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Investment behavior and status quo bias of conventional and organic hog farmers: An experimental approach

Daniel Hermann*, Oliver Mußhoff and Katrin Agethen

Faculty of Agricultural Sciences, Department for Agricultural Economics and Rural Development, Georg-August-University Göttingen, Platz der Göttinger Sieben 5, D-37073 Göttingen, Germany
*Corresponding author: daniel.hermann@agr.uni-goettingen.de

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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, understanding this behavior is important for policy recommendations. Therefore, we experimentally investigate and compare the investment behavior of organic and conventional hog farmers. We examine whether the investment behavior depends on the organic or conventional farmers' status quo of their production method. Our results show that farmers are more reluctant to invest in production methods they are not currently using compared with those already in use on their farm. Conventional, more risk-averse farmers, and those farmers holding a university degree, invest later in a hog barn. The results provide evidence that investment decisions depend on the status quo production method of a farmer and, thus, reveal that current subsidy structures may be ineffective in encouraging farmers to invest in production methods they are not currently using on their farms.

Key words: organic farming, investment behavior, status quo bias, experimental economics, hog production

Introduction

In contrast to conventional farming, organic farming is considered to be more advantageous in providing ecosystem services (Maeder et al., 2002; Scialabba and Müller-Lindenlauf, 2010). Thus, the European Union is developing political measures to encourage and promote the expansion of organic farming (Läpple, 2010). In Germany, the strategy for sustainable development of the German government (2012) aims for 20% of arable land in organic farming. Even though the expansion of organic farming has been stimulated through governmental subsidies for a long time, only a small proportion of the farms employ organic cultivation methods (AMI, Agrarmarkt Informations-Gesellschaft mbH, 2013).

This situation also applies to organic hog production. Despite the increasing demand for organic pork in Germany, only small quantities of organic hogs are farrowed and finished (AMI, Agrarmarkt Informations-Gesellschaft mbH, 2013), and national consumer demand is satisfied by imports (BÖLW, Bund Ökologische Lebensmittelwirtschaft E. V., 2012). There is little evidence that conventional hog producers would invest in organic production; the number of organic hog production farms is in fact decreasing (Statistisches Bundesamt, 2011). This is quite surprising from an economic perspective. Compared with conventional hog producers, organic producers obtain higher and more stable financial receipts per fattened hog (Zerger et al., 2010). The reasons for farmers' reluctance to invest in organic hog production are generally unknown. One explanation may the local problems with the disposal of organic products expected by the organic farmers (Schramek and Schnaut, 2004; Bello, 2008). In addition, organic hog production is more labor intensive than conventional hog production. Furthermore, organic hog production is associated with more animal husbandry requirements (Bornett et al., 2003).

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 those during the conversion to organic farming (Flaten et al., 2006; Koesling et al., 2008; Kuminoff and Wossink, 2010; Uematsu and Mishra, 2012). In these studies, the phenomenon of whether farmers invest or not in organic farming is mainly explained by economic indicators. Fairweather (1999) as well as Kuminoff and Wossink (2010) state that profitability is the most important factor for a transition of production. Additionally, 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 their investment behavior has already been discussed in the literature (Knight et al., 2003).

Yet, studies from the field of behavioral economics reveal that the exclusive focus on the economic factors in decision making may be too narrow (Kahneman, 2003). In the agricultural context, non-economic decision-making determinants must also be examined, more particularly of farmer's behavior towards business decisions and environmental sustainability (Willock et al., 1999). Moreover, investigations about the differences between organic and conventional farmers have been carried out. In this study, Mzoughi (2011) describes the differences between organic and conventional farmers with regard to their moral and social aspects. Läpple and Kelly (2013) attribute the not transitioning to organic farming to social constraints (e.g., the social acceptance of organic farming). Läpple (2013) shows that organic farmers are more environmentally aware than conventional and former organic farmers. Darnhofer et al. (2005) provide insights into the decision-making process of farmers when choosing their production method by identifying five types of farmers that allow for the characterization of strategies and values. Previous studies about farmers' investment behaviors have not taken into account farmers' perceptions of different production methods. From an investment-theoretic perspective, a different presentation of a decision-making problem should not, *ceteris paribus*, have any impact on the preferences of a profit-maximizing actor. However, Samuelson and Zeckhauser (1988) point out that decision-makers can be influenced by the current status quo, even if financial portfolio projects show identical economic returns.

The transferability of previous studies concerning the influence of hog production status quo on investment behavior is seemingly difficult. 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). Previous studies predominantly used field data-based econometric approaches (Thijssen, 1996; Flaten et al., 2006; Koesling et al., 2008; Kuminoff and Wossink, 2010; Uematsu and Mishra, 2012) which have limitations regarding the analysis of investment behavior in general, and the investigation of decision-makers' characteristics and personal motives in particular. These limitations include that the framework conditions influencing the decision are very heterogeneous between farms and farmers, including capital available, number of investment alternatives, individual attitudes and preferences (Thijssen, 1996; Gardebroek and Oude Lansink, 2004; Kuminoff and Wossink, 2010). Moreover, it is often not possible to establish a connection between real investment decisions and the personal characteristics of the decision-makers due to a lack of information in the data. Furthermore, the number of actually observed cases where farmers invested in a hog barn is rather low.

Experiments are an alternative approach that avoids the limitations mentioned above and allow for a better description of farmers' investment behaviors. Experimental investigations permit constant framework conditions, and the data gathered in the course of the experiment are often not collected in field data. However, real farm panel data would have advantages, such as the possible connection and analysis of real life investment decisions with high external validity (Roe and Just, 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 (Maart-Noelck et al., 2013; Ihli et al., 2014). However, differences in the investment behavior of organic and conventional farmers, especially in a hog-finishing context, have not been analyzed experimentally. The aim of this study is to experimentally investigate the investment behavior of farmers and the influence of the organic or conventional hog farmers' status quo regarding their production method. The 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. Secondly, we examine the investment behavior of two groups: conventional and organic hog farmers. Thirdly, the influence of the organic or conventional farmers' status quo on differences in investment behavior in an organic and conventional hog barn is investigated. This way, we hope to make an explanatory contribution to the following question: are hog farmers reluctant to invest in a production method they are not currently using? On this basis, we can derive recommendations for policy-makers if an expansion of organic or conventional hog production needs further promotion and awareness-raising rather than economic compensations.

Hypotheses are derived from the existing literature in the section 'Hypotheses', while the experimental design is presented in the section 'Methods'. Subsequently, the section 'Descriptive statistics and data analysis' presents the descriptive statistics and describes the applied analytical approach. In the section 'Results and discussion', the validity of the hypotheses is tested. The article ends with conclusions and future research perspectives provided in the section 'Conclusions'.

Hypotheses

Samuelson and Zeckhauser (1988) provide some of the first evidence that the status quo of a participant influences the participants' decisions. They found that portfolio composition is biased when participants are continuing an existing portfolio, compared with a situation in which they can create a completely new portfolio. If the participants have a certain status quo, they tend to maintain this current status quo. The fact that status quo can bias findings has been confirmed by Hartman et al. (1991) with California electric power consumers. Mzoughi (2011) as well as Läpple and Kelly (2013) suggest some indicators implying that the selection of the production method of farmers is not solely motivated by economic reasons. Darnhofer et al. (2005) as well as Cranfield et al. (2010) show that net income maximization is not a primary goal for some farmers. Similarly, Peterson et al. (2012) reveal that organic farmers are not solely motivated by economic objectives. They found evidence for multiple objectives besides profit maximization, such as environmental stewardship and an organic lifestyle. Thus, Peterson et al. (2012) confirm the findings of Koesling et al. (2008) that organic farmers pursue the objective of sustainable and environmentally-friendly farming. Furthermore, conventional farmers have prejudices against the organic production method based on, for example, the disapproval of organic farming by the social environment (Gardebroek, 2006; Läpple and Kelly, 2013). In contrast, for organic farmers, conventional farming has negative effects on the environment, and they therefore refuse to adopt this production method (McCann et al., 1997; Darnhofer et al., 2005). To date, little attention has been paid in the literature to the effect of organic or conventional farmers' status quo on the investment decisions in either production methods. This leads to the following hypothesis:

Hypothesis 1 'status quo': Organic and conventional farmers' willingness to invest decreases if they have the possibility to invest in another hog production method for the same profit and risk.

Agricultural production involves many different risks (Flaten et al., 2005; Gardebroek, 2006). Hardaker et al. (2004) point out that the decision-maker's risk attitude influences investment decisions. As a result, *ceteris paribus*, the willingness to make a risky investment decreases 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/her willingness to invest in a risky investment.

Methods

The aforementioned hypotheses were tested using an internet-based experiment that was carried out by organic and conventional farmers. It represents a framed field experiment, since the experiment was conducted with a non-standard subject pool (farmers) and in an agricultural context with a prescribed information set provided to the participants (Harrison and List, 2004). This type of experiment provides high internal and external validity (Roe and Just, 2009). The structure of our investment experiment was inspired by Maart-Noelck and Musshoff (2013), who conducted an investment experiment in land, as well as by Ihli et al. (2014), who carried out an investment and disinvestment experiment in irrigation technologies. The experiment consisted of four parts. In the first part, information about the participants' farms was gathered. Afterwards, an investment experiment with two consecutive treatments, namely the investment in an organic hog barn ('organic treatment') and in a conventional hog barn ('conventional treatment'), was conducted. The participants decided in each treatment. The order of the two treatments was randomized. According to the employed production method indicated in the first part of the experiment, the participants were divided into two groups (organic and conventional farmers) to ensure a guaranteed randomized order of treatments. The randomization was carried out as follows: if one participant in a group started with the conventional treatment, the next participant started with the organic treatment, the next with the conventional etc. This sequence was applied to both organic and conventional farmers. This randomization helped to improve the internal validity and reliability (Harrison et al., 2009). In the third part, the participants' risk attitudes were determined using a Holt and Laury task (HLL) (Holt and Laury, 2002). The investment experiment and the HLL involved financial incentives. Subsequently, in the fourth part, socio-economic data of the participants were collected. The final part of the experimental design was a result of numerous pre-tests conducted with students and farmers. The experimental procedure for each farmer is illustrated in Figure 1. A detailed description of the experimental instructions is provided online in Appendix 1. The structure of the core elements of the experiment is described in detail in the following.

Structure of the investment experiment

In both treatments of the investment experiment, the participants faced a decision over a hypothetical investment in a hog barn. Each participant was faced with ten repetitions of the respective treatment and, therefore, carried out 20 repetitions in total. The goal for the participants was to receive as much total capital as possible in each repetition. The investment costs of €300,000 for the hog barn remained constant over 5 'years' in every repetition. We chose the investment costs with an amount of €300,000 to reach a realistic amount of investment costs for farmers of both production methods (Schmitt and Polzin, 2004). However, for organic hog production, the

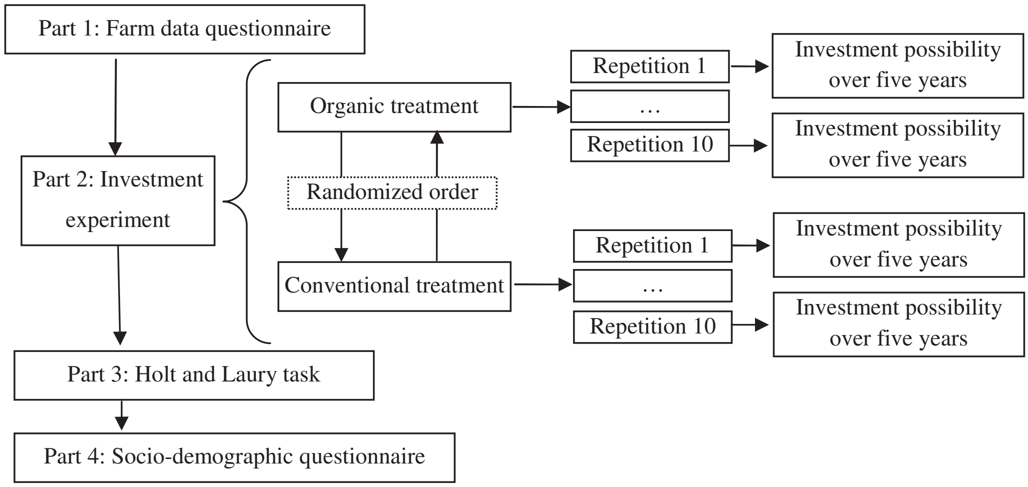

Figure 1. Illustration of the experimental procedure for each farmer.

Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
					€600,000
				€540,000	(3.12%)
			€480,000	(6.25%)	**€480,000**
		€420,000	(12.5%)	**€420,000**	(15.62%)
	€360,000	(25%)	**€360,000**	(25%)	**€360,000**
€300,000	(50%)	**€300,000**	(37.5%)	**€300,000**	(31.25%)
(100%)	**€240,000**	(50%)	**€240,000**	(37.5%)	**€240,000**
	(50%)	**€180,000**	(37.5%)	**€180,000**	(31.25%)
		(25%)	**€120,000**	(25%)	**€120,000**
			(12.5%)	**€60,000**	(15.62%)
				(6.25%)	**€0**
					(3.12%)

Figure 2. Binomial tree of the potential present values of the returns from the investment in the hog barn (probabilities of occurrence in parentheses).

investment is relatively high, whereas it is relatively moderate for an investment in the conventional hog production. At the beginning of a repetition, every participant was provided with liquid assets in the amount of €300,000. Therefore, there were no financial restrictions for the participants regarding an investment in the hog barn, and the investment could be carried out in each of the 5 years of a repetition. Furthermore, for the liquid assets, each participant earned a risk-free interest rate fixed at 10% per year.

Within each of the repetitions, a participant had to decide whether to invest in a hog barn or not. Every participant could invest once within 5 years in one repetition. This 5-year time horizon is comparable with a building permit that is usually valid for 5 years. Consequently, participants had the following options available in every repetition: they could either invest in the hog barn immediately in year 0 or once within the following years, 1–4. Alternatively, participants could also decide against the investment over one entire repetition and earn the interest for their liquid assets over 5 years. If participants invested in a hog barn, they could realize the investment returns, which are uncertain in the year in which the investment is implemented.

The binomial tree shown in Figure 2 visualizes all possible developments of the returns from the investment in the hog barn within one repetition, starting from investment returns of €300,000 in year 0 in every repetition. The investment return was an aggregation of different decision-relevant indicators, e.g., hog price, variable costs and subsidies. By aggregating decision-relevant variables with the specification of the present value of the annual return and the investment costs, including all potential subsidies and payments, we simplified the decision situation (Maart-Noelck and Musshoff, 2013). The investment returns were realizations of an arithmetic Brownian motion without a drift and with a standard deviation of €60,000 per year. An arithmetic Brownian motion has three typical characteristics, with the first one being the Markov property, which states that the

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probability distribution for all future values depends only on its current value. The second is a possible change in signs, which is a necessary characteristic for reasonable gross margins. The third and last characteristic is the non-stationary nature of the process, so arbitrary drift is possible. For further information, please refer to Dixit and Pindyck (1994). The probability that the uncertain investment returns increased or decreased by €60,000 in the subsequent year is 50%.

In order to fully understand the experiment design, we shall describe the decision faced by the farmers in more detail. In year 0, a participant could decide not to invest in the hog barn. Thus, the participant would earn the interest of €30,000 (€300,000 liquid assets – 10% interest rate) for the liquid asset and, therefore, have a bank account of €330,000 in year 1. Alternatively, the participant could decide to invest. Then, the participant would have earned €360,000 with a probability of 50% in year 1, or €240,000 also with a probability of 50% in year 1. However, here, the participant would not earn any interest because the capital would have been tied to the investment for this year. Therefore, the uncertain expected return of the investment would be €300,000 in year 1.

In the course of the experiment, the illustrated binomial tree was shown to the participants at the beginning of each repetition and was adjusted automatically to the decisions made and the stochastic development of the investment returns (Maart-Noelck and Musshoff, 2013). Furthermore, the possible investment returns and the recalculated probabilities of occurrence were displayed to the participants. In Online Appendix 1, it is briefly explained which effects the decisions and the random returns had on the displayed binomial tree. Moreover, the calculation of the total capital earned in one repetition was outlined for the participants.

The 'organic treatment' and the 'conventional treatment' did not differ in economic parameters; there were only differences with respect to the decision-making situation, namely the framing. In the experiment, the financial basis, the investment costs and the potential returns were assumed to be the same for each farmer. The actual economic parameters of an investment on the individual farms were thus not possibly reflected. Before the ten repetitions started, participants were made aware of whether they were dealing with the 'organic treatment' or 'conventional treatment'. This was illustrated by using figures of a conventional or an organic hog barn, respectively. After the participants had finished all ten repetitions of one treatment, they were passed on to the other treatment. Before the investment experiment started, all participants had been informed about the underlying assumptions and experimental values as well as the calculation of financial incentives. The participants' understanding regarding the framework conditions was tested using control questions. Moreover, they were made familiar with the experiment in a trial run.

Structure of the lottery

Data about the participants' risk attitudes were collected using a variant of the HLL (Holt and Laury, 2002; Viscusi et al., 2011) where participants could choose from an alternative A and B. In alternative A, participants could win either €200 or 160 with a given probability, while in alternative B, they could earn €385 or 10 with a given probability (Online Appendix 1). Thus, lottery B was riskier than lottery A. The probabilities were systematically varied so that the expected value changed each time. The more often a participant chose lottery A, the higher the HLL value (number of safe choices) and the more risk-averse the person. For farmers who switched multiple times between option A and option B, the total number of 'safe' A choices was used as the 'HLL value' as implemented by Holt and Laury (2002) and also used in other studies, e.g., Masclet et al. (2009) and Baker et al. (2008). Three types of risk attitudes could be distinguished. A HLL value of 0–3 stood for a risk-seeking attitude; these participants switched before decision-situation 5 to lottery B. A risk-neutral attitude was represented by a value of 4 and meant that a participant switched in decision-situation 5 to lottery B. Finally, a value of 5–10, i.e., a farmer switched to lottery B later than in decision-situation 5, indicated a risk-averse participant. Barseghyan et al. (2011) as well as Einav et al. (2010) reveal that risk preferences are not stable over different context situations. Also, Dohmen et al. (2011) provide evidence for potentially different risk attitudes of individuals in the context of financial matters, car driving, sports, career and health related choices. Based on the results of Dohmen et al. (2011) identifying financial matters as a specific context and Viscusi et al. (2011) combining an investment experiment with the HLL, we decided to include an incentivized HLL.

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. In our experiment, we used a combination of fixed payouts and performance-related payouts, which depended on the success in the experiment. This is a recognized procedure for financial incentives in experiments (Holt and Laury, 2002). We used financial incentives to produce realistic framework conditions since it is necessary to strengthen the external validity of this type of experiment (Levitt and List, 2007; Roe and Just, 2009). For completing the experiment, each participant received an expense allowance of €10. The investment experiment and the HLL had an incentive-compatible design and were linked to real payouts. The payout of the investment experiment resulted from the total capital achieved in a randomly selected repetition divided by 750. The possible earnings from the HLL arose from the task formulation. At least 1 of up to 100 participants was randomly chosen to receive a cash payout. If a participant won, his/her earnings from the investment experiment were added to those from the HLL. The potential earnings varied between €96 and 1590. The amount of the possible earnings was determined by chance and by the decisions made by the participants in the investment experiment and HLL. Holt and Laury (2002) pointed out that the stake size used for measuring the risk attitude has an effect on the stated risk attitude. They indicate that with an increasing payoff for the HLL, participants became more risk averse. However, as other researchers have tried (Brick et al., 2011), we incentivized our HLL to measure the risk attitude. We used 100 times the initial value of Holt and Laury (2002) to receive as realistic results as possible, since this is also a common method in the literature (Holt and Laury, 2002).

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.

Descriptive statistics

A list of potential participants was developed from records maintained by German associations in the sector of hog production and organic farming, as well as certification bodies for organic farming and working groups. Within the achievable potential participant group, each hog farmer had the same chance to take part in the experiment. The link to access the online experiment was sent to the aforementioned institutions in spring 2013. In total, 363 persons clicked the link to our experiment, and 83 farmers (22.9%) completed the experiment, providing a total of 1660 investment decisions (two treatments – ten repetitions – 83 farmers). On average, participants needed 31 min to complete the experiment. One out of the 83 participants received the cash premium at the end.

The descriptive statistics shown in Table 1 demonstrate the socio-economic characteristics and the operative farm structure of the experimental sample.

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 of the HLL reveal an average value of 5.3 for organic farmers, while the HLL value for conventional farmers is 6.0, indicating a higher risk aversion for this group. According to Holt and Laury (2002), we can classify the participants in three groups: risk-averse, risk-neutral and risk-seeking. The smallest proportion among the three risk groups is risk seeking farmers with two organic and seven conventional farmers. Ten organic and eight conventional farmers can be classified as risk-neutral. However, most participants are risk-averse as 21 organic farmers and 35 conventional farmers stated a risk-averse attitude.

Mann–Whitney U tests reveal no significant differences between the groups regarding the data of 'age' ($P = 0.14$), 'average size of farmland' ($P = 0.40$) and 'HLL value' ($P = 0.15$). Less surprisingly, significant differences ($P < 0.001$) are observed in the number of fattened hogs and the number of bred hogs. Organic farmers keep 180 hogs on average whereas conventional farmers keep 1696 hogs on average. The average number of sows of the sow husbandry farms is 58 (from 14 organic farmers) and 236 (from 26 conventional farmers).

Approach to data analysis

Our dataset shows specific characteristics that motivate the choice of our analysis methods. We investigate if participants exercise a given investment option at different discrete points in time (years) within the 20 repetitions of the experiment and therefore provide data that are quite similar to panel data. In other words, the time that has elapsed up to a certain event (here, the investment) is observed. Furthermore, in each repetition 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 rightly censored.

Taking into account the characteristics of the data, our analysis is based on the statistical method of Survival Analysis. More precisely, 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 adjust the Cox regression as suggested by Schemper et al. (2009) into the so-called weighted Cox regression to receive robust estimations. Furthermore, we use the Kaplan–Meier survival estimator (Cox, 1972), 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'.

Results and discussion

In order to investigate the influence of different factors on the investment behavior of hog farmers, we carried out a weighted Cox regression. Doing so, the connection between the independent variables and the probability to implement an investment can be analyzed. We use socio-economic and socio-demographic factors as control

Table 1. Descriptive statistics

	Organic farmers ($n = 33$)		Conventional farmers ($n = 50$)	
	Mean	SD	Mean	SD
HLL value	5.3	2.2	6.0	2.4
Proportion of female participants (%)	12.1		2.0	
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	
Size of farmland (ha)	91.9	93.9	98.6	61.0
Number of hogs[1]	179.6	236.1	1,696.2[2]	1,574.3
Number of breeding hogs[1]	58.0[3]	53.1	236.0[4]	155.5
Willingness to invest in the own farm business (%)[1]	54.5		32.0	

SD, standard deviation; HLL, Holt and Laury task.
[1] For the original questions from our questionnaire, please refer to Online Appendix 1.
[2] $n = 49$.
[3] $n = 14$.
[4] $n = 26$.

Table 2. Weighted Cox regression ($n = 1660$)

Explanatory variable	Coefficient	*P*-value
Conventional farmers in organic treatment (1 = yes)	−0.340	<0.001***
Organic farmers in conventional treatment (1 = yes)	−0.729	<0.001***
HLL value	−0.039	<0.001***
Repetition	−0.019	<0.001***
Farm type (1 = organic)	0.279	<0.001***
Age (in years)	−0.002	0.492
University degree (1 = holding a university degree)	−0.105	0.034*
Agricultural education (1 = holding an agricultural degree)	−0.429	<0.001***
Source of income (1 = farm is main source of income)	−0.025	0.763
Size of farmland (in ha)	-6.10^{-4}	0.036*
Number of hogs kept	-3.10^{-5}	0.308
Willingness to invest (1 = yes/possibly)	0.356	<0.001***

HLL, Holt and Laury task.
Wald-$x^2 = 286$.
Significance level * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$.

variables for our regression. The results of the Cox regression for the 1660 repetitions are presented in Table 2. Coefficients with negative signs indicate that the explanatory variable has a delaying effect on the investment implementation, and the number of the investment options that has not been realized will increase. The estimation results are robust to changes in explanatory variables ('years of education' instead of 'university degree') and also once non-significant variables are removed.

Hypothesis 1 'status quo'

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 they are currently using 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 two coefficients 'conventional farmers in organic treatment' and 'organic farmers in conventional treatment' differ significantly ($P < 0.001$) according to a Wald-test. This means that the reluctance to invest is therefore 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 3 shows the survival functions for the investment options in the two treatments of the

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experiment for organic and conventional farmers. The *x*-axis shows the years 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.

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 reserved to use the investment option in the organic treatment. This means that organic and conventional farmers are more reluctant to invest in the other hog production method than in their own current production method. This confirms the results of the weighted 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 the 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 farmers' status quo regarding the production method influences their investment behavior. Differences appear regarding the time to implement an investment and the probability to invest. *On the basis of these results, hypothesis 1 is supported.*

More particularly for current organic farmers, we reveal a substantial difference between investing in their own and the other hog production method and, therefore, detected a tendency for the status quo to bias the outcome. 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 (Darnhofer et al., 2005; Läpple, 2010). Austin et al. (2005) and Mzoughi (2011) establish a positive correlation between moral and social concerns and the investment behavior in environmentally friendly technologies, such as organic farming. For conventional farmers, Gardebroek (2006) as well as Uematsu and Mishra (2012) indicate that social and psychological factors may prevent conventional farmers from switching to organic farming. These factors together with traditional moral values help explain the significant difference in the behavior of conventional farmers when they make these investment decisions.

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 'HLL value' is defined as the number of safe choices a farmer has taken in the HLL. The coefficient (−0.039) of the variable in the Cox regression describes the influence of the value from the HLL 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. Therefore, our results are comparable with the findings of Viscusi et al. (2011). Moreover, we are able to confirm the field data-based results of Knight et al. (2003) and Acs et al. (2009). Knight et al. (2003) reveal for households in rural Ethiopia that risk aversion reduces the probability of innovation adoption. Acs et al. (2009) show that it is optimal to convert to organic farming for risk-neutral farmers, whereas risk-averse farmers should only invest if subsidies are paid, or if the organic market is more stable. Furthermore, it can be suspected that risk-averse decision-makers attach 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 is supported.*

Further results

Table 2 shows additional socio-economic variables that we examine in the weighted Cox regression. The variable 'repetition' is included in the model in order to take into account the influence of possible learning effects on the probability to invest. The values 1–20 are possible, considering the two times ten 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 completed. Consequently, learning effects can be observed, which are also pointed out in the literature by Maart-Noelck and Musshoff (2013) as well as Oprea et al. (2009). For farmers, Maart-Noelck and Musshoff (2013) show learning effects within an investment experiment on farmland. They found that farmers who repeat an investment experiment more often tend to invest significantly later. Oprea et al. (2009) reveal that when students carry out more repetitions of an experiment in a real options framework, they tend to exercise the option to wait too early.

The dummy variable 'farm type' is included to detect if the investment behavior of organic and conventional farmers is different in the treatment when they decide whether 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. Notably, organic farmers invest earlier in the organic treatment than conventional farmers in the conventional treatment, meaning that organic farmers may be more

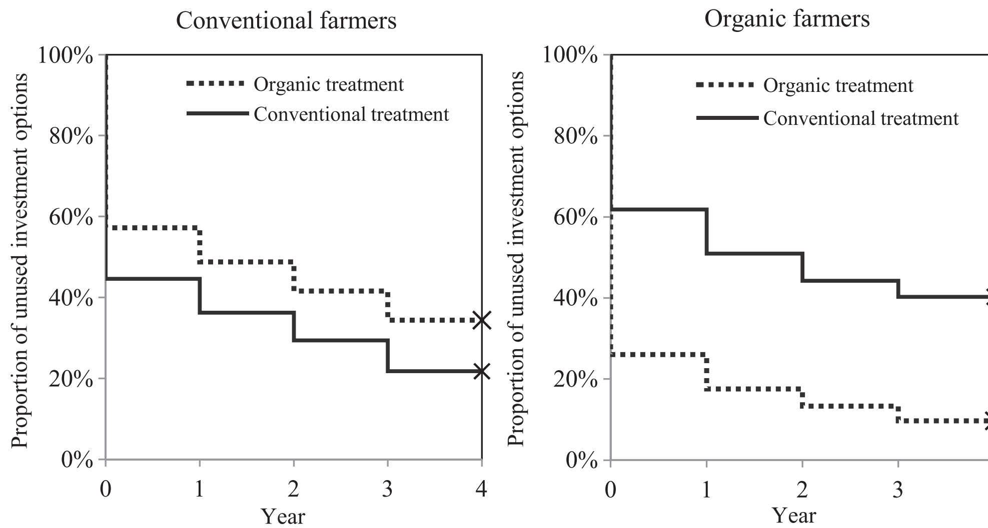

Figure 3. Survival functions of the investment options in both treatments for organic and conventional farmers.

strongly allied with their own production method. Even though the investment possibility has the same economic indicators, an investment in an organic hog barn is more useful for organic farmers than an investment in a conventional hog barn for conventional farmers.

The results of Gardebroek and Oude Lansink (2004) as well as Dohmen et al. (2011), revealing that the willingness to invest decreases with an increasing age of the participants, cannot be confirmed. Indeed, 'Age' does not have any significant ($P = 0.492$) influence on the time of the investment implementation in our experiment, consistent with findings from Maart-Noelck and Musshoff (2013). The dummy variables 'university degree' and 'agricultural education' show a significant ($P = 0.034$) negative influence on the probability to invest. Jianakoplos and Bernasek (1998) as well as Maart-Noelck and Musshoff (2013) reached similar results, while Gardebroek and Oude Lansink (2004) as well as Knight et al. (2003) found a positive correlation between education and willingness to invest. However, if we replace the dummy variable 'university degree' with the variable coding 'years of education', no significant influence of the years of education can be found. We can therefore conclude that more educational years do not lead to later investments, but a university degree leads to later decisions 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 ($P = 0.763$) between the source of income and the probability to invest on the basis of the experimental data. Also, the number of hogs does not have any significant influence on the time of investment. However, the 'size of farmland' shows a significant ($P = 0.036$) negative influence on the probability to invest. The dummy variable 'willingness to invest' influences the probability to make an investment in a positive and highly significant manner. Decision-makers who intend to invest in hog production are more willing to invest. Consequently, they transfer their willingness to invest to their decisions in the investment experiment.

Conclusions

In Germany, organic farming, and in particular organic hog production, is not as prevalent as policymakers desire. Farmers are reluctant to invest in organic hog production even though recent market and price analyses have revealed the economic potentials for this industry. A range of factors influences investment behaviors, and experiments provide a useful tool to investigate them. Until now, investment behaviors of organic and conventional farmers regarding their production method have not been the focus of any previous research study. Thus, we investigate if organic and conventional hog farmers are biased due to their current status quo regarding their production method. To examine the effect of the status quo and identify the influence of risk attitudes on investment behavior, the present study applied an experimental approach. The experimental setting included one whereby decision-makers are repeatedly faced with decision-making situations regarding the investment in organic or conventional hog barns.

The results showed that organic or conventional farmers' status quo has an effect on decision-makers and can partly explain the reluctance to invest in another hog production method. For organic as well as conventional farmers, a significant reluctance to invest in the other economically equal method 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 are reluctant to invest in organic farming. Moreover, the risk attitude had a significant influence on the investment behavior. Risk-seeking decision-makers revealed a higher willingness to invest, while more risk-averse decision-makers were more reluctant to invest. Conventional farmers and farmers holding a university degree invested later during the whole experiment. Thus, it does not appear to be adequate to reduce the discussion on investment behaviors to the economic evaluation of the two methods of production.

Our findings are an indirect measure of factors (different from economic expected return) that discourage farmers to adopt a production method different from the one they are currently using. This may be an interesting hint for policy-makers. The results suggest that the barriers that prevent farmers from adopting other production methods go beyond simple economic terms. With respect to the motives of this reluctance, it can be supposed that there are other factors that discourage investment, such as uncertainty about the other production methods, steep learning curves to implement the production method, or simply the fact that people may be fundamentally reluctant to change. Both conventional and organic farmers are reluctant enough to adopt the alternative production method that, in a basic economic experiment, they invest less once the other production method is mentioned. This would suggest that policy efforts should increasingly focus on identifying the farmers' psychological or pecuniary/non-pecuniary factors that prevent them from investing in the respective alternative production method. Public information campaigns that promote 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 to organic farming are not as effective as would be expected, assuming a profit-maximizing decision-maker. The reluctance to invest in another hog production method might be influenced by economic incentives or education on information policies to reduce misconceptions.

For future research, organic farmers who have not yet entered the business of organic hog production should be included in this research and could be asked about their willingness to invest in this branch of production. Another interesting research question might be to investigate how farmers, who are considering switching to another production method, would make their decision in such an experiment. In addition, future 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 the status quo bias need to be examined. Moreover, context-dependent risk attitude measures should be integrated in the experiment since risk measurement was found to be context dependent.

Supplementary Material

For supplementary material accompanying this paper, visit http://dx.doi.org/10.1017/S1742170515000265

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