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Maren Röhrig*, Bernd Hardeweg

Risk attitude and risk perception of apple producers in Germany: Developement of a measurement concept

*Corresponding Author:

Maren Röhrig
Center for Business Management in Horticulture and Applied Research at the Leibniz University of Hannover
Germany
Email: roehrig@zbg.uni-hannover.de

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Risk attitude and risk perception of apple producers in Germany: Developement of a measurement concept

Maren Röhrig, Bernd Hardeweg

Center for Business Management in Horticulture and Applied Research
at the Leibniz University of Hannover

1. Introduction, Knowledge, Objectives

Apple production is inherently a risky business due to the crop's exposure to weather risks such as late frost, hail and sunburn as well as considerable price fluctuations on the market side. Given a comparatively long pay off period for the investment in apple orchards, external risk management options are surprisingly scarce and so is research on risk management in apple production. Farmers' risk behavior depends on their risk preferences and risk perception. Both determine which strategies farmers choose to secure themselves against situations with uncertain outcomes. Risk preference, also known as risk attitude, is seen as person's sensitivity to risks (Bocquého et al., 2013). More precisely, risk preference characterizes to which degree a person tries to avoid or to eagerly face risks (Dillon and Hardaker, 1989, p. 134). It is therefore related to the interpretation of the risk contents of particular situations relative to their attitude towards risks. By contrast, risk perception refers to the probability people associate with being exposed to a specific risk and the magnitude of risk (Pennings et al., 2002). Only if a risky situation is perceived, are risk processing, evaluation and an appropriate response feasible (Trimpop, 1994, p. 15; van Winsen et al., 2011).

The overall aim of or our research is to develop a tool for supporting decisions on risk management in German apple production, which will be based on utility efficient programming and presumes rational behavior in an uncertain environment. This requires detailed information on risk attitude and risk perception among apple producers in Germany, which is lacking so far. In this paper, we discuss the concept of measuring risk attitude and perception among apple producers as a first step to closing this gap.

2. Material and Methods

We compile the required data from topical interviews with apple orchard operators in the two main apple production regions of Germany (Altes Land, Lower Saxony and Lake Constance, Bavaria and Baden-Württemberg).

Since our analytical purpose is normative-prescriptive, we rely on the subjective expected utility theory (SEU) framework as the appropriate theoretical basis for our purposes (Starmer, 2000). In what follows, the methods for eliciting risk attitudes and risk perception are outlined separately.

For an elicitation of risk attitude, probability and outcome scale experiments can be applied. The Holt and Laury Lottery (hereafter HLL, Holt and Laury, 2002) is a probability scale experiment, which is based on constant consequences and variable probability scales. It offers two risky lotteries A and B to the subject. Both of these lotteries consist of two possible payoffs, one of which is always larger. Comparing these two lotteries, lottery A is less risky, since the related payoffs are less variable than in lottery B. The subject is asked to choose one of the given lotteries for ten different rounds. Within the course of every decision round, the probability for gaining the higher payoff increases. Thereby, Lottery B becomes increasingly attractive. The point, at which the subject switches from lottery A to lottery B, identifies an interval for the risk aversion coefficient (CRRA) of the individual (Holt and Laury, 2002).

Outcome scale experiments are based on constant probabilities, which make the decision-process between two options easier. However, Menapace and Colson (2012) find framing and payoff effects in the frequently applied Eckel and Grossman lottery (hereafter EGL). They considered a few gamble tasks and one context dependent task. The latter is related to farm gross income as a percentage of usual annual income. The results of the two hypothetical EGL tasks yield different relative risk aversion coefficients. The consideration of context (framing effect) and outcome scale (payoff effect) are therefore crucial drivers in the development of experiments for eliciting risk preferences (Menapace and Colson, 2012). This is in line with Reynaud and Couture (2012), who discover a significant payoff effect in the hypothetical EGL, whereas the effect was not observed in the hypothetical HLL. Likewise, Holt and Laury (2002) find no changes in risk preferences for higher payoffs in hypothetical HLL experiments in comparison to a HLL with low, real payoffs. In this context the HLL might provide some advantages, although it is cognitively more demanding.

Apart from experiments, self-assessment questions offer a simple way to elicit the subjects risk attitude (Ogurtsov, 2008, p. 20). Many studies using large panel data, applied this method by presenting a Likert scale (e. g. Dohmen et al., 2011; Menapace and Colson, 2012; Reynaud and Couture, 2012; Hardeweg et al., 2013). The main drawbacks are that this method is neither incentive compatible nor does it yield conventional numerical indicators of risk preference (Dohmen et al., 2011; Reynaud and Couture, 2012; Hardeweg et al., 2013). On the other hand their advantage is their applicability to different contexts. The results of Reynaud and Couture (2012) indicate deviations when people are asked to assess their risk attitudes for different contexts. Even so, they are positively correlated and highly significant (Dohmen et al., 2011; Reynaud and Couture, 2012). They conclude that subjects may have a constant underlying risk trait and divergences in risk preferences emerge through context specific situations (Dohmen et al., 2011).

Within SEU theory, risk perception is the other driving factor on risk behavior. Even though many models rely on objective (i. e. historical) data for characterizing probabilities of outcomes (Ogurtsov, 2008, p. 11), such data might be inadequate for predicting the future distribution if underlying conditions have changed. The subjectivist view of probability as an alternative interpretation of probabilities can therefore be used to improve the validity of existing data. Here, subjective probabilities can be seen as stated estimates of individuals for the occurrence of specific risks (Hardaker et al., 2004, p. 39; Hoag, 2010, p. 195; Lien et al., 2011).

3. Results

For the elicitation of risk attitudes, we apply, in line with other recent studies investigating farmers' risk attitudes (e. g. Reynaud and Couture, 2012), the HLL as an experimental approach. Two HLL-type lottery experiments were used to explore whether framing effects or payoff effects have an impact on the risk preferences elicited by the lottery. For this purpose, we carried out a few gamble HLLs and a context dependent one.

In addition, we test, whether self-assessments in general are significantly correlated to domain specific questions. Domain specific questions refer to factors affecting yield and quality and the use of outside capital. If the results confirm the hypothesis of a stable underlying risk trait, self-assessments as a simple method can be taken into account for further risk analysis.

Accounting for subjective probabilities, we ask farmers to state their risk perceptions with respect to yields, prices, losses due to fire blight (*Erwinia amylovora*) and weather related influences, i. e. hail, frosts and sunburn. For this purpose two question types are used. For yield, which occur under normal conditions, we apply the "estimation of probabilities, based on experience"- method. This method only requires the minimum, maximum and modal values of a random variable to generate an associated triangular or beta probability distribution (Hoag, 2010, p. 212-213). Nevertheless, our pretest has shown that farmers feel uncomfortable stating those parameters for losses and prices. To circumvent this problem, we used the fixed value method. Here, farmers are asked to state numbers of growing seasons as absolute frequencies for intervals of the desired distribution. After that, these absolute frequencies are converted to relative probabilities, from which cumulative probability distributions can be constructed (Menapace et al., 2012). The latter are fed into a stochastic simulation model from which the distributions of relevant decision criteria, like the net present value are generated. In addition, the consideration of correlations between specific factors in stochastic analyses is of great importance, otherwise deceptive results may be obtained (Ogurtsov, 2008, p. 25). For accounting stochastic dependencies, we use expected values as well as standard deviations of historical data and subjective probability functions (Hardaker et al., 2004, p. 80-83).

4. Discussion

Data collection according to the methodology outlined above is still ongoing. We expect to obtain new information on risk preferences and risk perceptions among apple growers, which can be used for the determination of optimal farming strategies under risk. The literature suggests that farmers are risk averse (e.g. Hardeweg et al., 2013; Ihli et al., 2013; Nielsen et al., 2013). Consequently, we expect the same for apple producers. By the consideration of two production regions, varying in their climatic conditions, we anticipate to find a substantial variation in the perceived exposure to risks, e. g. hail and late frosts.

Future work will consider and include insights of risk behavior within the development of a decision support tool. This tool will be based on a normative-prescriptive approach and specifically on utility efficient programming. It shall be used for deriving recommendations for optimal farming strategies. The results of our analysis will provide information on which variety should be cultivated to which extent and which risk management tools should be applied from a rational point of view.

5. Conclusions

Especially in fruit production, where long-term investment decisions are necessary, rational behavior is crucial for long-term economic success. This requires sound risk management to which this research is intended to contribute. The approach outlined in this paper will generate estimates of risk perception and risk preference required for a decision support model and at the same time provide insights into contextual differences in risk preferences in and the relationship between risk perception and risk preference, which are traditionally seen as independent factors.

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