ha special crops are cultivated and on the greatest farm 3,200 ha arable land and 450 ha grassland are cultivated.

5.2 Testing of hypotheses

To analyze our experimental data, we maximize the likelihood functions of equation (10) and (15), with the statistic software Stata 12. For our analysis, we use on the one hand a maximum likelihood approach with homogenous preferences to compare the estimated discount rates of both methods. On the other hand, we estimate a maximum likelihood model which allows for heterogeneous preferences over socio-economic factors for answering hypothesis two. Since each individual makes 20 decisions in every task, we use clustered standard errors for our estimations. Table 5 shows the results of the discount rate estimations for the two examined methods.

Table 5: Maximum likelihood estimates of risk and time preferences[a)]

Parameter	Estimate	Standard Error	p-value	Lower 95% confidence interval	Upper 95% confidence interval
Joint estimation (CW task and HL task; n=6,660)					
r	0.268	0.079	0.001	0.114	0.423
δ	0.102	0.021	0.000	0.061	0.142
μ	0.201	0.024	0.000	0.155	0.247
ν	0.019	0.004	0.000	0.011	0.027
				Pseudo-Log Likelihood = -3,418	
Probability discounting estimation (p task; n=4,440)					
δ	0.296	0.050	0.000	0.198	0.393
ξ	0.050	0.006	0.000	0.039	0.062
				Pseudo-Log Likelihood = -2,647	

[a)] With $\lambda = 1$

Source: Authors own calculations

Hypothesis 1

As it is apparent from the results shown in Table 6, the measured discount rate of farmers differ between the two methods according to Andersen et al. (2008) und Laury et al. (2012). The discount rate estimated with the joint estimation method according to Andersen et al. (2008) is considerably smaller compared to the estimated discount rate according to the probability discounting method by Laury et al. (2012). The confidence bounds of the δ parameters of the joint estimation and the probability discounting estimation validate a significant difference. The 95 per cent confidence bounds do not overlap regarding the discount rate estimates. Therefore, our results contradict the findings of Laury et al. (2012), that the two discount rate measurement methods are leading to equal discount rates. While Laury et al. (2012) find no significant difference between the discount rate measured in both methods for students, we found a significant greater discount rate in a within-subject comparison with farmers when we use the method according to Laury et al. (2012).

To test the robustness of our results, we subsequently relax the assumption that λ is equal to one, which we made to receive the results of Table 5. Therefore, we vary the λ parameter and consider changes in the estimates of δ. Figure 2 reveals the estimates of the discount rate and the respective 95 per cent confidence intervals for both methods with varying λ.

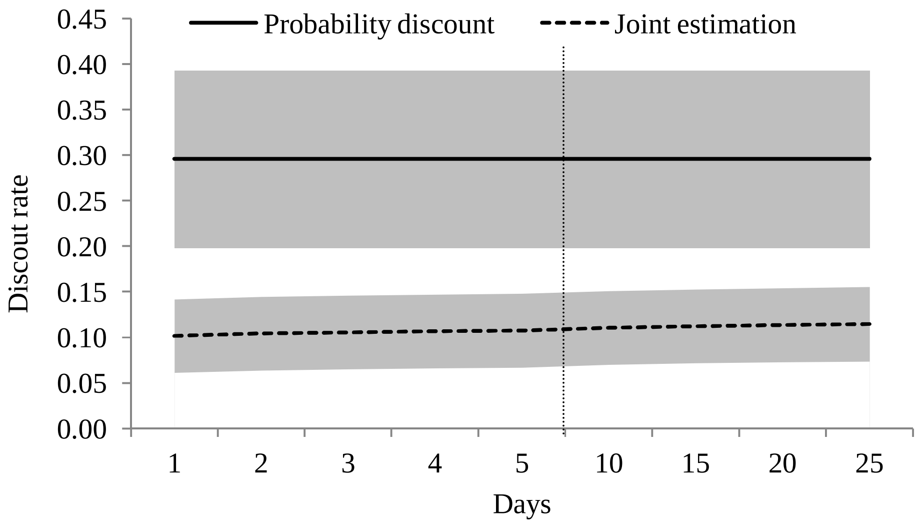

Figure 1: Estimate and 95% Confidence interval of the joint estimation and the probability discounting method with varying $\boldsymbol{\lambda}$ parameter (vertical dotted line identifies a change in $\boldsymbol{\lambda}$ steps on the x-axis)

Source: Authors own calculations

Figure 1 reports the result that an increased λ is accompanied with a slightly increasing discount rate in the joint estimation procedure according to Andersen et al. (2008). The discount rate estimated with the method according to Laury et al. (2012) is not sensitive to changes in λ, since the two delayed payouts are equal in their amount. However, it can be seen that the 95 per cent confidence interval of the joint estimation and the probability discount estimation do not overlap in terms of a λ parameter range from 1 to 25 days. Andersen et al. (2008) found that the likelihood is maximized when they assume the parameter λ is equal to one. However, we found out that our pseudo likelihood is maximized if we set λ to 4.9. Andersen et al. (2008, p. 602) describe 'empirical evidence' for a λ lower than seven days. However, Duquette et al. (2014, p. 212) point out that the optimal consumption period is 'substantially longer' than assumed in other studies. To proof the validity of our results also in the light of the findings of Duquette et al. (2014), we run the estimation with the assumption of risk neutrality ($r = 0$), since Andersen et al. (2008) describe that a λ value of nearly infinity tends to the estimates under risk-neutral conditions. For the risk-neutral conditions, we estimate 0.130 for δ and an upper 95 per cent confidence boundary at 0.180. when applying the method according to Andersen et al. (2008). Hence, also for the assumption of a risk-neutral participant, a significant difference between the two methods can be identified because the results of the discount rate estimation according to Laury et al. (2012) remain the same as displayed in Table 5.

Finally, based on our robust results, we cannot support **hypothesis 1**, that, for farmers, there is no difference between the discount rate estimation according to Andersen et al. (2008) und Laury et al. (2012). One possible reason for the identified differences is mentioned by Harrison et al. (2013, p. 11) stating that the method of Laury et al. (2012) 'places an undue reliance on the cognitive abilities of subjects'. Especially the marginal differences between the probabilities in the first rows could be associated with a huge cognitive effort (Harrison et al. 2013).

Hypothesis 2

For testing our second hypothesis which states that the discount rate of farmers decreases if the used amount of money for elicitation increases, we estimate our models allowing for heterogeneous preferences. Heterogeneous preferences mean that the global parameters r and δ can also be dependent on socio-demographic and socio-economic factors. Thereby, the parameter r (CRRA) is only relevant in the estimate according to Andersen et al. (2008). However, in the likelihood function of the estimates according to Laury et al. (2012), no risk aversion coefficient is specified or relevant. Furthermore, we use an additional treatment variable, which potentially influences the discount rate parameter δ. The treatment variable which indicates a measurement of the discount rate in the €300 treatment is only useful for the discount rate estimation and not for the estimation of the CRRA coefficient because only the discount rate tasks (CW task and p task) are carried out in two different payout treatments. Table 6 displays the correlations of the socio-demographic and the socio-economic factors as well as the treatment variable with risk and time preferences.

Table 6: Model estimates of risk and time preference with individual characteristics

	(Ln) Discount rate according to Laury et al. (2012)	(Ln) Discount rate according to Andersen et al. (2008)	Risk aversion according to Andersen et al. (2008)
	Estimate	Estimate	Estimate
Treatment (1=€300)	-0.119	-0.420**	–
Age	0.000	-0.042**	0.001
Female (1=yes)	0.076	0.980***	-0.426**
Years of education[a)]	0.054	0.144	-0.041**
Agricultural education[b)] (1=yes)	0. 471	0.082	-0.138
Self-assessment[c)]	0.055	-0.023	-0.052
Average size of farmland	0.001**	0.000	0.000
Farm main income (1=yes)	-0.336	-0.154	-0.243*
Constant	-2.523	-2.858*	1.565***

Single, double, and triple asterisks (*, **, and ***) denote $p<0.05$, $p<0.01$, and $p<0.001$, respectively.
[a)] Without vocational school; according to the conversion factor of the OECD (1999)
[b)] An agricultural education includes everything from a rich agricultural apprenticeship to a study of agricultural sciences.
[c)] Values from 0 to 10 are possible; 0-4 = below average, 5 = average, 6-10 = above average

Source: Authors own calculations

The results in Table 6 show that – among other explanatory variables – the variable treatment is significant for the discount rate measurement according to Andersen et al. (2008). Here, the significant negative coefficient indicates that a lower discount rate is stated in the €300 treatment compared to the €100 treatment. However, the treatment coefficient for the discount rate estimated according to Laury et al. (2012) rather tends to have a negative sign, nevertheless, the coefficient is not significant. Therefore, we can conclude that farmers, within our payout range, do not react sensitively to varying payoffs in the p task despite their magnitude dependence in the CW task. Our results indicate that, for farmers in the payout range used, we **can support hypothesis 2** for the method according to Andersen et al. (2008), however we **cannot support hypothesis 2** for the discount rate measurement according to Laury et al. (2012).

Further results are that female farmers, higher educated farmers as well as farmers' for who their farm work is the main source of income are more risk averse. Regarding the interest rate, the influences of the socio-economic factors within the heterogeneous model are different between the two methods. For the method according to Laury et al. (2012), an increasing farm size is associated with an increasing discount rate. However, the discount rate is larger for female farmers and lower for older farmers if we take into account the estimation results of the method according to Andersen et al. (2008).

6. Conclusion and outlook

The individual time preference is an essential factor influencing the decision-making behaviour. To determine the time preference, different methods are available. We investigate two common experimental methods to measure discount rates: the method according to Andersen et al. (2008) which is a well-established method and the method according to Laury et al. (2012), which has been developed as a simplification of the method introduced by Andersen et al. (2008). Laury et al. (2012) showed that the two methods do not differ significantly for estimated discount rates of students. Since the results of students cannot be transferred to entrepreneurs in general and farmers in particular, we compared the two methods for measuring time preference of farmers. Additionally, we examined whether different magnitudes of the offered payout used for the discount rate elicitation have an influence on the stated discount rate.

Contrary to the findings of Laury et al. (2012), our results reveal that the two methods differ in the estimated discount rate. For farmers, the estimated discount rate of the method according to Andersen et al. (2008) is significantly lower than the estimated discount rate according to the method of Laury et al. (2012). We also found evidence for a 'magnitude effect' when we use a €300-based treatment instead of a €100-based treatment for measuring the discount rate. However, this result is only valid for the method according to Andersen et al. (2008) and not for the method according to Laury et al. (2012). The two methods used lead to different results and, therefore, the method to measure farmers' discount rates has to be carefully selected. Furthermore, regarding the discount rate of students, one should be careful to transfer the results to farmers. To evaluate the goodness of the estimated discount rate of both methods, we finally conclude the following: The method according to Laury et al. (2012) simplifies the elicitation and estimation of the discount rate for the experimenter. Additionally, no assumption regarding the utility function and the consumption smoothing is necessary. The estimates computed with the method according to Andersen et al. (2008) are closer to the observed market interest rate.

For future research, it is of interest to apply the method according to Laury et al. (2012) with farmers and feasible interest rates displayed as it is common practice when applying the method according to Coller and Williams (1999). In order to avoid multiple switching and to test the robustness of the separate elicitation, the risk attitude measurement according to Holt and Laury (2002) could be replaced by another method for the elicitation of risk attitudes e.g. the method according to Eckel and Grossman (2008). Further research should also compare both methods applied to entrepreneurs located in other countries, from other occupational groups, e.g. forestry, and with various payment amounts in order to test the generalizability of our results.

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Appendix I: Experiment Description

Translation from German.

Instruction

To investigate the influence of time and risk on your decisions, we subsequently offer five different lotteries and choice decisions. **There is no right or wrong!**

The experiment consists of two parts: First, you make choices between different payouts; afterwards. you will be asked some questions regarding your farm and your person.

What can you gain?

For each participant there is a 10 per cent chance to be drawn for winning a cash premium. More precisely, five of 50 participants will receive a cash premium and, for each of them, one of the following five lotteries and choice decisions will be randomly selected for determining a cash premium. The cash premium per participant can be up to €388.45. **With your decisions you determine the amount of your potential cash premium!**

For detailed explanation of the chances of winning, please click the 'stack of coins' on the respective page. […]

We will inform you via e-mail if you won a cash premium. The disbursement of the cash premium occurs either immediately after drawing a winner or at the time specified in the respective sub-experiment.

The completion of the experiment will take about **20 minutes** of your time. Of course, your information will be kept confidentially and anonymously. For further questions, please do not hesitate to contact us. […]

Part 1: Choices

[The order of the following sub-experiments is randomized. Before and after the Holt and Laury task, both discount tasks are carried out in a randomized treatment of €100 or €300. The remaining tasks are carried out in the same order as before the Holt and Laury task, however, in the remaining treatment. In this case, we assume that the experiment was conductedon 11/02/2014 to illustrate the calendar sheets.]

Please choose between payment A and B in each row!

We offer you choices between two secure money amounts: Payout A and Payout B. You would receive **Payout A (€100) in three weeks**. **Payout B** you would receive **in twelve weeks**. The stated interest rate illustrates the percentage at which **€100** have to be **compounded** in order to receive Payment B.

[…]

Please decide in <u>each</u> row for payment A or B.

	Payment option **A** in **3 weeks**		Payment option **B** in **12 weeks**	*Annual interest rate*	*Annual effective interest rate*
1	**€100.00**	A ○ ○ B	**€100.00**	*0.00%*	*0.00%*
2	**€100.00**	A ○ ○ B	**€100.17**	*1.00%*	*1.01%*
3	**€100.00**	A ○ ○ B	**€100.35**	*2.00%*	*2.02%*
4	**€100.00**	A ○ ○ B	**€100.69**	*4.00%*	*4.08%*
5	**€100.00**	A ○ ○ B	**€101.04**	*6.00%*	*6.18%*
6	**€100.00**	A ○ ○ B	**€101.39**	*8.00%*	*8.33%*
7	**€100.00**	A ○ ○ B	**€101.74**	*10.00%*	*10.52%*
8	**€100.00**	A ○ ○ B	**€102.09**	*12.00%*	*12.75%*
9	**€100.00**	A ○ ○ B	**€102.45**	*14.00%*	*15.02%*
10	**€100.00**	A ○ ○ B	**€102.80**	*16.00%*	*17.35%*
11	**€100.00**	A ○ ○ B	**€103.15**	*18.00%*	*19.72%*
12	**€100.00**	A ○ ○ B	**€103.51**	*20.00%*	*22.13%*
13	**€100.00**	A ○ ○ B	**€103.96**	*22.50%*	*25.22%*
14	**€100.00**	A ○ ○ B	**€104.41**	*25.00%*	*28.39%*
15	**€100.00**	A ○ ○ B	**€105.31**	*30.00%*	*34.97%*
16	**€100.00**	A ○ ○ B	**€107.14**	*40.00%*	*49.15%*
17	**€100.00**	A ○ ○ B	**€109.01**	*50.00%*	*64.82%*
18	**€100.00**	A ○ ○ B	**€113.81**	*75.00%*	*111.54%*
19	**€100.00**	A ○ ○ B	**€118.81**	*100.00%*	*171.46%*
20	**€100.00**	A ○ ○ B	**€129.48**	*150.00%*	*346.79%*

Please choose between lottery A and B!

We offer you the opportunity to choose between a potential payout of €100 in three weeks (lottery A) or in twelve weeks (lottery B). In **lottery A,** you receive **€100 or €0** with a **probability of 50 per cent** each in **three weeks**. However, in **lottery B,** you receive **€100 or €0** in **twelve weeks**. The probability to receive €100 increases throughout the decision situations from **50 per cent up to 64.7 per cent**

[…]

Please decide in <u>each</u> row for lottery A or B.

	Lottery A Chance of **€100** in **3 weeks**		Lottery B Chance of **€100** in **12 weeks**
1	**50%**	A ○ ○ B	**50.0%**
2	**50%**	A ○ ○ B	**50.1%**
3	**50%**	A ○ ○ B	**50.2%**
4	**50%**	A ○ ○ B	**50.4%**
5	**50%**	A ○ ○ B	**50.5%**
6	**50%**	A ○ ○ B	**50.7%**
7	**50%**	A ○ ○ B	**50.9%**
8	**50%**	A ○ ○ B	**51.1%**
9	**50%**	A ○ ○ B	**51.2%**
10	**50%**	A ○ ○ B	**51.4%**
11	**50%**	A ○ ○ B	**51.6%**
12	**50%**	A ○ ○ B	**51.8%**
13	**50%**	A ○ ○ B	**52.0%**
14	**50%**	A ○ ○ B	**52.2%**
15	**50%**	A ○ ○ B	**52.7%**
16	**50%**	A ○ ○ B	**53.6%**
17	**50%**	A ○ ○ B	**54.5%**
18	**50%**	A ○ ○ B	**56.9%**
19	**50%**	A ○ ○ B	**59.4%**
20	**50%**	A ○ ○ B	**64.7%**

Please choose between lottery A and B in each row!

You can decide between lotteries A and B. With certain probabilities, you receive **€180.00 or €144.00 in lottery A** and **€346.50 or €9.00 € in lottery B**.

[…]

Please decide in <u>each</u> row for lottery A or B.

	Lottery A		Lottery B
1	With 5% gain of €180.00 With 95% gain of €144.00	A ○ ○ B	With 5% gain of €346.50 With 95% gain of €9.00
2	With 10% gain of €180.00 With 90% gain of €144.00	A ○ ○ B	With 10% gain of €346.50 With 90% gain of €9.00
3	With 15% gain of €180.00 With 85% gain of €144.00	A ○ ○ B	With 15% gain of €346.50 With 85% gain of €9.00
4	With 20% gain of €180.00 With 80% gain of €144.00	A ○ ○ B	With 20% gain of €346.50 With 80% gain of €9.00
5	With 25% gain of €180.00 With 75% gain of €144.00	A ○ ○ B	With 25% gain of €346.50 With 75% gain of €9.00
6	With 30% gain of €180.00 With 70% gain of €144.00	A ○ ○ B	With 30% gain of €346.50 With 70% gain of €9.00
7	With 35% gain of €180.00 With 65% gain of €144.00	A ○ ○ B	With 35% gain of €346.50 With 65% gain of €9.00
8	With 40% gain of €180.00 With 60% gain of €144.00	A ○ ○ B	With 40% gain of €346.50 With 60% gain of €9.00
9	With 45% gain of €180.00 With 55% gain of €144.00	A ○ ○ B	With 45% gain of €346.50 With 55% gain of €9.00
10	With 50% gain of €180.00 With 50% gain of €144.00	A ○ ○ B	With 50% gain of €346.50 With 50% gain of €9.00
11	With 55% gain of €180.00 With 45% gain of €144.00	A ○ ○ B	With 55% gain of €346.50 With 45% gain of €9.00
12	With 60% gain of €180.00 With 40% gain of €144.00	A ○ ○ B	With 60% gain of €346.50 With 40% gain of €9.00
13	With 65% gain of €180.00 With 35% gain of €144.00	A ○ ○ B	With 65% gain of €346.50 With 35% gain of €9.00
14	With 70% gain of €180.00 With 30% gain of €144.00	A ○ ○ B	With 70% gain of €346.50 With 30% gain of €9.00
15	With 75% gain of €180.00 With 25% gain of €144.00	A ○ ○ B	With 75% gain of €346.50 With 25% gain of €9.00
16	With 80% gain of €180.00 With 20% gain of €144.00	A ○ ○ B	With 80% gain of €346.50 With 20% gain of €9.00
17	With 85% gain of €180.00 With 15% gain of €144.00	A ○ ○ B	With 85% gain of €346.50 With 15% gain of €9.00
18	With 90% gain of €180.00 With 10% gain of €144.00	A ○ ○ B	With 90% gain of €346.50 With 10% gain of €9.00
19	With 95% gain of €180.00 With 5% gain of €144.00	A ○ ○ B	With 95% gain of €346.50 With 5% gain of €9.00
20	With 100% gain of €180.00 With 0% gain of €144.00	A ○ ○ B	With 100% gain of €346.50 With 0% gain of €9.00

Please choose in each row between payment A and B!

We offer you choices between two secure amounts of money: Payout A and Payout B. You would receive **Payout A (€300) in three weeks** and **Payout B in twelve weeks**. The stated interest rate illustrates the percentage at which **€300** have to be **compounded** in order to receive Payment B.

[…]

Please decide in <u>each</u> row for payment A or B.

	Payment option **A** in **3 weeks**		Payment option **B** in **12 weeks**	*Annual interest rate*	*Annual effective interest rate*
1	**€300.00**	A ○ ○ B	**€300.00**	*0.00%*	*0.00%*
2	**€300.00**	A ○ ○ B	**€300.52**	*1.00%*	*1.01%*
3	**€300.00**	A ○ ○ B	**€301.04**	*2.00%*	*2.02%*
4	**€300.00**	A ○ ○ B	**€302.08**	*4.00%*	*4.08%*
5	**€300.00**	A ○ ○ B	**€303.12**	*6.00%*	*6.18%*
6	**€300.00**	A ○ ○ B	**€304.17**	*8.00%*	*8.33%*
7	**€300.00**	A ○ ○ B	**€305.22**	*10.00%*	*10.52%*
8	**€300.00**	A ○ ○ B	**€306.28**	*12.00%*	*12.75%*
9	**€300.00**	A ○ ○ B	**€307.34**	*14.00%*	*15.02%*
10	**€300.00**	A ○ ○ B	**€308.40**	*16.00%*	*17.35%*
11	**€300.00**	A ○ ○ B	**€309.46**	*18.00%*	*19.72%*
12	**€300.00**	A ○ ○ B	**€310.53**	*20.00%*	*22.13%*
13	**€300.00**	A ○ ○ B	**€311.88**	*22.50%*	*25.22%*
14	**€300.00**	A ○ ○ B	**€313.22**	*25.00%*	*28.39%*
15	**€300.00**	A ○ ○ B	**€315.94**	*30.00%*	*34.97%*
16	**€300.00**	A ○ ○ B	**€321.43**	*40.00%*	*49.15%*
17	**€300.00**	A ○ ○ B	**€327.02**	*50.00%*	*64.82%*
18	**€300.00**	A ○ ○ B	**€341.42**	*75.00%*	*111.54%*
19	**€300.00**	A ○ ○ B	**€356.43**	*100.00%*	*171.46%*
20	**€300.00**	A ○ ○ B	**€388.45**	*150.00%*	*346.79%*

Please choose between lottery A and B!

We offer you the opportunity to choose between a potential payout of €100 in three weeks (lottery A) or in twelve weeks (lottery B). In **lottery A,** you receive **€300 or €0** with a **probability of 50 per cent** each in **three weeks**. However, in **lottery B,** you receive **€300 or €0** in **twelve weeks**. The probability to receive €100 increases throughout the decision situations from **50 per cent up to 64.7 per cent**

[…]

Please decide in <u>each</u> row for lottery A or B.

	Lottery A Chance of **€300** in **3 weeks** 		Lottery B Chance of **€300** in **12 weeks** 
1	**50%**	A ○ ○ B	**50.0%**
2	**50%**	A ○ ○ B	**50.1%**
3	**50%**	A ○ ○ B	**50.2%**
4	**50%**	A ○ ○ B	**50.4%**
5	**50%**	A ○ ○ B	**50.5%**
6	**50%**	A ○ ○ B	**50.7%**
7	**50%**	A ○ ○ B	**50.9%**
8	**50%**	A ○ ○ B	**51.1%**
9	**50%**	A ○ ○ B	**51.2%**
10	**50%**	A ○ ○ B	**51.4%**
11	**50%**	A ○ ○ B	**51.6%**
12	**50%**	A ○ ○ B	**51.8%**
13	**50%**	A ○ ○ B	**52.0%**
14	**50%**	A ○ ○ B	**52.2%**
15	**50%**	A ○ ○ B	**52.7%**
16	**50%**	A ○ ○ B	**53.6%**
17	**50%**	A ○ ○ B	**54.5%**
18	**50%**	A ○ ○ B	**56.9%**
19	**50%**	A ○ ○ B	**59.4%**
20	**50%**	A ○ ○ B	**64.7%**

Part 2: Information about the agricultural operation and your person

Now, we would like to ask you a few questions about your farm. In addition, we explicitly point out that all results of the survey will be used exclusively in an anonymous form.

[…]

Finally, we would like to ask you a few questions about your person. As mentioned above, all results of the experiment will be used exclusively in anonymous form.

[…]

How do you assess your financial situation compared to other farmers?	○ 0	- significantly worse
	○ 1	
	○ 2	
(Please indicate the value that fits your financial situation best.)	○ 3	
	○ 4	
	○ 5	- average
	○ 6	
	○ 7	
	○ 8	
	○ 9	
	○ 10	- much better

[…]

Diskussionspapiere

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Institut für Agrarökonomie
Georg-August-Universität, Göttingen

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Die Wurzeln der **Fakultät für Agrarwissenschaften** reichen in das 19. Jahrhundert zurück. Mit Ausgang des Wintersemesters 1951/52 wurde sie als siebente Fakultät an der Georgia-Augusta-Universität durch Ausgliederung bereits existierender landwirtschaftlicher Disziplinen aus der Mathematisch-Naturwissenschaftlichen Fakultät etabliert.

1969/70 wurde durch Zusammenschluss mehrerer bis dahin selbständiger Institute das **Institut für Agrarökonomie** gegründet. Im Jahr 2006 wurden das Institut für Agrarökonomie und das Institut für Rurale Entwicklung zum heutigen **Department für Agrarökonomie und Rurale Entwicklung** zusammengeführt.

Das Department für Agrarökonomie und Rurale Entwicklung besteht aus insgesamt neun Lehrstühlen zu den folgenden Themenschwerpunkten:

- Agrarpolitik
- Betriebswirtschaftslehre des Agribusiness
- Internationale Agrarökonomie
- Landwirtschaftliche Betriebslehre
- Landwirtschaftliche Marktlehre
- Marketing für Lebensmittel und Agrarprodukte
- Soziologie Ländlicher Räume
- Umwelt- und Ressourcenökonomik
- Welternährung und rurale Entwicklung

In der Lehre ist das Department für Agrarökonomie und Rurale Entwicklung führend für die Studienrichtung Wirtschafts- und Sozialwissenschaften des Landbaus sowie maßgeblich eingebunden in die Studienrichtungen Agribusiness und Ressourcenmanagement. Das Forschungsspektrum des Departments ist breit gefächert. Schwerpunkte liegen sowohl in der Grundlagenforschung als auch in angewandten Forschungsbereichen. Das Department bildet heute eine schlagkräftige Einheit mit international beachteten Forschungsleistungen.

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