# I WILL NEVER SWITCH SIDES: AN EXPERIMENTAL APPROACH TO DETERMINE DRIVERS FOR INVESTMENT DECISIONS OF CONVENTIONAL AND ORGANIC HOG FARMERS

Daniel Hermann[1], Oliver Musshoff[1], Katrin Agethen[1]

[1] Georg-August-University of Göttingen, Faculty of Agricultural Sciences, Department of Agricultural Economics and Rural Development, Farm Management Group, Platz der Göttinger Sieben 5, D-37073 Göttingen, Germany
daniel.hermann@agr.uni-goettingen.de (corresponding author)


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**Abstract**

*Despite the economic benefits of organic farming, the conversion rates to this production method are low. The reasons for this reluctance are largely unknown; however, they are important for policy recommendations. Therefore, we experimentally investigate and compare the investment behavior of organic and conventional hog farmers. We examine the question of whether the investment behavior depends on the framing of the investment possibility as organic or conventional. The results provide evidence that investment decisions depend on the framing of an investment possibility and thus reveal that current subsidy structures may be inefficient for encouraging farmers to convert.*

**Keywords**: experimental economics; investment behavior; framing; organic farming; hog production

## 1. Introduction

In contrast to conventional farming, organic farming is considered to be more advantageous with regard to the provision of ecosystem services (Maeder et al., 2002). Thus, the European Union develops political measures to encourage and promote the expansion of organic farming (Läpple, 2010). In Germany, this aim has been quantified by the strategy for sustainable development of the German government (2012) which provides that 20% of the arable land in Germany should be used for organic farming. Even though the expansion of organic farming has been stimulated through governmental subsidies for a long time, still only a small proportion of the farms employ organic cultivation methods (AMI, 2013).

The comparable development applies to organic hog production. Despite the increasing demand for organic pork in Germany, only small quantities of organic hogs are produced (AMI, 2013). There is little evidence that conventional hog producers convert to organic production; the number of organic hog production farms is even decreasing (Statistisches Bundesamt, 2011). This is quite surprising from an economic perspective. Compared to conventional hog producers, organic producers reach a higher and more stable performance per fattening place that is free of direct costs (Zerger et al., 2010). The reasons for farmers' reluctance to invest and to switch to organic hog production are still unknown.

There are numerous contributions in which the investment behavior of farmers has been econometrically analyzed using field data. Studies have been conducted on the investment behavior of hog (Gardebroek and Oude Lansink, 2004) and dairy farmers (Thijssen, 1996). In addition, there have been econometric investigations of investments in new technologies, such as switching to organic farming (Koesling et al., 2008; Kuminoff and Wossink, 2010; Uematsu and Mishra, 2012). In these studies, the phenomenon whether farmers convert or do not convert to organic farming is exclusively explained by economic indicators. Hence, Kuminoff and Wossink (2010) state that profitability is the most important factor for a transition of production. Uematsu and Mishra (2012) provide empirical evidence that increasing proceeds from organic farming encourage conventional farmers to convert their production methods. Koesling et al. (2008) show that farms' factor endowment influences the farmers' decision to switch. Furthermore, the impact of the decision-makers' risk attitude on both their investment behavior (Knight et al., 2003) and their decision to convert to organic farming (Acs et al., 2009) has been discussed.

Studies from the field of behavioral economics reveal that the exclusive focus on economic influencing factors in decision making may be too narrow (Kahnemann, 2003). In the agricultural context, also non-economic decision-making determinants are examined for business and environmental behaviors of farmers (Willock et al., 1999). Moreover, investigations regarding the differences between organic and conventional farmers have been carried out corresponding-

ly. Mzoughi (2011) describes the differences between organic and conventional farmers with regard to their moral and social aspects. Läpple and Kelly (2013) attribute the absence of the switch to organic farming to social constraints. Previous studies about farmers' converting behaviors have not taken into account farmers' perceptions of the different production methods. From an investment-theoretic perspective, a ceteris paribus different presentation of a decision-making problem should not have any impact on the preferences of a rational actor. However, Tversky and Kahnemann (1981) point out that decision-makers can reach different perceptions and evaluations of projects, even if these projects show identical economic parameters. These differences originate from the decision makers' personal values and characteristics.

To answer the question about the influence of different perceptions of organic and conventional hog farmers on the investment behavior, the methodology of previous studies is not necessarily appropriate due to various reasons. These studies, for instance, analyze economic parameters from plant cultivation (Acs et al., 2009; Kuminoff and Wossink, 2010; Uematsu and Mishra, 2012) or from dairy farming (Thijssen, 1996). Thus, the transferability to hog farmers is rather difficult. Moreover, previous studies predominantly used field data-based econometric approaches (Koesling et al., 2008; Kuminoff and Wossink, 2010; Thijssen, 1996; Uetmatsu and Mishra, 2012) which has limitations regarding the analysis of investment behavior in general and the investigation of decision-makers' characteristics and personal motives in particular. Furthermore, the framework conditions influencing the decision are very heterogeneous between farms and farmers, including capital available, number of investment alternatives, individual attitudes, and preferences (Gardebroek and Oude Lansink, 2004; Kuminoff and Wossink, 2010; Thijssen, 1996). Moreover, it often is not possible to establish a connection between real investment decisions and the personal characteristics of the decision-makers.

Experiments are an alternative approach that avoid the mentioned limitations and allow a better description of farmers' investment behaviors. Experimental investigations permit constant framework conditions, and the data gathered in the course of the experiment are in the field data often not available. Thus, causal relationships become more evident, and the internal validity of the research results is strengthened (Chang et al., 2009).

The experimental investigation of farmers' decision-making and investment behaviors has already been discussed in the literature. For instance, previous studies examined the willingness to invest in arable land or irrigation systems (Ihli et al., 2012). However, differences in the investment behavior of organic and conventional farmers, especially in a hog finishing context, have not been analyzed experimentally. Therefore, the aim of this study is to experimentally investigate the investment behavior and the influence of the framing of an investment possibility as organic or conventional on hog farmers. Hence, the present study is an extension of the existing literature with regard to three aspects: First, to the best of our knowledge, this is the first experimental investigation of the investment behavior of hog farmers. Second, we examine the investment behavior of two groups: conventional and organic hog farmers. Third, the influence of the framing of investment decisions with the organic and conventional production method will be clarified. In this way, we hope to make an explanatory contribution to the question why conventional hog farmers are reluctant to invest in organic hog production. On this basis, we can derive recommendations for policymakers on how an expansion of organic hog production - if this is desired - can be promoted.

In section 2, hypotheses derive from the existing literature, while the experimental design is presented in section 3. Subsequently, section 4 presents the descriptive statistics and describes the used analyzing approach. In section 5, the validity of the hypotheses is tested. The article ends with conclusions and future research perspectives, provided in section 6.

## 2. Hypotheses

Tversky and Kahnemann (1981) conduct economic experiments to describe the framing effect. They show that the framing, in which a decision is made, is crucial for the participants of their experiments. Läpple and Kelly (2013) and Mzoughi (2011) suggest some indicators that imply

that the selection of the production method of farmers is not solely motivated by economic reasons. So far the effects of framing on the investment behavior of organic and conventional farmers have received little attention in the literature. This leads to the following hypothesis:

*Hypothesis 1 'framing': Organic and conventional farmers' willingness to invest decreases if they have the possibility to invest in a not-practiced production method for the same profit and risk.*

Agricultural production involves many different risks (Gardebroek, 2006). Hardaker et al. (1997:15; 86pp.) point out that risk factors and the decision-maker's risk attitude influence investment decisions. As a result, the willingness to make a risky investment decreases ceteris paribus with the decision-maker's risk aversion (Isik and Khanna, 2003). This leads to the following hypothesis:

*Hypothesis 2 'risk attitude': The higher a conventional or organic farmer's risk aversion, the lower his willingness to invest in a risky investment.*

Many socio-economic factors, such as age and educational background, may influence farmers' investment decisions (Gardebroek and Oude Lansink, 2004). In addition to the personal characteristics, Padel (2001) emphasizes the importance of the business structure for investment decisions. Läpple and van Rensburg (2011) examine the impact of various factors on the time of converting to organic farming and found the variables age, business structure, and personal attitudes to be correlated. This leads to the following hypothesis:

*Hypothesis 3 'socio-economic factors': Socio-economic factors influence the willingness to invest of conventional and organic hog farmers.*

## 3. Methodology

The aforementioned hypotheses will be tested using a computer-based experiment that is carried out with organic and conventional farmers. As the experiment is conducted with a nonstandard subject pool (farmers) and with agricultural context in the information set provided to the participants, it represents a framed field experiment (Harrison and List, 2004). This type of experiment provides high internal and external validity (Roe and Just, 2009) and is therefore used in other studies (Hill and Viceisza, 2012; Bouma and Ansink, 2013) also conducted with farmers (Cummings et al., 2004; Maart-Noelck and Musshoff, 2012). The experiment consists of four parts. In the first part, information about the participants' farms is gathered. Afterwards, an investment experiment with two consecutive treatments, namely the investment in an organic hog barn and in a conventional hog barn, is conducted. Each participant makes decisions in both treatments.[1] The order of the two treatments is randomized. According to the employed production method indicated in the first part of the experiment, the participants are divided into two groups (organic and conventional farmers).[2] Following the investment experiment, the participants' risk attitudes are determined using a Holt and Laury lottery (HLL) (Holt und Laury, 2002). Both the investment experiment and the lottery involve financial incentives. Subsequently, socio-economic data of the participants is collected.

Before the investment experiment starts, all participants are informed about the underlying assumptions and values as well as about the calculation of financial incentives. The participants' understanding regarding the framework conditions is tested using control questions. Moreover, they are made familiar with the experiment in a trial run and thus receive an overview of the calculation of the total yield of their decision obtained in the trial run. The structure of the core elements of the experiment is described in detail in the following.

[1] We obtain observations from each participant that facilitate the comparison of the different behavior an individual shows in the two treatments which, therefore, results in a stronger statistical power of the research findings (Charness et al. 2012).

[2] The randomization of the treatments between the groups avoids the bias of possible learning effects and facilitates a separate termination of the experiment according to the production methods.

### *3.1. Structure of the investment experiment*

The investment experiment consists of two times ten repetitions of a game with the same underlying structure. One repetition consists of five periods in which the participants can decide for and against an investment in a hog barn. Within the 5 periods a participant can only invest once. The investment costs of €300,000 remain constant over the five periods. Participants start each repetition with liquid assets in the amount of €300,000. For the liquid assets available, participants receive a risk-free interest rate of 10% at the end of each period. In each repetition, participants have three options available: They can either invest in the hog barn in period 0 or once within the following periods 1 to 4. Alternatively, participants can also decide against the investment over all periods. If a participant invests in a hog barn, he/she can realize the investment returns that correspond to the uncertain present value of the annual returns from the hog barn over its useful lifetime of 20 years. In accordance with Dixit and Pindyck (1994: 26pp.), it is assumed for simplification reasons that the annual returns, in the case of an investment, are hedged by a corresponding insurance over the whole production period. The investment returns are, however, realized in the period following the period of the investment implementation and are, therefore, uncertain at the time of implementing the investment. In each repetition, participants are supposed to earn as much capital as possible since the total capital forms the calculation basis of possible real payoffs for the participants.

A binomial tree visualizes all possible developments of the uncertain present value of the returns from the investment in a hog barn. The binomial tree start from investment returns of €300,000 in period 0 in each repetition of the experiment. The investment returns are realizations of an arithmetic Brownian motion (Dixit and Pindyck, 1994: 59pp.) without drift and with a standard deviation of €60,000 per period. The probability that the uncertain investment returns increase by €60,000 in the subsequent period is 50%. In the course of the experiment, the binomial tree shown to the participants adjusts automatically to the decisions made and the stochastic development of the investment returns. Furthermore, the possible investment returns and the recalculated probabilities of occurrence are displayed to the participants.

In the investment experiment, decisions to invest in organic and conventional hog production are to be made during ten repetitions, respectively. Organic and conventional hog production do not differ in possible economic parameters; there are only differences with respect to the decision-making situation, that is the framing. Before the ten repetitions start, participants always are made aware of whether they deal with the organic or conventional treatment. It is described and illustrated by using figures that it is possible to invest in an organic or in a conventional hog barn. After the participants have finished all ten repetitions of one treatment, they are passed on to the other treatment. The two investment treatments appear in a randomized order meaning that 50% of the group of organic farmers as well as 50% of the group of conventional farmers first deal with the organic investment treatment before they continue with the conventional treatment and vice versa. This randomization should help to improve the internal validity and reliability (Harrison et al., 2009).[3]

### *3.2. Structure of the lottery*

Data about the participants' risk attitudes is collected using a variant of the HLL (Holt und Laury, 2002; Viscusi et al., 2011). Here, participants can choose from an alternative A and B. In alternative A, participants can win either €200 or €160 with a given probability, while, in alternative B, they can earn €385 and €10 with a given probability. Thus, lottery B is more risky than lottery A. In 10 decision situations, the participants have to choose one of the two alternatives, while the probabilities are systematically varied in a way that the expected value changes in each decision situation. Starting with a probability of 10% for the higher gain (€200 in A; €385 in B), the probability of winning the larger amount in each alternative is increased by 10% in each decision situation down to decision-making situation ten, where the probability of winning the lager amount is

[3] For a detailed description of the experiment, please do not hesitate to contact the corresponding author.

100%. The more often a participant chooses lottery A, the higher the HLL value (number of safe choices) and the more risk averse the person. Three types of risk attitudes can be distinguished (Holt und Laury, 2002). A HLL value of 0 to 3 stands for a risk-loving attitude, a value of 4 represents a risk-neutral attitude, and a value of 5 to 10 means that a participant is risk averse.[4]

### *3.3. Financial incentives*

Before the experiment started, participants were informed about the probability to win, the range of possible earnings, and the variables influencing the amount of earnings. We use in our experiment a combination of fixed and cash payouts depended on the success in the experiment. This is a recognized procedure for financial incentives in experiments (Maart-Noelck and Musshoff, 2013). For completing the experiment, each participant received an expense allowance of €10. The investment experiment and the lottery had an incentive-compatible design and were linked to real payouts. The payout of the investment experiment results from the total capital achieved in a randomly selected repetition divided by 750. The possible earnings from the lottery arise from the task formulation. We have provided that one random participant is selected out of 100 to receive a cash payout. If a participant won, his/her earnings from the investment experiment were added to those from the lottery. The potential earnings varied between €96 and €1,590. The amount of the possible earnings is determined by chance as well as by the decisions made by the participants in the investment experiment and lottery.

## 4. Descriptive statistics and data analysis

In this section, we provide descriptive information about the participants' characteristics. Subsequently, we will present the methodological approach used for data analysis.

### *4.1. Descriptive statistics*

The experiment participants were acquired by contacting German associations in the sector of hog production and organic farming as well as certification bodies for organic farming and working groups. The link to access the online survey was sent to the aforementioned institutions in spring 2013. On average, participants needed 31 minutes to complete the experiment. The descriptive statistics shown in Table 1 demonstrate the socio-economic characteristics and the operative farm structure of the experimental sample.

**Table 1.** Descriptive statistics

| | Organic farmers (n=33) | | Conventional farmers (n=50) | |
|---|---|---|---|---|
| | Mean | *SD* | Mean | *SD* |
| Average HLL value | 5.3 | *2.2* | 6.0 | *2.4* |
| Proportion of female participants (%) | 12.1 | | 2.0 | |
| Average age in years | 41.9 | *10.5* | 38.9 | *8.9* |
| Participants holding a university degree (%) | 51.5 | | 52.0 | |
| Participants holding an agricultural degree (%) | 81.8 | | 100.0 | |
| Farm is main source of income (%) | 81.8 | | 92.0 | |
| Average size of farmland (ha) | 91.9 | *93.9* | 98.6 | *61.0* |
| Average number of hogs | 179.6 | *236.1* | 1,696.2[a] | *1,574.3* |
| Average number of breeding hogs | 58.0[b] | *53.1* | 236.0[c] | *155.5* |
| Willingness to invest in the own farm business (%) | 54.5 | | 32.0 | |

[a] n = 49; [b] n = 14; [c] n = 26

Among the 83 participants, there are 33 organic farmers and 50 conventional farmers. On average, organic as well as conventional farmers can be considered to be risk averse. The results

[4] For an application of the HLL in an agricultural context, we refer to Brick et al. (2012).

of the HLL reveal an average HLL value of 5.3 for organic farmers, while the value for conventional farmers is 6.0, indicating a higher risk aversion for this group.

### *4.2. Approach to data analysis*

Our data set shows specific characteristics that motivate the choice of our analysis method. We investigate whether participants exercise a given investment option at different discrete points in time (periods) within the 20 repetitions of the experiment. In other words, the time that has elapsed up to a certain event (here the investment). Furthermore, in each repetition also the possibility not to exercise the investment option and, thus, not to invest is available. These observations of not exercised investment options make clear that the data are right censored.

Taking into account the characteristics of the data, our analysis is based on the statistical method of Survival Analysis; in more detail, the Cox regression (Cox, 1972) also known as proportional hazard model and the Kaplan-Meier survival estimator (Kaplan and Meier, 1958) are applied. We use the Cox regression to assess the impact of specific variables on the farmers' investment decisions. Since the condition of time independence is not fulfilled, we adapt the Cox regression as suggested by Schemper et al. (2009) as the so-called weighted Cox regression to receive robust estimations. Furthermore, we use the Kaplan-Meier survival estimator (Kaplan and Meier, 1958), as modified by Kiefer (1988), to deal with censored data for a more detailed analysis and a more descriptive approach. In the present study, we apply the concept of hazard rate as the rate of investment, meaning that if participants implement the investment their investment option 'dies'.

## 5. Testing of hypotheses

In the following, the hypotheses formulated in section 2 are tested. The weighted Cox regression is in the focus of hypotheses testing. In addition, the Kaplan-Meier function is used for detailed analysis.

To investigate the influence of different factors on the investment behavior of hog farmers, we carried out a weighted Cox regression. By doing so, the connection between the independent variables and the probability to implement an investment can be analyzed. The results of the Cox regression are presented in Table 2. Coefficients with negative signs indicate that the explanatory variable has a retarding effect on the investment implementation and the number of the investment options that have not been realized will increase.

**Table 2.** Weighted Cox regression (N=1,660)

| Explanatory variable | Coefficient | p-value | |
|---|---|---|---|
| Conventional farmers in organic treatment (1=yes) | -0.340 | <0.001 | *** |
| Organic farmers in conventional treatment (1=yes) | -0.723 | <0.001 | *** |
| HLL value | -0.051 | <0.001 | *** |
| Repetition | -0.018 | <0.001 | *** |
| Farm type (1=organic) | 0.261 | <0.001 | *** |
| Gender (1=male participant) | 0.529 | <0.001 | *** |
| Age | -0.005 | 0.098 | |
| University degree (1=holding a university degree) | -0.172 | <0.001 | *** |
| Agricultural education (1=holding an agricultural degree) | -0.400 | <0.001 | *** |
| Source of income (1=farm is main source of income) | -0.093 | 0.219 | |
| Number of hogs kept | $-4 \cdot 10^{-5}$ | 0.059 | |
| Willingness to invest (1=yes/possibly) | 0.354 | <0.001 | *** |

Wald-$x^2$=310; Significance level * = p<0.05, ** = p<0.01, *** = p<0.001

*5.1. Hypothesis 1 'framing'*

The highly significant and negative coefficients of the dummy variable 'conventional farmers in organic treatment' and 'organic farmers in conventional treatment' mean that farmers are more reluctant to invest in the treatment that does not describe the production method that are currently practicing on their farms. Thus, conventional farmers are more reluctant to invest in the organic treatment, whereas organic farmers are more reluctant to invest in the conventional treatment. The coefficients of the weighted Cox regression imply that this reluctance to invest is more pronounced for organic farmers in the conventional treatment than for conventional farmers in the organic treatment.

For a better visualization and more detailed analysis of the results, Figure 1 shows the survival functions[5] for the investment options in the two treatments of the experiment for organic and conventional farmers. The x-axis shows the periods with option to invest, while the y-axis shows the percentage of all investment options that have not been realized. Higher lines indicate that the decision-makers are more reluctant to invest.

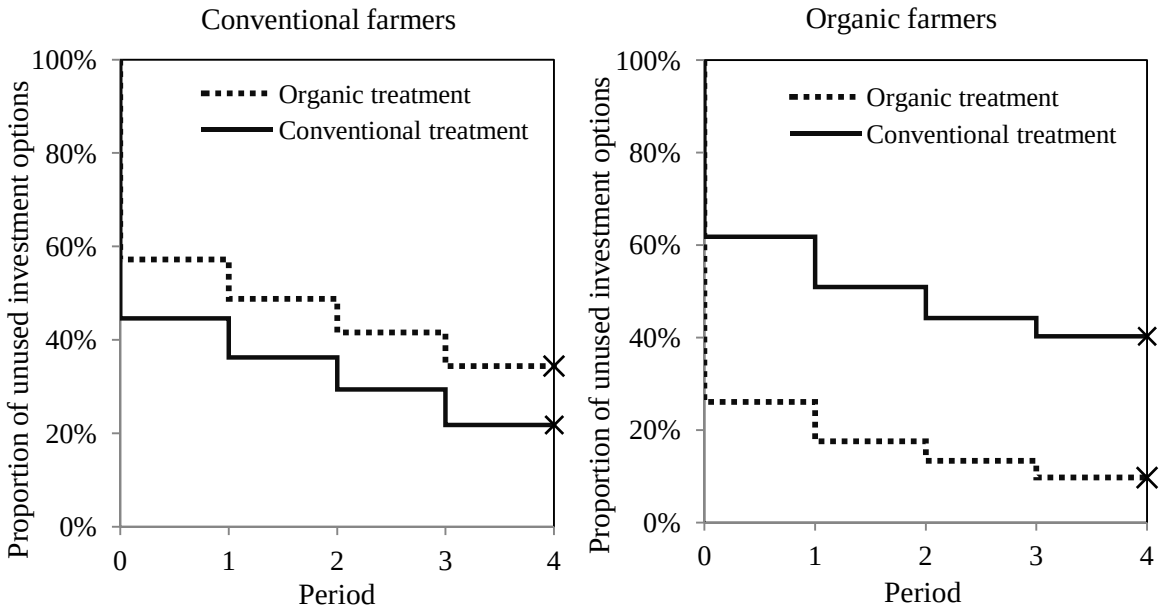


**Figure 1.** Survival functions of the investment options in both treatments for organic and conventional farmers

The survival functions of organic as well as conventional farmers differ highly significantly (Log-Rank test, $p<0.001$) between both investment treatments. The use of the investment option by organic farmers is more extensive in the organic than in the conventional treatment, shown by the higher survival function of the conventional treatment. The opposite is true for the conventional farmers, who are more reserve to use the investment option in the organic treatment. This means that organic and conventional farmers are more reluctant to invest in the production method, which they are not practicing on their own farm, than in their current production method. This confirms the results of the Cox regression (Table 2). The higher difference between the use of the investment option of the current and the alternative production method that is observed for organic farmers shows a stronger reluctance to invest for this group of participants.

Despite equal economic parameters for the investment in organic or conventional hog production, significant differences of the investment behavior occur between the group of farmers and the investment treatments. The framing, meaning the description of the treatment as organic

[5] The Kaplan-Meier estimator between organic and conventional farmers and the treatments can be distorted by different paths of investment returns over the periods. In this case, differences in the investment behavior would be caused by the different realizable investment returns. Due to this reason, we first tested all Kaplan-Meier estimators regarding equal paths of the investment returns in order to exclude this bias.

or conventional investment alternative, influences the investment behavior. Differences appear regarding the time to implement an investment and the probability to invest. On the basis of these results, hypothesis 1 cannot be rejected.

Especially for current organic farmers, the influence of the framing effects on their investment implementation is very high. These farmers deny considerably more often the investment in the conventional method of production than their conventional counterparts refuse to invest in organic production. One possible reason for this behavior might be the higher importance of ecology and environment for organic farmers (Läpple, 2010). Mzoughi (2011) establish a positive correlation between moral and social concerns and the investment behavior in environmentally friendly technologies, such as organic farming. Gardebroek (2006) and Uematsu and Mishra (2012) make some indications that social and psychological factors prevent farmers from switching to organic farming. These factors together with traditional moral values can be explanatory approaches for the significant difference in the behavior of conventional farmers.

*5.2. Hypothesis 2 'risk attitude':*

The results of the weighted Cox-Regression displayed in Table 2 include the variable 'HLL value' which is bounded between 0 and 10. The coefficient (-0.051) of the variable in the Cox regression describes the influence of the value from the HLL lottery of a farmer on his/her investment implementation. Furthermore, it is negative and highly significant ($p<0,001$), meaning that the higher the HLL value or the more risk averse a farmer is, the more reluctant he/she is to invest. Viscusi et al. (2011) report on comparable results. This gives us a first indication that risk-averse farmers implement an investment later.

For a further testing of hypothesis 2, we use the results of the Holt and Laury lottery and divide the participants into three risk categories: 'risk loving', 'risk neutral', and 'risk averse'. The survival function in Figure 2 shows that risk-loving participants decide to invest earlier than risk-neutral participants. For risk-averse decision-makers the longest deferment of the investment implementation was determined. The survival function of risk-loving farmers has a significantly different shape compared to the shape of the survival function of risk-averse (Log-Rank test, $p=0.001$) and risk-neutral (Log-Rank test, $p=0.046$) farmers. In contrast, the survival function of risk-averse and risk-neutral farmers does not differ significantly from each other (Log-Rank test, $p=0.184$).

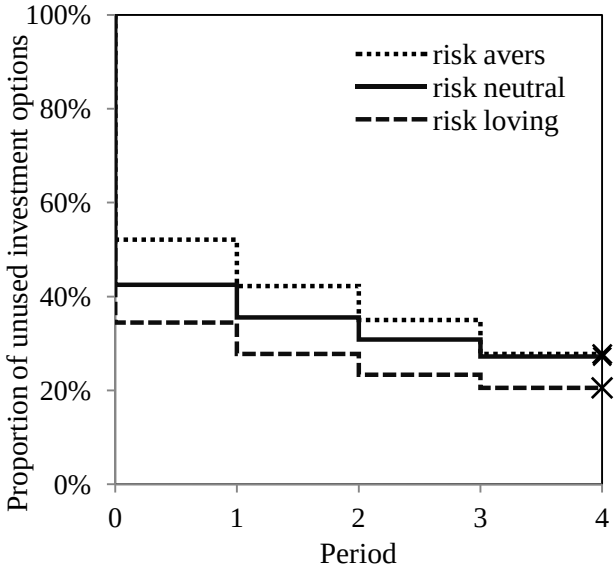


**Figure 2.** Survival functions of the investment options for the three categories of risk attitude

If the investment behavior of the risk attitudes is analyzed separately according to the method of production and investment treatments, it becomes clear that the risk attitude influences the farmers' willingness to invest in their own and in the alternative method of production. Risk-

loving farmers do not differentiate statistically between their own and the alternative method of production (Log-Rank test, p=0.247). The situation is different among risk-averse decision-makers, where the comparison reveals a highly significant difference (Log-Rank test, p<0.001). This is the case within the group of organic as well as conventional farmers. Risk-averse decision-makers are more reluctant to invest in the alternative production method. Thus, we are allowed to confirm the field data-based results of Acs et al. (2009) and Knigth et al. (2003). Furthermore, it can be suspected that risk-averse decision-makers combine a risk to the investment in an alternative production method that is not based on the economic parameters. The analysis reveals that risk attitudes influences farmers' investment behaviors. Thus, hypothesis 2 cannot be rejected.

### *5.3. Hypothesis 3 'socio-economic factors':*

Table 2 shows the socio-economic variables we examine in the Cox regression. The variable 'repetition' was included in the model in order to take into account the influence of possible learning effects on the probability to invest. It can have the values 1 to 20 corresponding to the two times 10 repetitions that the decision-maker has to face. The dummy variable 'repetition' is negative and highly significant (p<0.001). The time of investment shifts to a later period with an increasing number of repetitions that a decision-maker can complete. Consequently, learning effects can be observed which are also pointed out by Maart-Noelck and Musshoff (2012) and Oprea et al. (2009).

The dummy variable 'farm type' is included to detect if the investment behavior of organic and conventional farmers is different in the treatment where they are deciding to invest or not in their own production method. The coefficient has a positive and highly significant (p<0.001) influence on the investment behavior. Organic farmers invest earlier in the organic treatment than conventional farmers' in the conventional treatment.

The influence of the variable 'gender' is highly significant (p<0.001). This finding has to be carefully interpreted as only five women participated in the experiment. Female decision-makers invest later than male farmers. This result is consistent with the findings of Jianakoplos and Bernasek (1998); however, it contradicts the findings of Maart-Noelck and Musshoff (2012). The results of Dohmen et al. (2011) and Gardebroek and Oude Lansink (2004), revealing that the willingness to invest decreases with an increasing age of the participants, cannot be confirmed. Nevertheless, our results show a similar trend. 'Age', however, does not have any significant (p=0.098) influence on the time of the investment implementation (consistent with Maart-Noelck and Musshoff, 2013). The dummy variables 'university degree' and 'agricultural education' show a highly significant (p<0.001) negative influence on the probability to invest. Jianakoplos and Bernasek (1998) ) and Maart-Noelck and Musshoff (2012) reached similar results, while Gardebroek and Oude Lansink (2004) and Knight et al. (2003) found a positive correlation between education and willingness to invest.

Our results do not support the findings of Adesina et al. (2000) that farms where the agricultural business is the main source of income are more reluctant to invest. It is not possible to confirm a significant correlation (p=0.219) between the source of income and the probability to invest on the basis of the experimental data. Also, the number of hogs and, therefore, the farm size does not have any significant influence on the time of investment. The dummy variable 'willingness to invest' influences the probability to make an investment in a positive and highly significant manner. Decision-makers who indicate planning to invest in hog production are more willing to invest. Consequently, they transfer their willingness to invest to their decisions in the investment experiment. On the basis of the finding that socio-economic variables influence the investment implementation, hypothesis 3 cannot be rejected.

## 6. Conclusions

Organic farming and in particular organic hog production in Germany is not as prevalent as desired by policymakers. Farmers are reluctant to invest in organic hog production even though recent market and price analyses have revealed economic potentials for this branch of industry.

The investment behavior is influenced by a range of factors. Economic approaches based on field data answer one part of the scientifically relevant questions regarding investment behavior. So far, the different investment behaviors of organic and conventional farmers have been explained only to a limited extent. Until now, no studies have examined the effect of framing investment possibilities as organic and conventional. To examine this effect of framing of an investment possibility and to identify further influencing factors of the investment behavior, the present study applies an experimental approach. The investment decisions are investigated in an experimental setting, where decision-makers are repeatedly faced with decision-making situations regarding the investment in organic or conventional hog barns.

We reveal that the framing of the investment alternatives as organic or conventional has an effect, which can contribute to explaining the observed differences in the investment behavior of organic and conventional farmers. For organic as well as conventional farmers, a significant reluctance to invest in the other economically equal type of production was observed. On the one hand, this supports the hypothesis that organic farmers are strongly attached to their method of production by conviction and values. On the other hand, this also indicates that conventional farmers have a low willingness to invest in organic farming. Moreover, the risk attitude has a significant influence on the investment behavior. Risk-loving decision-makers reveal a higher willingness to invest and distinguish less between their own and an alternative method of production, while risk-averse decision-makers are more reluctant to invest in general and invest later in an alternative production method in particular. Conventional farmers and farmers holding a university degree invest later during the whole experiment. Thus, it does not appear to be adequate to reduce the discussion about the conversion and investment behavior to the economic evaluation of the two methods of production.

The possibility to expand organic hog production by switching from the conventional counterpart is influenced due to framing effects and farmers are thereby possibly more reluctant. If politically intended, more public information campaigns and a change in the perception of organic farming would be possible instruments to reduce the inhibition levels of conventional farmers. Therefore, subsidies as a policy tool to encourage the conversion of conventional farms to organic farming are thus not as effective as would be expected, assuming a profit maximizing decision maker. The framing effects might be encountered through economic incentives or educational work in the context of an information policy.

For future research, examining the enhancement of the attractiveness of organic hog production to conventional farmers could be recommended. In a further step, organic farmers, who have not entered the business of organic hog production, could also be included in the investigation and could be asked about their willingness to invest in this branch of production. In addition, further research could contribute to the existing literature by identifying the most appropriate approach to reduce the perception-based investment inhibition levels. To do so, the reasons for framing effects need to be examined.

## References


Acs, S., Berentsen, P., Huirne, R., van Asseldonk, M. (2009). Effect of yield and price risk on conversion from conventional to organic farming. *Australian Journal of Agricultural and Resource Economics* 53: 393–411.

Adesina, A.A., Mbila, D., Nkamleu, G.B., Endamana, D. (2000). Econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of southwest Cameroon. *Agriculture, Ecosystems & Environment* 80: 255–265.

AMI (Agrarmarkt Informations-Gesellschaft mbH) (2013). *Markt Bilanz Öko-Landbau 2013*. Agrarmarkt Informations-Gesellschaft mbH, Bonn.

Bouma, J., Ansink, E. (2013). The role of legitimacy perceptions in self-restricted resource use: A framed field experiment. *Forest Policy and Economics* 37: 84–93.

Brick, K., Visser, M., Burns, J. (2012). Risk aversion: experimental evidence from South African fishing communities. *American Journal of Agricultural Economics* 94: 133–152.

Chang, J.B., Lusk, J.L., Norwood, F.B. (2009). How closely do hypothetical surveys and laboratory experiments predict field behavior? *American Journal of Agricultural Economics* 91: 518–534.
Charness, G., Gneezy, U., Kuhn, M. A. (2012). Experimental methods: between-subject and within-subject design. *Journal of Economic Behavior & Organization* 81: 1–8.
Cummings, R.G, Holt, C.A., Laury, S.K. (2004). Using laboratory experiments for policymaking: an example from the Georgia Irrigation Reduction Auction. *Journal of Policy Analysis and Management* 23: 341–363.
Cox, D.R. (1972). Regression models and life-tables. *Journal of the Royal Statistical Society. Series B (Methodological)* 34: 187–220.
Dixit, A.K., Pindyck, R. (1994). Investment under uncertainty. Princeton University Press, Princeton, New Jersey.
Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J. and Wagner, G.G. (2011). Individual risk attitudes: measurement, determinants and behavioral consequences. *Journal of the European Economic Association* 9: 522–550.
Gardebroek, C. (2006). Comparing risk attitudes of organic and non-organic farmers with a Bayesian random coefficient model. *European Review of Agricultural Economics* 33: 485–510.
Gardebroek, C., Oude Lansink, A. (2004). Farm-specific adjustment costs in Dutch pig farming. *Journal of Agricultural Economics* 55: 3–24.
German government (2012). *Nationale Nachhaltigkeitsstrategie. Fortschrittbericht 2012*. Bundesregierung, Berlin.
Hardaker, J.B., Huirne, R.B.M., Anderson, J.R. (1997). *Coping with risk in agriculture*. CAB International, Wallingford, Oxfordshire.
Harrison, G.W., Lau, M.I., Rutström, E. (2009). Risk attitudes, randomization to treatment, and self-selection into experiments. *Journal of Economic Behavior and Organization* 70: 498–507.
Harrison, G.W., List, J.A. (2004). Field Experiments. *Journal of Economic Literature* 42: 1009-55.
Hill R, Viceisza A (2012). A field experiment on the impact of weather shocks and insurance on risky investment. *Experimental Economics* 15: 341–371.
Holt, C.A., Laury, S.K. (2002). Risk aversion and incentive effects. *American Economic Review* 92: 1644–1655.
Ihli, H.J., Maart, S.C., Musshoff, O. (2013). Does timing matter? A real options experiment to farmers' investment and disinvestment behaviours. *Australian Journal of Agricultural and Resource Economics*, DOI: 10.1111/1467-8489.12028.
Isik, M., Khanna, M. (2003). Stochastic technology, risk preferences, and adoption of site-specific technologies. *American Journal of Agricultural Economics* 85: 305–317.
Jianakoplos, N.A., Bernasek A. (1998). Are woman more risk averse? *Economic Inquiry* 36: 620–630.
Kahneman, D. (2003). A psychological perspective on economics. *The American Economic Review* 93: 162–168.
Kaplan, E.L., Meier, P. (1958). Nonparametric estimation from incomplete observations. *Journal of the American Statistical Association* 53: 457–481.
Kiefer, N.M. (1988). Economic duration data and hazard functions. *Journal of Economic Literature* 26: 646–679.
Knight, J., Weir, S., Woldehanna, T. (2003). The role of education in facilitating risk-taking and innovation in agriculture. *Journal of Development Studies* 39: 1–22.
Koesling, M., Flaten, O., Lien, G. (2008). Factors influencing the conversion to organic farming in Norway. *International Journal of Agricultural Resources, Governance and Ecology* 7: 78–95.
Kuminoff, N.V., Wossink, A. (2010). Why isn't more US farmland organic? *Journal of Agricultural Economics* 61: 240–258.
Läpple, D. (2010). Adoption and abandonment of organic farming: an empirical investigation of the Irish drystock sector. *Journal of Agricultural Economics* 61: 697–714.
Läpple, D., Kelly, H. (2013). Understanding the uptake of organic farming: accounting for heterogeneities among irish farms. *Ecological Economics* 88: 11–19.

Läpple, D., van Rensburg, T. (2011). Adoption of organic farming: are there differences between early and late adoption? *Ecological Economics* 70: 1406–1414.
Maart-Noelck, S.C., Musshoff, O. (2012). Investing today or tomorrow? An experimental approach to farmers' decision behaviour. *Journal of Agricultural Economics* 64: 295–318.
Maart-Noelck, S.C., Musshoff, O. (2013). Measuring the risk attitude of decision-makers: are there differences between groups of methods and persons? *Australian Journal of Agriculture and Resource Economics*, DOI: 10.1111/j.1467-8489.2012.00620.x.
Maeder, P., Flieβbach, A., Dubois, D., Gunst, L., Fried, P., Niggli, U. (2002). Soil fertility and biodiversity in organic farming. *Science*, 296: 1694–1697.
Mzoughi, N. (2011). Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter? *Ecological Economics* 70: 1536–1545.
Oprea, R., Friedman, D., Anderson, S.T. (2009). Learning to wait: a laboratory investigation. *Review of Economic Studies* 76: 1103–1124.
Padel, S. (2001). Conversion to organic farming: a typical example of the diffusion of an innovation? *Sociologia Ruralis* 41: 40–61.
Prentice, R.L. (1978). Linear rank tests with right censored data. *Biometrika* 65: 167–179.
Roe, B.E., 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* 91: 1266–1271.
Schemper, M. (1992). Cox analysis of survival data with non-proportional hazard functions. *Journal of the Royal Statistical Society. Series D (The Statistician)* 41: 455–465.
Schemper, M., Wakounig, S., Heinze, G. (2009). The estimation of average hazard ratios by weighted Cox regression. *Statistics in Medicine* 28: 2473–2489.
Statistisches Bundesamt (2011). *Land- und Forstwirtschaft, Fischerei. Betriebe mit ökologischem Landbau. Landwirtschaftszählung/Agrarstrukturerhebung 2010*. Wiesbaden (Fachserie 3, Reihe 2.2.1).
Thijssen, G. (1996). Farmers' investment behavior: an empirical assessment of two specifications of expectations. *American Journal of Agricultural Economics* 78: 166–174.
Tversky, A., Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science* 211: 453–458.
Uematsu, H., Mishra, A.K. (2012). Organic farmers or conventional farmers: where's the money? *Ecological Economics* 78: 55–62.
Viscusi, W.K., Phillips, O.R., Kroll, S. (2011). Risky investment decisions: how are individuals influenced by their groups? *Journal of Risk and Uncertainty* 43: 81–106.
Willock, J., Deary, I. J., McGregor, M. J., Sutherland, A., Edwards-Jones, G., Morgan, O., Dent, J. B., Grieve, R. and Gibson, G. J. (1999). The role of attitudes and objectives in farmer decision making: business and environmentally-oriented behaviour in Scotland. *Journal of Agricultural Economics* 50: 286–303.
Zerger, U., Löser, R., Rasch, H., Deerberg, F., Volling, O., Ebert, U., Puffert, M., Kemptkens, K. (2010). *Aufbau eines bundesweiten Berater-Praxis-Netzwerks zum Wissensaustausch und Methodenabgleich für die Bereiche Betriebsvergleich (BV) und Betriebszweigauswertung (BZA).* Foundation Ecology & Agriculture (SÖL). Bad Dürkheim (FKZ: 06OE231).