ANALYSING FARMERS' USE OF PRICE HEDGING IN-STRUMENTS: AN EXPERIMENTAL APPROACH

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Abstract

This paper analyses the influencing factors of farmers' use of price hedging instruments (PHIs) based upon a discrete choice experiment with German grain farmers. A mixed logit model is used to determine whether farmers' choices of PHIs against cash sales are influenced by their price expectation, their risk attitude and their available storage capacities. The results show that farmers with a price expectation below the actual price level have a higher preference for using PHIs against cash sales in general and that the individual degree of risk aversion can have a significant impact on farmers' choices of a specific PHI. A generally lower preference of farmers with available storage capacities for using PHIs as assumed in many theoretical contributions in the literature, however, cannot be confirmed.

1.   Introduction

European farmers are increasingly exposed to substantial price risks that were formerly absorbed by politically induced price supports (e.g. EUROPEAN COMMISSION, 2005). Currently, farmers need to manage these risks on their own, which emphasises the need for PHIs. In order to design and offer need-based PHIs to farmers, it is important to analyse what factors influence their hedging decisions (e.g. GARCIA and LEUTHOLD, 2004).

During the past two and a half decades, there have been numerous studies analysing farmers' use of PHIs in North America. SHAPIRO and BRORSEN (1988), as well as MUSSER et al. (1996) used tobit models to examine the factors that determine whether or not grain farmers from Indiana decided to use pre-harvest marketing techniques. These factors included personal and farm characteristics such as age, education, risk attitude, debt-to-asset ratio and acreage. Goodwin and SCHROEDER (1994) surveyed Kansas farmers to investigate similar factors influencing the adoption of futures and/or forward contracts by using probit and tobit models. SARTWELLE et al. (2000) investigated Kansas, Texas and Iowa grain producers' use of cash sales, forward contracts, futures and options and analysed the influencing characteristics by means of tobit and multinominal logit models. Further research conducted by KATCHOVA and MIRANDA (2004) examined how farm characteristics affect marketing contract decisions by separating these decisions into the adoption decision itself, quantity, frequency and contract type. This was done by using the USDA's Agricultural Resource Management Study data on grain farmers and a two-step econometric model. Finally, FRANKEN et al. (2012) extended the previous studies by analysing the proportion in which different contract types are used by grain producers, instead of looking at just one contract type in isolation.

The described literature reveals two research gaps: First, the aforementioned studies focus on the marketing decisions of North American farmers only. These operate under fundamentally different conditions than, for example, European farmers with regard to farm structures, climate, agricultural market structures and agricultural policy. For Europe, there are only a few studies analysing the use of PHIs. However, these mainly look into optimising the use of available tools (e.g. MAHUL, 2003; LOY and PIENIADZ, 2009), but do not investigate the influencing factors on farmers' hedging decisions. Second, existing contributions to the use of PHIs are mainly empirical studies based on past marketing decisions of farmers. Therefore, it is challenging to clearly distinguish the influencing factors of these marketing decisions. For instance, it is difficult to say in retrospect whether hedging a wheat price by means of a futures contract prior to the harvest was due more to the farmers' price expectation, risk attitude or completely different, un-

known reasons. Experiments can provide a solution for this issue as they collect data under controlled conditions. In particular, discrete choice experiments (DCEs) allow for the determination of preferences for decision alternatives without explicitly asking for them and by including hypothetical action alternatives (e.g. TRAIN, 2009: 152). By relating the participants' choice behaviour to the features of the action alternatives and the participants' individual characteristics, complex structures of the decision-making process can be revealed (e.g. Louviere, 2001). In agriculture, DCEs have typically been used to analyse farmers' technology choices (e.g. BREUSTEDT et al., 2008), farmers' preferences for agri-environmental schemes (e.g. ESPINOSA-GODED et al., 2010) or consumer choices for agricultural products (e.g. LUSK et al., 2003). To the authors' knowledge, DCEs with respect to farmers' use of risk management instruments have not yet been conducted.

Against the background of these research gaps, the objective of the paper is to analyse the influencing factors of farmers' use of PHIs against conventional cash sales in Europe in an experimental setting. The considered PHIs are forward, futures and options contracts, as well as managed marketing. While the first three tools are commonly known and used (e.g. GOODWIN and SCHROEDER, 1994; SARTWELLE et al., 2000), managed marketing is a relatively new approach for European farmers. It can be understood as a complete delivery of marketing decisions to a third party. The considered determinants on farmers' hedging decisions are, amongst others, the price expectation compared to the actual price, the risk attitude and storage capacities as a proxy for the risk bearing ability and the already available risk management tools of a farm. The data for the analysis was gained through a DCE that was carried out by 136 German grain farmers in the year 2012. The grain producers had to choose their preferred marketing alternative out of the available PHI under differing price constellations. The analysis of the DCE was conducted by using a mixed logit model within a maximum likelihood framework.

This study provides farmers as well as agricultural trading companies, consultants and politicians with important information regarding an improved understanding of marketing practices and motives. For example, the results indicate that in general, farmers with a price expectation below the actual price level have a higher preference for using PHIs against cash sales. Furthermore, the individual degree of risk aversion can have a significant impact on farmers' choice of a specific PHI. Based on this, the study might also lay the foundation for designing more efficient need-based PHIs in Europe in the future.

The rest of the paper is structured as follows: In section 2, the hypotheses that shall be tested by means of the DCE are derived from the literature. The design of the questionnaire, which includes the DCE, is described in the subsequent section. After the descriptive data is presented in section 4, the theoretical background of the analysis methods is explained in section 5. Finally, the results of the DCE are presented and discussed in section 6. The paper ends with some conclusive remarks (section 7).

2. Hypothesis generation

The hypotheses derived in this section directly refer to the main factors which potentially influence farmers' preferences for using PHIs. These factors are identified by looking at the goals farmers potentially pursue by using PHIs. In general, farmers' goals are recognised as being multi-dimensional (e.g. PATRICK et al., 1983; SUMPSI et al., 1996). For farmers' marketing decisions, there are two goals which have been most comprehensively discussed in the literature, namely price enhancement and risk reduction, including their trade off (e.g. PECK, 1975; MUSSER et al., 1996).

An important factor that determines the extent to which a farmer achieves price enhancements by using a PHI is his individual price expectation. If, for example, the farmer expects prices to fall at the time of the harvest, he/she should have a higher preference to hedge the actual price level by using a PHI. This is, amongst others, supported by the analysis of MUSSER et al. (1996). Furthermore, EALES et al. (1990) find that the prices for futures and options grain contracts re-

flect the price expectations of Illinois farmers and grain merchandisers. Consequently, farmers with price expectations below the actual price level are expected to be more willing to use PHI. From this information, we can hypothesize the following:

H1 (price expectation): An individual price expectation below the actual price level leads to a significantly higher preference for using PHIs.

With regard to the objective of risk reduction, the influence of a farmers' degree of risk aversion on the use of PHIs to reduce the income risk is emphasised in the literature. PATRICK et al. (1980) come to the result that farmers generally see sequential marketing as a risk-reducing strategy. HOLT and BRANDT (1985) name numerous contributions, which state that it can be beneficial for risk averse farmers to hedge, even though hedging leads to lower prices on average. The studies of SHAPIRO and BRORSEN (1988) and SARTWELLE et al. (2000) confirm that a higher level of risk aversion generally leads to a stronger preference for hedging. This leads to the following hypothesis:

H2 (risk aversion): Farmers with a higher degree of risk aversion generally have a significantly higher preference for using PHIs.

In the literature, the available storage capacities of a farmer are seen as an important means of a farmer to manage price risks (e.g. BARRY and FRASER, 1976; BEAL, 1996; SAHA and STROUD, 1994) and to potentially achieve higher prices in the future (e.g. PARK, 2006). This means that, in addition to PHIs, the availability of storage capacity expands the choice set of a farmer by a further option, namely inventory management, to reduce price risks and to enhance prices. As a consequence, the storage capacities of a farm can be expected to have a negative influence on the usage of PHIs:

H3 (storage capacities): A smaller storage capacity leads to a significantly higher preference for using PHIs.

In addition to the above factors and following other contributions, sociodemographic factors, for example age and eduction, were queried in the DCE and subsequently evaluated (e.g. MUSSER et al., 1996; PAULSON et al., 2010). Although hypothesis testings were not performed for these additional factors, the respective results are also presented and briefly discussed in the results section (cf. section 6).

3. Experimental design

The questionnaire is divided into three sections. The first section queries data with regard to farm characteristics. In the second section the respondents have to conduct the DCE. Finally, the farmers are asked in the third section to answer questions about their risk attitude and their socioeconomic background.

In the decision-making situation of the DCE, farmers are asked to market 75% of their milling wheat in November by chosing their preferred marketing alternative. Prior to making a decision, they are advised to make a decision that is as realistic as possible for their farm. The marketing alternatives comprise four PHIs ('Forward contract', 'Managed marketing', 'Futures contract' and 'Futures-options contract') and the alternative of not hedging at all ('Cash contract'). The contract types are chosen based on contract types that are for instance also analysed by Sartwelle et al. (2000), as well as information gained through comprehensive discussions with trading experts. To the experts' knowledge, 'Forward contracts' are the primary PHI utilised in Germany and are offered by most grain collectors. Using these kinds of contracts, farmers fix the price for a delivery date in the future with fixed quantity and quality requirements. 'Managed marketing', understood as a complete delivery of marketing decisions to a third party (e.g. a collector), is a wide spread marketing alternative in France. However, due to similarities in both markets, it could also be a useful alternative for German farmers. It allows farmers to deliver their harvest in August and receive the given harvest price right away. A professional trader tries to achieve a higher price throughout the year to be able to pay the farmer an additional supplement in June of

the next year. By selling a 'Futures contract', farmers hedge a future price for the underlying product at the commodity exchange. If the farmer does not want to physically fulfill the traded quantity, he/she is obliged to buy the contract back, before it expires. Through the redemption of the contract, he/she makes a hedging profit or loss, which can be added to the received spot market price for the product. If the farmer buys a put-option on a futures contract instead, he/she has the right, but not the obligation, to sell a futures contract in a given period and therefore eliminates the risk of making a hedging loss at the commodity exchange. Alternatively to a PHI, a 'Cash contract', where delivery and price fixation occurs on the same day, is offered. If required, the respondents can optionally open a pop-up window for each of the above PHIs, in which a more detailed explanation is provided.

In Figure 1, an example of a respective choice set is presented. The contract types were explained to the respondents prior to the decision-making situation itself, including the respective requirements and possible outcomes without judgment.

Figure 1. Example of a choice-set [a]

Imagine that the actual market price for milling wheat is **140 €/mt**.
The following marketing alternatives are offered for a delivery by November 2012.
Which alternative would you choose?

Marketing-alternatives	Forward contract (A)	Managed marketing (B)	Futures contract (C)	Futures-options contract (D)	No price setting (E)
Benefits	Fixed price 182 €/mt	Harvest price + possible supplement in June of next year	195 €/mt Futures price	190 €/mt Futures minimum price	-
Basis	-	-	approx. -10 €/mt	approx. -10 €/mt	-
Requirements	Delivery requirements (quantity and quality)	Trust in the marketing know-how of the trading partner	Know-how in Futures trading and market observation; Liquidity (about 30 €/mt); Min. 2 trading partners	Know-how in Futures trading and market observation; Min. 2 trading partners	Constant market observation
Risk	No additional profit at price increase	Dependency on marketing accomplishment of trading partner	No additional profit at price increase; Basis risk (+/-10 €/mt); Liquidity risk at rising prices	Basis risk (+/-10 €/mt)	Price risk
Premium and costs	-	5 €/mt fix costs + 10 % of additional profit	0.5 €/mt	10.5 €/mt	-

Which of these marketing alternatives would you choose?

   ○ (A)   ○ (B)   ○ (C)   ○ (D)   ○ (E)

Source: Author's own illustration.
[a] Translated from German into English.

'Benefits' describe the revenues a farmer fixes by using the given PHI. 'Basis' represents the average, but not a fixed difference between the futures price at the commodity exchange and the spot market price. 'Requirements' and 'Risk' briefly explain the main obstacles linked to the different marketing alternatives. Finally, the related 'Premium and costs' are shown. As the real names of the marketing alternatives are used, the experiment is labelled. The prices for the different marketing alternatives were strictly correlated with the spot market price (e.g. 'forward contract': +2 €/mt). Consequently, the price cannot vary independently between the marketing alternatives. The price differences were chosen in a way that there is no dominant PHI with regard to the calculated on-farm price (e.g. average on farm price for 'Futures contracts' is always +2.5 €/mt higher than for 'Forward contracts' due to additional liquidity and basis risk). All in all, there exists no alternative-specific or generic attributes that can be independently varied

from each other within the DCE. Merely in the initial situation, which is determined by the spot market as observed in February 2012, the price for wheat changes from one choice-set to another. Due to the complex set-up of the choice situation, varying attributes could have added too much information to the decision process resulting in potential inconsistencies in the results (cf. DeSHAZO and FERMO, 2002). Therefore and in contrast to standard DCEs, the DCE in this study does not allow for varying attributes over alternatives. To reduce the influence of fatigue due to a large number of choice-sets, the number of different price levels is restricted to six (120, 140, 160, 180, 200, and 220 €/mt). The resulting six choice-sets, as exemplarily shown in Figure 1, are presented in a random order.

After conducting the DCE, the farmers are asked for information about their usual marketing behavior and past usage of different contract types. In addition, the farmer's price expectation for August 2012 is queried in order to gain further insight into their marketing behavior. Following DOHMEN et al. (2011), the farmers risk attitude is measured by the 'general risk question' using an ordinal scale from 0 to 10, whereby 0 represents 'not willing to take risk at all' and 10 'very willing to take risk'. Hence, farmers evaluate their risk attitude subjectively. Finally, the respondents are also asked to answer questions about their socioeconomic background, such as age, and farm characteristics, such as farm size.

4. Descriptive statistics

The online survey was completed by 136 farmers from all over Germany in February 2012 and was brought to farmers' notice through online newsletters of two agricultural consulting companies. In addition, students from the University were also asked to make farmers aware of the experiment. Table 1 reports personal information and farm characteristics of the participants.

Table 1. Descriptive statistics for personal and farm characteristics [a]

Personal characteristics	
Proportion of male farmers in %	95
Average age in years	41 (14)
Proportion of farm-managers in %	70
Proportion of farmers with a university or college degree in %	38
Average risk attitude as a self-assessment [b]	6.4 (1.7)
Average spot market price expectation for milling wheat for August 2012 in €/mt	183 (21)
Farm characteristics	
Average farm size in ha	440 (894)
Average storage capacity in % of the grain harvest	73 (41)
Proportion of farmers who use storage as a central risk managment tool	75

Source: Author's own calculations.
[a] The number of farmers, who answered the questions, varied from 115 to 136; standard deviation in parenthesis.
[b] Ordinal scale from 0 to 10; 0='not willing to take risk at all'; 10='very willing to take risk' (cf. Dohmen et al., 2011). The following pairs show the frequency distribution: 0→0; 1→1; 2→1; 3→5; 4→14; 5→16; 6→26; 7→28; 8→26; 9→9; 10→2.

The farmers are 95% male, with an average age of 41 and a standard deviation of 14. 70% of them are farm-managers and 38% hold a college or university degree. On average, they are slightly risk-seeking ($\mu=6.4$; $\sigma=1.7$; ordinal scale from 0='not willing to take risk' to 10='very willing to take risk'). Their expected average spot market price for milling wheat for August 2012 is on average 183 €/mt ($\sigma=21$ €/mt). The average farm size is 440 hectares ($\sigma=894$ ha). On

average, 73% of the grain harvest can be stored and 75% of the participating farms use storage as their primary method of reducing price risks.

The volume of actual PHI usage of the participating farmers over the past five years is structured as follows: 36% forward contracts, 35% cash contracts, 6% managed marketing, 5% futures contracts, 2% futures-options contracts and 15% others. The share of others can be interpreted mainly as grain usage for on-farm animal feeding, as well as special contract types offered by local collectors (e.g. premium contracts). Hence, forward and cash contracts are the dominant marketing alternatives. In the DCE, the 'Forward contract' was chosen in 32%, 'Managed marketing' in 9%, 'Futures contracts' in 12%, 'Futures-options contracts' in 10% and the 'Cash contract' in 36% of all cases.

On the basis of the descriptive statistics, it becomes clear that the sample is not representative for the population of all German farmers. However, the study aims to recruit farmers who are diverse regarding their farm structure, instead of generating a representative sample, which is indicated by the large standard deviation of the variable 'Farm size'.

5. Analysis method of the discrete choice experiment

In the DCE, the farmer q chooses one out of I marketing alternatives. Under the assumption that all relevant marketing alternatives are offered, his/her relative utility U of marketing alternative i in the t-th occasion is represented by the following equation (for further insight see Hensher and Greene, 2003):

$$U_{iqt} = ASC_q{}'c_{it} + \varepsilon_{iqt} \tag{1}$$

$ASC_q{}'c_{it}$ denotes the alternative-specific constant, where the dummy-coded variable c_{it} takes on the value one for marketing alternative i and otherwise the value zero. Instead of attributes that are not available due to the set-up of the DCE (cf. section 3), the alternative-specific constants represent the average effect on utility for a given marketing alternative i in the t-th occasion (TRAIN, 2009: 20). ε_{iqt} is a non-observable error term that is assumed to be an independent and identically distributed (i.i.d.) extreme value type 1. In this framework, a farmer who aims to maximize his/her utility chooses marketing alternative i instead of j, if and only if $U_i > U_j \ \forall j \in I, \ i \neq j$.

Assuming that one would observe ASC_q and ε_{iqt}, the choice probability would be standard logit and therefore conditional on ASC_q (GREENE and HENSHER, 2003):

$$L_{iq}(ASC_q) = \prod_t \frac{e^{ASC_q{}'c_{it}}}{\sum_j e^{ASC_q{}'c_{jt}}} \tag{2}$$

Yet, the farmers' individual preferences are unknown. Therefore, ASC_q and ε_{iqt} are treated as random variables and normal distributions are assumed. If the standard deviations of ASC_q are highly significant, their specification as random variables can be confirmed (HENSHER and GREENE, 2003: 145). In order to test the hypotheses (cf. section 2), individual-specific variables s_q are also added into the model. BOXALL and ADAMOWICZ (2002) pointed out, that these variables are important to explain the heterogeneity in preferences. The estimated parameters matrix Δ of the individual-specific variables s_q expresses how the preference of chosing a certain marketing alternative changes due to the influence of individual characteristics in comparison to the reference farmer[1] while all other effects remain constant. In line with Greene and Hensher (2003), the following definition of ASC_q is assumed:

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[1] The reference farmer defines the zero-point of all individual-specific variables. Therefore, he/she is 41 years old, has no university degree and is slightly risk-seeking. The difference between the current price and the reference farmer's price expectation for the future is zero. Moreover, his/her farm has no capacity to store the grain harvest (cf. Table 1).

$$ASC_q = ASC + \Delta s_q + \Gamma v_q \tag{3}$$

where ASC is the fixed mean of the distribution and v_q is the underlying random effect with variances on the diagonals of Γ. The fixed underlying parameters of the distribution are summarized by $M = (ASC; \Delta; \Gamma)$.

As previously mentioned, it is not possible to condition on ASC_q. Thus, the unconditional choice probability has to be calculated as the integral of the conditional probability over all values of ASC_q weighted by its density f (HENSHER and GREENE, 2003). This model is also called the mixed logit model:

$$P_{iq}(M) = \int_{ASC_q} L_{iq}(ASC_q) \, f(ASC_q|M) dASC_q \tag{4}$$

The estimation procedure is done using maximum-likelihood estimation. Since the integral of $L_{iq}(ASC_q)$ over all possible ASC_q does not have a closed form, it has to be approximated through simulation. To do so, R simulation runs are conducted, in which R realizations of the moments of the chosen distributions M^R out of the density function $f(ASC_q|M)$ are raised and the associated utility parameters ASC_q^R are calculated. The necessary quasi random numbers are determined with halton sequences[2]. For every ASC_q^R, the conditional logit probability L_{iq}^R is calculated. The simulated mixed logit probability P_{iq} is calculated as the average of all calculated conditional logit probabilities L_{iq}^R.

6. Results discussion

For illustration purposes, the explanatory variables are listed and explained in Table 2. It is also depicted to which of the three hypotheses (cf. section 2) each variable refers to.

Table 2. List of variables

Variable name	Description	Test on
ASC_i	Alternative specific constant for a sepcific marketing altenative i	
Age	Age in years is centered around the mean (41) of the sample	
Education	Decision makers with a university or college degree (dummy-coded: 1=having a university or college degree; 0=not having a university or college degree)	
Price expectation	Difference between the price level of the choice-set and the individual expected spot market price for milling wheat in August 2012 [a]	H1
Risk attitude	Risk attitude [b] is centered around the mean (6.4) of the sample	H2
Storage	Storage capacity in percent of the grain harvest	H3

Source: Author's own illustration.
[a] Presented price levels in €mt: 120, 140, 160, 180, 200, 220; average expected spot market price 183 €mt.
[b] Ordinal scale from 0 to 10; 0='not willing to take risk at all'; 10='very willing to take risk' (cf. Dohmen et al., 2011).

In the following, the results of the mixed logit model are presented in Table 3. All statements are understood as being in comparison to the base alternative 'Cash contract'. In the mixed logit model, the utility parameters of the ASCs are not significant for the PHIs except for the 'Managed marketing' alternative. The reference farmer, therefore, is indifferent between choosing a

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[2] Halton sequences are numerical sequences which are generated in the way that they equally fill the integration volume with points that are not correlated with each other as in regular grids (for further inside cf. BHAT, 2001).

'Forward contract', a 'Futures contract', a 'Futures-options contract' or a 'Cash contract'. The utility parameter of the alternative 'Managed marketing', by contrast, is significantly negative. Thus, the reference farmer prefers the 'Cash contract' over the 'Managed marketing' alternative. This may be partly explained by the fact that the alternative 'Managed marketing' is still a new and unknown concept for the majority of German farmers.

Table 3: Results of the mixed logit model [a]

Variable	Forward contract	Managed marketing	Futures contract	Futures-options contract
ASC [b]	-0.301	-2.941**	-0.3636	-0.670
	(0.40)	(-2.58)	(-0.52)	(-0.78)
Standard deviation ASC	2.971***	2.568***	2.204***	2.949***
	(7.11)	(4.89)	(5.93)	(4.92)
Individual-specific variables				
Age [c]	-0.021	0.008	-0.036	-0.050[+]
	(-0.84)	(0.30)	(-1.56)	(-1.70)
Education [d]	0.839	-0.345	0.547	-1.895*
	(1.23)	(-0.44)	(0.84)	(-2.08)
Price expectation [e]	0.089***	0.026***	0.033***	0.031***
	(-10.54)	(-4.05)	(-5.83)	(-4.94)
Risk attitude [f]	-0.485**	-0.877***	0.145	0.197
	(-2.96)	(-3.59)	(0.76)	(0.83)
Storage [g]	-0.166*	-0.063	-0.191*	-0.080
	(-1.99)	(-0.59)	(-2.48)	(-0.83)
Choosen in % of all decisions	32	9	12	10
Participants / Observations	136 / 816			
Simulated Log Likelihood	-650.88			
AIC / BIC	1357.77 / 1528.61			

Source: Author's own calculation using the command 'mixlogit' (Hole, 2007) in Stata 12.

[a] + p<0.1; * p<0.05; ** p<0.01; *** p<0.001; z-values in brackets; 1 000 Halton Draws; in the model we bear in mind that each farmer answer six choice sets.

[b] ASC-forward: 1='Forward contract', 0=other; ASC-managed: 1='Managed marketing', 0=other; ASC-futures: 1='Futures contract', 0=other; ASC-option: 1='Futures-options contract', 0=other.

[c] Reference: 41 year old farmer (mean of the sample).

[d] Binary coded; reference: 0= no university degree.

[e] Reference: no difference between the current price and the farmer's price expectation for the future.

[f] Reference: farmer with a risk attitude of 6.4 (mean of the sample) measured at a ordinal scale from 0 to 10; 0='not willing to take risk at all'; 10='very willing to take risk'.

[g] Reference: farmer has no has no capacity to store the grain harvest.

Looking at the individual-specific variables, 'Age' is significantly negative for the alternative 'Futures-options contract'. This means that a farmer who is older than the reference farmer *ceteris paribus* prefers a 'Cash contract' over a 'Futures-options contract', whereas a farmer who is younger than the reference farmer *ceteris paribus* prefers the 'Futures-options contract' over the 'Cash contract'. This partly reflects the results of MUSSER et al. (1996) who argue that older farmers do not use futures and options because they do not recover the associated learning and adjustment costs in their short time until retirement. For all other alternatives, the variable 'Age' has no effect on the utility.

Furthermore, the variable 'Education' has a negative effect on the utility of the alternative 'Futures-options contract'. This means that a farmer with a university degree would *ceteris paribus* prefer a 'Cash contract' over a 'Futures-options contract', whereas a farmer without a university degree would be indifferent to both alternatives. This partly confirms SHAPIRO and BRORSEN (1988), who find significantly negative effects of the personal characteristic education on farmers' usage of futures markets in general. However, this negative effect cannot be confirmed for the alternative 'Futures-contract'. Likewise, 'Education' has no effect on the utility of all other alternatives.

Hereafter, the generated hypotheses from section 2 are tested.

Test on H1 (price expectation)

The utility parameters of the individual specific variable 'Price expectation' are significantly positive for all PHI alternatives. Taking into account that the reference farmer, first, expects no changes in the wheat price, second, evaluates the alternative 'Managed markting' as significantly negative compared to the 'Cash contract' and third, is indifferent to the other alternatives, one can conclude: If a farmer's individual price expectation is below the actual price level in the choice-set, he/she has *ceteris paribus* a preference for using PHIs in the form of a 'Forward contract', a 'Futures contract' and/or a 'Futures-options contract' instead of a 'Cash contract'. If, however, his/her individual price expectation is above the actual price level of the choice set, he/she would prefer a 'Cash contract' over using a PHI. A Wald test confirms that the utility parameters of the variable 'Price expectation' are not significantly different for the 'Managed marketing' alternative, the 'Futures contract' and the 'Futures-options contract' at a 5% level. The influence of the variable 'Price expectation' on the utility of the 'Forward contract' is significantly stronger than for the other PHIs. In light of these results, hypothesis 1 is accepted.

Test on H2 (risk attitude)

The utility parameters of the variable 'Risk attitude' are significantly negative for the alternatives 'Forward contract' and 'Managed marketing'. Furthermore, a Wald test confirms that both parameters are not significantly different. Considering that the reference farmer is slightly risk-loving, this indicates the following: First, farmers who are less risk-loving than the reference farmer would prefer a 'Forward contract' over a 'Cash contract' and *vice versa*. Second, farmers who are less risk-loving would prefer the 'Cash contract' over the 'Managed marketing' alternative less pointedly than the reference farmer and *vice versa.* This follows from the aforementioned fact that the reference farmer generally prefers the 'Cash contract' over the 'Managed marketing' alternative. However, the variable 'Risk attitude' has no influence on the farmers' preference for the remaining PHIs 'Futures contract' and 'Futures-options contract'.

Due to the results revealing no general direction in the general relationship between the farmer's preference for PHIs and his/her risk attitude, hypothesis 2 has to be partly rejected. However, we can conclude from the results that the degree of risk aversion has a significant impact on farmers' preferences for a specific PHI.

Test on H3 (storage)

The utility parameters of the variable 'Storage' are significantly negative for the alternatives 'Forward contract' and 'Futures contract'. A Wald test confirms that these utility parameters are not significantly different. Compared to the reference farmer who has no storage capacity, this means: The more of the harvest the farmer is able to store, the higher is *ceteris paribus* his/her preference for a 'Cash contract' compared to a 'Forward contract' or a 'Futures contract'. Hence, the storage capacity as an additional risk management tool decreases farmers' preference for using these two PHIs. However, according to the results, the storage capacity has no significant influence on farmers' preference for the remaining two PHIs 'Managed marketing' and 'Futures-options contract'. Therefore, farmers with (higher) storage capacitites show no general preference for using PHIs and hypothesis 3 has to be partly rejected.

7. Concluding remarks

Need-based PHIs have become increasingly important for European farmers in order to manage the increasing price risks on agricultural markets. Existing contributions on farmers' use of PHIs, however, mainly focus on North America only and do not consider the special conditions of agricultural production in Europe. Furthermore, these are mostly empirical studies, which makes it difficult to clearly distinguish the factors which influenced past marketing decisions. Additional experiments can represent a solution to this issue. Hence, the objective of this paper was to examine the influencing factors on European farmers' use of PHIs against conventional cash sales in an experimental setting. For this, a DCE was performed in which German grain farmers had to choose their preferred PHI under different price constellations. The gained data was subsequently analysed by means of a mixed logit model within a maximum likelihood framework.

The results of the DCE reveal interesting insights into the drivers of farmers' marketing decisions. Accordingly, it can be shown that farmers with a negative price expectation have a higher preference for using PHIs against cash sales in general, which is in-line with existing empirical studies. With regard to the risk attitude, the individual degree of risk aversion can have a significant impact on farmers' choices of specific PHIs. However, a general relationship with the preference for using PHIs cannot be observed. Here, the study contradicts most existing contributions which state that a higher degree of risk aversion generally leads to a stronger preference for hedging. Finally, the findings indicate that farmers with available grain storage capacities are less likely to hedge prices just with two out of the four investigated alternative instruments. A lower preference of using PHIs in general, as assumed in many theoretical contributions in the literature, however, cannot be confirmed.

The findings of this study are of practical importance for farmers as well as agricultural trading companies, politicians and consultants. On the basis of the results, farmers are able to market their grain more objectively and profitably due to an improved understanding of their marketing practices and motives. Consequently, this could generally increase farmers' use of PHI, especially in Europe. Moreover, agricultural trading companies receive useful information for the design of more effective customer-specific PHIs, instead of just offering standarised products. Finally, agricultural trading companies, consultants and politicians can include the results into the development of grain marketing educational programs.

Nevertheless, the results of the present study should be interpreted with care due to some limitations of the data gained in the DCE. In particular, the results are based on hypothetical decisions. The question of whether the decision-making behavior of real decision situations is different from those in hypothetical decision situations has been examined several times. The results of various studies provide abundant evidence that there is no discrepancy between real and hypothetical decision-making behavior (e.g. IRWIN et al., 1992; KUEHBERGER et al., 2002). Hence, hypothetical decision-making behavior can be considered as a "reasonable, qualitatively correct picture of real choices" (KUEHBERGER et al., 2002: 1164). Nevertheless, this should be confirmed by further studies within the agricultural context. Furthermore, the transferability of the findings, for example to other agricultural commodities or other countries, should be tested in additional DCEs. For comparison purposes, it could also be of interest to perform the experiment again in the same setting at a later point in time.

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