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Analyzing farmers' preferences for collaborative arrangements: an experimental approach

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1. Introduction

Currently the agricultural sector is globally exposed to strong changes in its general conditions, resulting in increasing pressure on costs and margins for farms. Especially, the costs for machinery and labour have escalated dramatically in recent years. For instance, the purchase prices for standard tractors with 188 horse powers on average rose 63% in real terms over the past decade in Germany, considering comparable technical configuration (cf. KTBL, 2005, 2015). Since both machinery and labor can often just be adopted in discrete amounts, such as the investment in one tractor or the recruitment of one worker, one way to counteract this rise in fixed costs would be to expand production and get access to economies of scale (e.g. Johnson and Ruttan, 1994). However, this strategy is not always appropriate or feasible in agriculture because of insufficient access to land and capital. Furthermore, the high (and further increasing) level of uncertainty in farming due to its weather-dependent nature often requires profound knowledge and quick decision-making, which cannot easily be taken over by employed workers. This can be seen as one of the main reasons for the prevalence of family owned and operated farms in many countries all over the world (e.g. Allen and Lueck, 1998; Deiniger and Byerlee, 2012).

For many farms, an alternative strategy to handle these increasing fixed costs is to share the associated assets and labor with other farms. In many European countries, farms are organized in collaborative arrangements (CAs) on a comparatively formal basis, that is, in the form of inter-farm cooperation, machine cooperatives, machine rings and the use of sub-contractors. This applies particularly to Germany, Great Britain and Sweden (e.g. Craig and Sumberg, 1997; de Toro and Hansson, 2004; Doluschitz, 2001). In Canada, some farmers are likewise organized in formal machinery cooperatives, such as 47 CUMA's (e.g. Harris and Fulton, 2000). In the United States, farms traditionally share equipment and labour on a more occasional basis, however, formal and routine-based CAs are also getting more and more popular in recent years (e.g. Artz, 2014).

Most of the existing literature on farm-level CAs focuses on the respective economic advantages for their members due to access to substantial economies of scale, based on exemplary case studies in different countries (e.g. Andersson et al., 2005; Artz et al., 2010; Aurbacher et al., 2011; de Toro and Hansson, 2004; Nielsen, 1999, Wolfey et al., 2011). Larsén (2010) confirms this by empirically analyzing the technical efficiencies of collaborating and non-collaborating Swedish farms by using FADN data, complemented with survey data. She finds that the average efficiency is indeed higher for collaborating farms than for non-collaborating farms, which applies to both crop and livestock farms.

The question arises, as to why farm-level CAs are still so rare in practice despite of the potential economic advantages of sharing equipment and labour with other members (e.g. Artz, 2014). Aurbacher et al. (2011) calculate the economic implications of a CA between five relatively small arable farms in south Germany and come to the result, that one reason that inhibits inter-farm machinery use could be path dependency. Lagerkvist and Hansson (2012) conduct a coordination game with farmers and find that personal factors like intolerance of ambiguity can influence famers' willingness to establish CAs. Apart from that, all of the aforementioned studies emphasize that a further important reason for not establishing CAs in reality is the risk of future conflicts with the potential partner, like problems of timeliness, free-riding and opportunism (e.g. Artz, 2014). These conflicts might moreover result in substantial additional transaction costs for the members of a CA, which might (partially) offset the economic advantages resulting from economies of scale. However, the actual influence of these potential conflicts on the decisions of farmers to establish CAs in the first place has not been investigated yet.

Against the background of this research gap, the objective of this paper is to analyze farmers' preferences for establishing CAs under explicit consideration of non-monetary factors that allow conclusions on the functioning of the future partnership. In this context, an empirical investigation based on historical data would be of limited explanatory power, as it is challenging or impossible to clearly distinguish the influencing factors of farmers' decisions to establish CAs in retrospective. Experiments can provide a solution to this issue as they collect data under controlled conditions. In particular, discrete choice experiments (DCEs) allow for the determination of preferences for action alternatives without explicitly asking for them (e.g. Train, 2009). By relating the respondents' choice behavior to the attributes of the action alternatives and the respondents' individual characteristics, complex structures of the decision-making process can be revealed (e.g. Louviere et al., 2010). DCEs have already been successfully applied to analyze farmers' preferences, including different technologies (e.g. Paulrud and Laitila, 2010) or agri-environmental schemes (e.g. Espinosa-Goded et al., 2010). And could hence also be an appropriate methodological approach to investigate farmers' preferences for CAs.

Therefore, the data for the analysis was gained through a DCE that was carried out by 107 German farmers in the year 2014. The farmers had to make a choice between two alternative collaboration partners and the opt-out alternative of no collaboration. The collaboration partners were specified by non-monetary attributes that varied over the different choice sets, like their years of acquaintance with the respondent, their age and their production activities. Moreover, the expected increase in profit of the respondent for establishing a collaboration with a partner was included as a monetary attribute, to allow for calculating the average individual's willingness-to-pay (WTP) or 'implicit price' for a change in each of the non-monetary attributes. Since WTP values are upwards biased when not considering for scale heterogeneity (Train and Weeks, 2005), we apply the generalized multinomial logit (GMNL) model introduced by Fiebig et al. (2010) to identify residual preference heterogeneity. The advantage of the GMNL over the more generally applied mixed logit (ML) model is that, in addition, it accounts for heterogeneity in the scale of the error term. This means it is possible to control for respondents with nearly lexicographic preferences and respondents showing very "random" behavior. To the authors' knowledge, GMNL have not yet been commonly applied to DCE studies in the agricultural context.

This study provides farmers, agricultural consultants and agricultural politicians with important information with regard to an improved understanding of the motives and obstacles of establishing farm-level CAs. For instance, it can be shown that a farmers' preference to establish a CA increases, the closer his/her age is to the age of the potential collaboration partner. Furthermore, farmers' preferences for CAs increase the more years of (positive) acquaintance between them and the potential partner exist. And the results show that farmers' willingness to establish mutual CAs increase, the more similar their production activities are. Based on this, the study might also lay the foundation for agricultural politicians to design potential measures for supporting farm-level CAs and thus actively affecting structural change in agriculture.

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

2. Farmers' motives and obstacles to establish CAs

A central motive for a farmer to establish a CA is the improvement of the own future profitability of his/her farm. This motive arises from the expectation that the participation in farm-level CAs, in which resources like machinery and labour are shared, and in which the purchasing of inputs and the marketing of outputs are coordinated, involve an access to internal and external economies of scale (e.g. Valentinov, 2007). Internal economies of scale result from improvements in technological efficiency. For instance, sharing machinery tends to increase the area under cultivation serviced by the same machinery size, like one mutual combine harvester instead of two, resulting in reduced average costs for a given amount of output. In practical terms, this means that sharing can make larger and more technologically advanced equipment economical. In addition, group members can improve labour productivity by coordinating their tasks within the CA. This effect is widely confirmed by many normative model-based case studies (e.g. Andersson et al. 2005; de Toro and Hansson, 2004), by surveys (e.g. Artz et al., 2010; Hein et al., 2011) as well as by empirical investigations of the technical efficiencies of farms in CAs (Larsén, 2010). External economies of scale result from potential advantages of larger farms in accessing and purchasing inputs, in obtaining and negotiating bank loans as well as in marketing their outputs (e.g. Johnson and Ruttan, 1994; McBride, 2003). Although these advantages of size are difficult to verify empirically based on real data, they are nonetheless widely confirmed in surveys among farmers already working in collaborations (e.g. Artz et al., 2010; Hein et al., 2011). One can expect that farmers are carefully estimating the potential increase in future profits resulting from internal and external economies of scale prior to making the decision to establish a CA with a potential partner. This leads to the following hypothesis:

H1 (profit increase): The higher the expected increase in profits, the higher is a farmer's preference to establish a CA.

Besides the potential positive economic effects resulting from internal and external economies of scale, CAs might also produce manifold conflicts between its members (e.g. Artz et al., 2010; Holderness, 2003). Examples are timeliness concerns, moral hazard problems, cost of collective decision-making and opportunism. These conflicts can imply additional considerable transaction costs and risks, which partially offset the economic advantages from the access to economies of scale. However, it can be expected that farmers have difficulties to quantify these costs and risks correctly when estimating the overall economic benefits of a CA prior to making the respective decision. This is due to the fact that these costs and risks resulting from the aforementioned conflicts are very difficult to measure. They may just occur occasionally and strongly depend upon the (mis)behavior of the potential collaboration partner (e.g. Artz, 2014; de Toro and Hanson, 2004). However, there are suggestions in the literature that these costs and risks can be reduced significantly by choosing a partner who is "like-minded" and with whom there exists a high degree of "trust" (e.g. Artz et al., 2010; Hein et al., 2011; Larsén, 2007). To operationalize these rather vague, superior and subjective concepts for the DCE, it is assumed that objectified factors exist, which directly affect the individually perceived "like-mindedness" and "trust" between potential collaboration partners and thus affect their willingness to collaborate. As a result of extensive expert discussions with collaborative and non-collaborative farmers as well as with agricultural consultants prior to the experiment, such objectified factors are the age of the potential collaboration partner, the duration of the acquaintance with the partner as well as the production activities of the partner. Accordingly, a similar age, a longest possible positive acquaintance and similar production activities can be seen as proxies for a high degree of trust and like-mindedness between potential collaboration partners. This is also confirmed by surveys among collaborating and non-collaborating farmers (e.g. Hein et al., 2011, Larsén, 2007). From this, the following three hypotheses can be derived:

H2 (age): The closer the age of the potential collaboration partners, the higher is a farmer's preference to establish a CA.

H3 (acquaintance): The more years of positive acquaintance between potential collaboration partners, the higher is a farmer's preference to establish a CA.

H4 (production activities): The more similar the production activities between potential collaboration partners are, the higher is a farmer's preference to establish a CA.

3. The experiment

The questionnaire is divided into two parts. In the first part, the farmers have to conduct the DCE. In the second part, they are asked to answer questions about their risk attitude and their socioeconomic background. In Subsection 3.1, the decision situation, the attributes and the respective levels of the DCE are described. Afterwards, the experimental design is shortly explained. Subsequently, the descriptive statistics of the questionnaire are presented in Subsection 3.3.

3.1. Decisions situation, attributes and levels

In the DCE, the decision-making situation in each choice-set comprises two different and mutually exclusive collaboration alternatives A and B, as well as the status-quo alternative of no CA. The farmers are advised to make a decision between these three alternatives as if it was their personal decision for their own farm. The DCE is adressed to both farmers already working in a CA (collaborative farmers) and farmers who are not (non-collaborative farmers). To ensure comparability of the decision-making situation, collaborative farmers are asked to make the decision as if they would still run their farm without a CA. The two different versions of the experiment instruction can be read up on in Appendix 1.

According to the four derived hypotheses in Section 2, the above-mentioned three decision alternatives are described by the four attributes 'average annual expected increase in the respondent's profit for the first ten years of collaboration', 'years of positive acquaintance with the potential collaboration partner', 'age of the potential collaboration partner' and 'production activities of the potential collaboration partner'. The levels, within which these attributes vary over the different choice sets, are provided in Table 1. The attributes as well as the levels are the result of extensive expert discussions with collaborative and non-collaborative farmers and agricultural consultants as well as a careful consideration between reality and complexity. It should also be noted that the farmers are asked to assume prior to each choice set that the level of the 'average annual expected increase in profit' has been determined in extensive calculations prior to the decision under explicit consideration of the production activities of the potential collaboration partner. This means that the attribute 'production activities of the potential collaboration partner' is merely included in the choice sets to additionally account for psychological factors, which could result in (potentially costly) conflicts of interest.

Table 1: Attributes and levels in the DCE

Attributes	Levels
Average annual expected increase in the farmer's profit for the first ten years of collaboration (in €/year)	10,000; 20,000; 30,000
Years of positive acquaintance with the potential collaboration partner (in years)	1; 5; 10
Age of the potential collaboration partner (in years)	30; 45; 60
Production activities of the potential collaboration partner	Arable farming; Arable farming and animal husbandry; Arable farming and biogas production

Source: Author's own illustration.

3.2. The experimental design

The experimental design of the DCE with two generic alternatives and four attributes with three levels respectively (cf. Table 1) results in a full factorial design of ($4^3_{CA\ A} \cdot 4^3_{CA\ B}$=) 6,561 potential possible choice sets. To minimize the concomitant and unavoidable loss of information when reducing the full factorial design, an optimal orthogonal in the differences (OOD) design (Burgess and Street, 2005) is used. In addition to maintaining orthogonality, an OOD design aims to maximise the differences in the attribute levels across alternatives. By means of the software Ngene 1.1.1 (ChoiceMetrics, 2012), we create an OOD design with a D-efficiency of 100%. Thus, the number of choice sets presented to the participating farmers is reduced to nine. Such a design has a D-efficiency of 100%. Table 2 shows one of these nine choice sets that are presented to the farmers in a random order to avoid order effects. A detailed explanation of the decision-making situation and the nine choice sets of the DCEs are illustrated in Appendix 1.

After conducting the DCE, the farmers are asked for information regarding their risk attitude and their socioeconomic background. 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 represents 'very willing to take risk'. Hence, farmers evaluate their risk attitude subjectively. The questions with regard to the farmers' socioeconomic background relate to factors like age, education and production activities.

Table 2: Choice set in the DCE

	Collaborative arrangement A	**Collaborative arrangement B**	**No collaborative arrangement**
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 10,000	€ 20,000	
Production activities of the potential collaboration partner	Arable farming	Arable farming and animal husbandry	
Years of positive acquaintance with the potential collaboration partner	1 year	5 years	
Age of the potential collaboration partner	30 years	45 years	
Which collaborative arrangement would you choose? (Please select and mark only one alternative)	○	○	○

Source: Author's own illustration.

After conducting the DCE, the farmers are asked for information regarding their risk attitude and their socioeconomic background. 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 represents 'very willing to take risk'. Hence, farmers evaluate their risk attitude subjectively. The questions with regard to the farmers' socioeconomic background relate to factors like age, education and production activities.

3.3. Descriptive statistics

The online survey was completed by 107 farmers from all over Germany during May and June 2014 and was brought to farmers' notice through social networks. In addition, students were also asked to make farmers aware of the experiment. On average it took about 23 minutes to complete the whole questionnaire. Table 3 reports personal information and farm characteristics of the participating farmers.

The farmers are 11% female, with an average age of 34 years and a standard deviation of 12 years. 45% of them manage the farm in an executive position and the remaining 55% are farm successors and/or employed on a farm. Overall, 66% hold a college or university degree. On average, they are nearly risk-neutral (μ=5.7; σ=1.7; ordinal scale from 0='not willing to take risk' to 10='very willing to take risk').

Furthermore, 64% of the farmers already work within a CA. The average farm size is 278 hectares with a standard deviation of 424 hectares.

Table 3: Descriptive statistics [a]

Farmers	
Share of female participating farmers	11
Average age (in years)	34 (12)
Share of farm managers	45
Share of participating farmers with an university degree	66
Average risk attitude (self-assessed) [b]	5.7 (1.7)
Share of farmers already working in a CA	64
Farms	
Share of farms who generate their main income with farming	85
Average farm size (in ha)	278 (424)
Share of farms with production activity 'arable farming' [c]	93
Share of farms with production activity 'animal husbandry' [c]	81
Share of farms with production activity 'renewable energies' [c]	35
Decision situation	
Number of non-answered choice sets out of 963 choice sets	0
Proportion of the decisions for CA A or B in %	73

Source: Author's own illustration.
Notes: [a] n=107, standard deviation in brackets.
[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).
[c] Multiple references possible.

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

4. Modelling approach

4.1. The generalized multinomial logit model

According to the random utility theory (McFadden, 1974), it is possible to determine an indirect utility function U_{int} for each respondent *n* and each collaboration alternative *I* in choice occasion *t* (cf. Hensher and Greene, 2003):

$$U_{int} = \boldsymbol{\beta}_n{}'\boldsymbol{x}_{int} + \boldsymbol{\varepsilon}_{int} \qquad (1)$$

U_{int} can be described by *K* attributes $\boldsymbol{x}_{int}$ (in our study the four attributes described in Section 3.1) weighted by the respondent-specific taste parameters $\boldsymbol{\beta}_n$ that cannot be observed by the researcher. Non-observable individual preferences are considered in the stochastic component $\boldsymbol{\varepsilon}_{int}$, for which we assume an independently and identically distributed (i.i.d.) extreme value distribution.

For the so called ML model, the following definition of $\boldsymbol{\beta}_n$ is assumed:

$$\boldsymbol{\beta}_n = \overline{\boldsymbol{\beta}} + \Delta \boldsymbol{s}_n + \boldsymbol{\Gamma} \boldsymbol{v}_n \tag{2}$$

where $\overline{\boldsymbol{\beta}}$ is the fixed mean of the assumed distribution for $\boldsymbol{\beta}_n$. The *K*x*M* parameter matrix Δ expresses how the preference of chosing a certain collaboration alternative *i* changes due to the influence of *M* respondent's individual characteristics $\boldsymbol{s}_n$ in comparison to the reference respondent (with taste parameter $\overline{\boldsymbol{\beta}}$) while all other effects remain constant. Therefore, $\Delta \boldsymbol{s}_n$ captures the observed heterogeneity in preferences, whereas $\boldsymbol{\Gamma} \boldsymbol{v}_n$ represents the unobserved heterogeneity in preferences. $\boldsymbol{v}_n$ is a vector of *K* variables for which zero means, known variances and zero covariances are assumed. In our case, $\boldsymbol{\Gamma}$ is a diagonal matrix. Thus, the stochastic parameters are not allowed to be correlated.

As e.g. Fiebig et al. (2010) and Keane (2006) state, the ML model and also the multinomial logit model do not adequatly consider for scale heterogeneity. Therefore, we also introduce the GMNL model here. Following Fiebig et al. (2010), the abovementioned definition of $\boldsymbol{\beta}_n$ is stretched out in the GMNL model in the following way:

$$\boldsymbol{\beta}_n = \sigma_n[\overline{\boldsymbol{\beta}} + \Delta \boldsymbol{s}_n] + [\gamma + \sigma_n(1-\gamma)]\boldsymbol{\Gamma} \boldsymbol{v}_n \tag{3}$$

σ_n is the respondent-specific scale of the error term. Fiebig et al. (2010) assume a log-normal distribution for σ_n with standard deviation τ and mean $(\bar{\sigma} + \boldsymbol{\delta z}_n)$, where $\bar{\sigma}$ is a normalizing constant and $\boldsymbol{z}_n$ is a vector of *L* indiviual-specific variables. If $\boldsymbol{z}_n$ is spezified in the model formulation, the researcher can explain why σ_n is heterogenous across respondents. γ is a weighting parameter that indicates how variance in unobserved preference heterogeneity varies with scale. As Greene and Hensher (2010: p. 2) point out, γ is essential for the GMNL model, because it "controls the relative importance of the overall scaling of the utility function, σ_n , versus the scaling of the individual preference weights contained in the diagonal elements of $\boldsymbol{\Gamma}$". In accordance with Keane and Wasi's (2012) argumentation, we do not impose the constraint that γ takes on values between 0 and 1, as Fiebig et al. (2010) do. Three special cases of the GMNL model are shortly named here: (i) the ML model: if $\sigma_n = 1 \rightarrow \boldsymbol{\beta}_n = \overline{\boldsymbol{\beta}} + \Delta \boldsymbol{s}_n + \boldsymbol{\Gamma} \boldsymbol{v}_n$ (cf. Equation (2)), (ii) the S-MNL model: if $\gamma = 0 \rightarrow \boldsymbol{\beta}_n = \sigma_n \overline{\boldsymbol{\beta}}$ and (iii) the MNL model: if $\sigma_n = 1$ and $\gamma = 0 \rightarrow \boldsymbol{\beta}_n = \overline{\boldsymbol{\beta}}$.

Respondent *n*, as a utility maximizer, chooses collaboration alternative *j* instead of *i* from a given set of alternatives C_{nt} if the following applies: $U_{jt} > U_{it}\ \forall\, j \in C_n,\ j \neq i$. For a given value of $\boldsymbol{\beta}_n$, the conditional choice probability that respondent *n* chooses choice sequence $y_n = \{y_{n1}, \dots, y_{nT}\}$ is given as follows:

$$Pr(y_n|\boldsymbol{\beta}_n) = \prod_{t=1}^{T} \frac{e^{\boldsymbol{\beta}_n' x_{y_{nt}nt}}}{\sum_{i=1}^{I} e^{\boldsymbol{\beta}_n' x_{int}}} \tag{4}$$

Since $\boldsymbol{\beta}_n$ is not observable, the unconditional probability should be calculated by integration of Equation (4) weighted by the population density distribution $f(\boldsymbol{\beta}_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma})$ of $\boldsymbol{\beta}_n$ (cf. Equation (3)):

$$Pr(y_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma}) = \int Pr(y_n|\boldsymbol{\beta}_n) f(\boldsymbol{\beta}_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma})\, d\boldsymbol{\beta}_n \quad (5)$$

The log likelihood for the GMNL model is the following:

$$LL(\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma}) = \sum_{n=1}^{N} ln\ Pr(y_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma}) \quad (6)$$

Since the integral 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 out of $f(\boldsymbol{\beta}_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma})$ are raised and the associated utility parameters $\boldsymbol{\beta}_n^R$ are calculated. For more detailed information how the simulated log-likelihood were calculated in STATA see Gu et al. (2013).

To obtain individual level parameters for the willingness to pay calculation, we follow the method described by Train (2009). The distribution of $\boldsymbol{\beta}_n$ conditional on the observed choice sequence y_n and the moments of the population density function $f(\boldsymbol{\beta}_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma})$ is calculated as follows (for further insights see Train, 2009):

$$h(\boldsymbol{\beta}_n|y_n, \overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma}) = \frac{Pr(y_n|\boldsymbol{\beta}_n)\ f(\boldsymbol{\beta}_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma})}{Pr(y_n|\overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma})} \quad (7)$$

Individual level utility parameters $\widetilde{\boldsymbol{\beta}_n}$ for each respondent *n* can be obtained by means of Equation (8):

$$\widetilde{\boldsymbol{\beta}_n} = \int \boldsymbol{\beta}_n \cdot h(\boldsymbol{\beta}_n|y_n, \overline{\boldsymbol{\beta}}, \Delta, \gamma, \tau, \boldsymbol{\delta}, \boldsymbol{\Gamma}) d\boldsymbol{\beta}_n \quad (8)$$

The integral in Equation (8) does not have a closed form and, therefore, has to be calculated by means of simulation. The willingness to pay for the attributes are calculated on the basis of the obtained individual level utility parameters as the quotient of the attribute's utility parameter and the utility parameter of the attribute 'profit' as the price attribute.

4.2. Variable coding and model estimation

All models include a dummy-coded, alternative-specific constant (ASC). The ASC takes on the value of one for collaboration alternatives and the value of zero for the status-quo alternative 'no CA'. Furthermore, the attribute 'profit' is included in the model estimations. A Wald test for linear restriction[1]

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[1] In order to examine the assumption that the utility in the utility parameters of the quantitative attributes is linear, a test of linearity is carried out. To do so, the attributes are dummy-coded (cf., Hensher et al., 2005: pp. 344-351). Each time, the middle value of the three levels is chosen as reference. Thus, for each attribute, there are two dummy-coded variables included in the model estimation - one variable codes the higher and one the lower level. The linearity assumption is regarded as complied if it is possible to estimate significant utility parameters, which are in the same ratio as the distances of the levels to the reference level, for both dummy-coded variables of an attribute. Based on the reference level, it is ensured in this way that a change in the attribute by one unit - no matter in which direction - results in a not significantly different change in the absolute value of the selection probability.

confirms the linearity of the attribute 'profit' (p-value=0.15). Thus, the attribute variable 'profit' is included in the model estimations as a continuous variable. Modelling the monetary attribute 'profit' as a continuous variable enables us to estimate WTP values as mentioned in Section 4.1, otherwise we had to employ a more complex calculation method. In contrast, for the attributes 'partner acquaintance' and 'partner's age' it is not possible to assume a linear interdependency (p-values of the Wald test for linear restriction<0.01). Therefore, effect-coded variables with discrete values instead of the continuous attribute variables are included in the model estimation. Moreover, the qualitative attribute 'production activities' is included in the model estimations as effect coded variable (for detailed information regarding the coding of all variables see Table A.2 in Appendix 2). Effect coding relaxes linearity assumptions and implies that level specific effects should be interpreted as deviations from the average, whereas dummy coded variables are interpreted as differences from the reference level. Therefore, orthogonalising the attribute effects with the ASC is one of several advantages of effect coding versus dummy coding. For a detailed comparison between these two types of coding, readers are referred to Bech and Gyrd-Hansen (2005). In addition, the WTP for the basic level of the effect coded attribute can be calculated as the negative sum of the estimated WTP values of the other two attribute levels ($WTP_{Basic}=(-WTP_{Level\ 1}-WTP_{Level\ 2})$).

The attribute 'profit' as well as the effect coded variables of the attribute 'partner acquaintance' and the variable 'partner's age 60years' were modeled as normally distributed random parameters. The statistical significance of the coefficients associated with the standard deviations of the random parameters indicates that they are significantly different from zero, and that the variables should indeed be modeled as random (Hensher and Greene, 2003: p. 145). Additionally, this is a strong evidence of unobserved preference heterogeneity. Furthermore, the structural parameter τ is significantly different from zero indicating substantial heterogeneity in individual scale. Therefore, using GMNL models is an appropriate approach, since unobserved heterogeneity in preferences and scale are both present. This is supported by means of the AIC-criterion, which indicates that the calculated GMNL models fit the data better than the ML model (cf. Table 4). The codes used to calculate the models and the WTP measures with STATA 12 are fully provided in Appendix 2.

Table 4: Results of different models [a]

Variable	ML model		GMNL model		GMNL model with interactions	
Utility parameters:						
ASC [b]	0.27635		0.01719		-0.03769	
Profit	0.00008	***	0.00018	***	0.00017	***
Partner's age 30years [c]	0.15863	*	0.22254		0.17265	
Partner's age 30years [c] · farmer's age [d]					-0.00705	*
Partner's age 60years [e]	-0.23433	*	-0.70634	*	-0.52349	*
Partner's age 60years [e] · farmer's age [d]					0.01404	*
Partner acquaintance 1year [f]	-1.16189	***	-2.60772	***	-2.41514	***
Partner acquaintance 10years [g]	0.87944	***	2.05799	***	1.90037	***
Partner arable [h]	0.47181	***	1.11749	***	1.69302	***
Partner arable [h] · farmer renewable [i]					0.09302	
Partner arable [h] · farmer husbandry [k]					0.32272	
Partner biogas [l]	-0.28110	**	-0.61778	**	-0.56706	+
Partner biogas [l] · farmer renewable [i]					3.23018	+
Partner biogas [l] · farmer husbandry [k]					-3.28280	+
Standard deviation (SD) of the random parameters:						
SD ASC [b]	2.98792	***	3.50567	***	3.57337	***
SD profit	0.00006	***	0.00013	**	0.00014	***
SD partner's age 60years [e]	0.73184	***	1.19586	**	1.05106	***
SD partner arable [h]	0.58359	***	1.03161	**	0.92109	***
SD partner biogas [l]	0.55028	***	1.09915	**	1.19919	***
Structural parameters:						
Tau	---		1.24774	***	1.10335	***
Gamma	---		-0.69725	+	-0.33551	
Model fit:						
Number of participating farmers (N)			107			
Observations (N · number of choice sets)			963			
Simulated log likelihood at convergence	-733.70		-717.43		-706.39	
AIC (calculated on the basis of the number of observations)	1,493.40		1,464.87		1,454.77	
Likelihood ratio index	0.18		0.20		0.22	

Source: Author's own calculations using the command 'mixlogit' (Hole, 2007) and 'gmnl' (Gu et al., 2013) in STATA 12.

Notes: [+] $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

[a] 10,000 Halton Draws; panel structure of the data was taken into account; indented variables depict the interaction terms.

[b] Binary coded; reference: Status-quo alternative 'no CA'.

[c] Effect coded attribute variable that takes on the value 1 if the potential collaboration partner is 30 years old, (-1) if he/she is 45 years old and 0 if he/she is 60 years old.
[d] Age of the participating farmer is centered around the mean (38.38).
[e] Effect coded attribute variable that takes on the value 1 if the potential collaboration partner is 60 years old, (-1) if he/she is 45 years old and 0 if he/she is 30 years old.
[f] Effect coded attribute variable that takes on the value 1 if the potential collaboration partners know each other with positive acquaintance of 1 year, (-1) if they know each other with positive acquaintance of 5 years and 0 if they know each other with positive acquaintance of 10 years.
[g] Effect coded attribute variable that takes on the value 1 if the potential collaboration partners know each other with positive acquaintance of 10 years, (-1) if they know each other with positive acquaintance of 5 years and 0 if they know each other with positive acquaintance of 1 year.
[h] Effect coded attribute variable that takes on the value 1 if the potential collaboration partner runs a farm with the production activity 'arable farming', (-1) if he/she runs a farm with the production activity 'animal husbandry' and 0 if he/she runs a farm with the production activity 'biogas production'.
[i] Effect coded respondent specific variable that takes on the value 1 if the farmer runs a farm inter alia with the production activity 'renewable energies', (-1) if the farmer runs a farm inter alia with the production activity 'arable farming' and 0 otherwise.
[k] Effect coded respondent specific variable that takes on the value 1 if the farmer runs a farm inter alia with the production activity 'animal husbandry', (-1) if the farmer runs a farm inter alia with the production activity 'arable farming' and 0 otherwise.
[l] Effect coded attribute variable that takes on the value 1 if the potential collaboration partner runs a farm with the production activity 'biogas production', (-1) if he/she runs a farm with the production activity 'animal husbandry' and 0 if he/she runs a farm with the production activity 'arable farming'.

Table 5: WTP measures based on the GMNL model with interactions in €

WTP in € [a]	N	Mean		SD	Confidence Interval	
Partner's age 30years	107	664		595	-516	1,844
Partner's age 45years	107	2,840	+	1,592	-316	5,997
Partner's age 60years	107	-3,504	*	1,529	-6,535	-474
Partner acquaintance 1year	107	-13,047	*	8,889	-24,723	-1,371
Partner acquaintance 5years	107	2,781	*	1,255	292	5,269
Partner acquaintance 10years	107	10,266	*	4,634	1,079	19,453
Partner arable	107	8,902	+	4,575	-168	17,973
Partner biogas	107	-3,370		4,470	-12,233	5,493
Partner biogas if farmer renewable [b]	40	20,500	***	7,915	4,491	36,509
Partner biogas if farmer husbandry [c]	55	-24,651	***	3,007	-30,679	-18.622
Partner husbandry	107	-5,532		5,312	-16063	4,999
Partner husbandry if farmer renewable [b]	40	-36,757	***	9,944	-56,869	-16,644
Partner husbandry if farmer husbandry [c]	55	12,057	***	2,939	6,164	17,950

Source: Author's own calculations using the post-estimation command 'gmnlbeta' (Gu et al., 2013) for the GMNL model with interactions (cf. Table 4) in STATA 12.
Notes: [+] $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
[a] We used a t-test to analyze whether the mean of the calculated WTP is statistically different from zero.
[b] The participating farmer runs a farm inter alia with the production activity 'renewable energies'.
[c] The participating farmer runs a farm inter alia with the production activity 'animal husbandry'.

5. Results

The results of all calculated models reveal a non-significant ASC (cf. Table 4). Therefore, a general willingness to establish a CA that cannot be explained by the attributes is not existent. In this respect, it should be noted that an additional GMNL model with the farmers individual risk attitude as interaction terms with the attributes was calculated. The results show that the preferences heterogeneity cannot be explained by the individual risk attitude of the farmer. The WTP measures calculated on the basis of the GNML model with interaction terms are presented in Table 5. The attribute 'profit' is chosen as the price attribute in the WTP calculations, therefore, the WTP values are measured in Euros of the average annual expected increase in the respondents' farm profit when establishing a collaboration with a potential partner.

H1 (profit increase): The higher the expected increase in profits, the higher is a farmer's preference to establish a CA.

The utility parameter of the attribute 'profit' is significantly positive in all calculated models (cf. Table 4). Thus, the farmers' willingness to establish a CA rises if the average annual expected increase in profit of the CA's first ten years rises as well. This result supports H1 that farmers' preferences to establish CAs rises with increasing profits. Thus, H1 cannot be rejected.

H2 (age): The closer the age of the potential collaboration partners, the higher is a farmer's preference to establish a CA.

The utility parameter of the effect coded attribute variable 'partner age 30years' is only significant in the ML model (cf. ML model in Table 4: significantly positive utility parameter), whereas the utility parameter of the effect coded attribute variable 'partner age 60years' is significantly negative in all calculated models.

In the GMNL model with interactions, the interaction term 'partner's age 30years · farmer's age' is significantly negative. This means that farmers who are older than 38 (which represents the age of the reference farmer) prefer a 45-year-old over a 30-year-old potential collaboration partner, whereas farmers who are younger than 38 prefer a 30-year-old over a 45-year-old partner. The interaction term 'partner's age 60years · farmer's age' is also significant in the GMNL model with interactions. This means that the reference farmer who is 38 prefers a 45-year-old over a 60-year-old partner. This preference increases with decreasing age of the farmer and decrease with increasing age of the farmer.

Looking at the respective WTP measures in Table 5, one can see that the WTP for a 30-year-old potential collaboration partner is not significantly different from zero. Furthermore, the average WTP for a 45-year-old partner is 2,840 €. The average compensation requirement for a 60-year-old partner is 3,504 €. Thus, the resulting marginal WTP for a partner who is 45 instead of 60 years old is 664 € (= 3,504 – 2,840).

In light of these results, H2 cannot be rejected, that is farmers' preferences to establish CAs increase the closer the age between the potential partners is.

H3 (acquaintance): The more years of positive acquaintance between potential collaboration partners, the higher is a farmer's preference to establish a CA.

The utility parameter of the effect coded attribute variable 'acquaintance 1year' is significantly negative in all calculated models (cf. Table 4). Therefore, a farmer will assign a negative utility to the case that he/she is acquainted with the potential collaboration partner for only one year. However, the utility parameter of the effect coded attribute variable 'acquaintance 10years' is significantly positive in all calculated models. As expected, the farmer's utility of establishing a CA is positive when the potential partners are acquainted for ten years.

The farmers' average maximum willingness to pay for being acquainted with the potential collaboration partner for five (ten) years is 2,781 € (10,266 €). If the farmer is only acquainted with the potential collaboration partner for one year, he/she will on average have a maximum compensation requirement of 13,047 €. The farmers' marginal willingness to pay for being acquainted with the potential collaboration partner for five (ten) years instead of one (five) year(s) is 10,266 € (7,485 €).

In summary, H3 cannot be rejected, that is farmers' preferences to establish CAs increase, the more years of positive acquaintance between the potential partners exist.

H4 (production activities): The more similar the production activities between potential collaboration partners are, the higher is a farmer's preference to establish a CA.

In all calculated models (cf. Table 4), the utility parameter of the effect coded attribute variable 'partner arable' is significantly positive. Therefore, the utility farmers assign to a potential collaboration partner with the production activity 'arable farming' is positive. The GMNL model with interactions in Table 4 reveals that the utility parameters of the interaction terms with the attribute variable 'partner arable' are not significantly different from zero. Thus, there exists no difference in the utility animal husbandry-farmers and renewable energy-farmers assign towards a potential collaboration partner with the production activity 'arable farming'. Farmers' average maximum WTP for a CA with such a potential collaboration partner is 8,902 € (cf. Table 5).

The utility parameter of the effect coded attribute variable 'partner biogas' is significantly negative in all calculated models (cf. Table 4). Hence, the utility linked to a CA where the partner has the production activities 'arable farming and biogas production' is negative. The utility parameter of the interaction term 'partner biogas · farmer renewable' ('partner biogas · farmer husbandry') is significantly positive (negative) (cf. GMNL model with interactions in Table 4). Thus, farmers with the production activity 'renewable energies' assign a positive utility to a CA with a partner that has the production activity 'biogas production'. As Table 5 depicts, farmers with the production activity 'renewable energies' have a maximum average WTP of 20,500 € for establishing a CA with a partner that has the production activity 'biogas production'. However, they have a maximum compensation requirement of 36,757 € for establishing a CA with a partner that has the production activity 'animal husbandry'. In contrast, animal husbandry-farmers have a maximum average WTP of 12,057 € for a CA with a partner that the production activity 'animal husbandry', whereas they have a maximum compensation requirement of 24,651 € for a CA with a partner with the production activity 'biogas production'.

In described results reveal that H4 cannot be rejected. Farmers who operate animal husbandry or renewable energies besides arable farming, are preferred more for establishing CAs by farmers who have the same production activities than by farmers who just operate arable farming.

6. Concluding remarks

Farm-level CAs are a possible strategy for agricultural entrepreneurs to handle escalating costs for equipment and labor, which can often just be adopted in discrete amounts. Existing studies on farm-level CAs mainly focus on the respective economic advantages for their members as a result of accessing economies of scale. However, these analyses do not consider potential conflicts between the members of CAs, like problems of timeliness, free-riding and opportunism. The risk of a future occurrence of these conflicts and the associated additional costs could be an important reason for farmers' reluctance to enter CAs in the first place in reality. Hence, the objective of this paper was to analyze farmers' preferences for CAs in an experimental setting. For this, a DCE was performed in which German farmers had to choose their preferred collaboration partner. Besides the monetary advantage of establishing a CA with a potential partner, also non-monetary attributes were considered, which could indicate the above-mentioned conflicts in the future of a partnership, like the age of the partner or the years of acquaintance with the partner. The gained data was subsequently analyzed by means of a GMNL model and average individual WTP measures for a change in each of the non-monetary attributes were calculated.

The results of the DCE reveal interesting insights into the drivers of farmers' decisions to establish CAs. Accordingly, it can be shown that a farmers' preference to establish a CA increases, the closer his/her age is to the age of the potential collaboration partner, which is in-line with existing survey results (e.g. Hein et al., 2011). This indicates that a similar age can be seen as an indicator for "trust" and "like-mindedness" among potential collaboration partners, which are suspected (but not investigated quantitatively) in many contributions to be important factors to mitigate future (costly) conflicts in CAs (e.g. Artz et al., 2010; Hein et al., 2011; Larsén, 2007). Furthermore, the results of the present study confirm that a farmers' preference for CAs increase the more years of (positive) acquaintance between him/her and the potential partner exist. Therefore, knowing the potential partner for a longer time can also be seen as an indicator for "trust" and "like-mindedness", which increases the preparedness to establish a CA. Finally, the outcome of the DCE suggests that the production activities also play an important role in the occurrence of CAs. Accordingly, the preferences of farmers to establish a mutual collaboration increase, if the production activities of the two potential partners are similar, for instance if both practice animal husbandry besides arable farming. Besides economic considerations, this could be also traced back to non-monetary motives like traditional thinking (e.g. Benz, 2006).

The findings of this study are of practical importance for farmers as well as for agricultural consultants and politicians. On the basis of the results, farmers are able to make decisions regarding the establishment of CAs in a more structured and objectified way due to an improved understanding of their respective motives and obstacles. In this respect, especially the calculated WTP measures for the non-monetary attributes like 'age of the collaboration partner' could help to improve comparability between monetary and non-monetary attributes and thus facilitate the establishment of farm-level CAs in the future. Likewise, agricultural consultants receive useful information for improved and objectified advices to farmers, if and which CAs are an appropriate strategy for the farm in the future. And agricultural politicians could include the results into the design of potential measures for supporting farm-level CAs in countries, in which a high potential for increasing the efficiency of primary agricultural production exist.

Nevertheless, the results of the study should be interpreted with due care due to some limitations of the data gained in the DCE. First, the results are based on hypothetical decisions like in all other studies which apply laboratory experiments. The question of whether the decision-making behavior of real decision situations is different of those in hypothetical decision situations has been examined several times. The respective results provide abundant evidence that there is little discrepancy between real and hypothetical decision-making behavior (e.g. Kuehberger et al., 2002). Nevertheless, this should be confirmed by comparable studies in the agricultural context. Second, the transferability of the findings should be tested in additional DCEs, particularly with regard to other countries in other regions where the conditions of agricultural production are different. And third, the preference of a farmer to establish a CA could also depend on the degree of collaboration (e.g. merely share machinery and labour, or additionally buy inputs together) and the chosen legal form. For complexity reasons, no specifications are made about this in the present DCE.

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Appendix 1: Decision-making situation and choice sets of the experiment

[The online survey was put online during May and June 2014 and was brought to farmers' notice through social networks. In addition, students from the University of Göttingen were also asked to make farmers aware of the experiment.

All participating farmers made the nine choice sets of the DCE in one sitting, although they had the possibility to interrupt the experiment. Farmers were not offered an incentive or compensation to participate in the experiment. In addition, any feedback was provided.

To avoid an order effect when presenting the choice sets to the farmers, the sequence of the choice sets was randomly chosen by the computer. In the following, the DCE is presented.]

[The instructions and choice sets are translated from German. The abbreviation "CA" is continued here for homogeneity in the paper. In the experiment, it was written out in full.]

[Decision situation for farmers who are already running their farms in (a) CA(s)]

You stated that you run your farm today in one or more agricultural CA(s). The decision regarding these arrangements was most likely up to you or your predecessor.

In the context of our study, we would like to examine what are reasons for or against a CA between farmers. Thus, we need to establish comparability between you as a collaborative partner and farmers who are not involved in a CA. Therefore, please, imagine that you do not run your farm within a CA. Furthermore, imagine that you are faced once more with the decision to enter a CA. Please, when deciding, use your knowledge and experience about CAs gained in the past.

In the following, we will ask you ninetimes, one behind the other, which alternative out of the supplied CAs you will choose. The CAs A and B differentiated in the following:

- average annual expected increase in your farm's profit for the first ten years of collaboration,
- years of positive acquaintance with the potential collaboration partner,
- age of the potential collaboration partner and
- production activities of the potential collaboration partner.

Of course, you can also choose the alternative 'no CA'. Please, choose the alternative that you consider to be appropriate for your farm!

Note: The information to the CAs always refers to the potential collaborative partner (except the increase of your profits).

Thank you!

[Decision situation for farmers who do not run their farms in a CA]

You stated that you do not run your farm today in an agricultural CA. The decision against a CA was most likely up to you, your predecessor or was not existent up to now.

In the context of our study, we would like to examine what are reasons for or against a CA between farmers. Thus, we need to establish comparability between you as a non collaborative farmer and farmers who run their farm within a CA. Therefore, please, imagine that you have the possibility to enter a CA.

In the following, we will ask you ninetimes, one behind the other, which alternative out of the supplied CAs you will choose. The CAs A and B differentiated in the following:

- average annual expected increase in your farm's profit for the first ten years of collaboration,
- years of positive acquaintance with the potential collaboration partner,
- age of the potential collaboration partner and
- production activities of the potential collaboration partner.

Of course, you can also choose the alternative 'no CA'. Please, choose the alternative that you consider to be appropriate for your farm!

Note: The information to the CAs always refers to the potential collaborative partner (except the increase of your profits).

Thank you!

[The nine following choice sets are presented to the farmers in a random order.]

[Choice set 1]

	CA A	CA B	No CA
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 10,000	€ 20,000	
Production activities of the potential collaboration partner	Arable farming	Arable farming and animal husbandry	
Years of positive acquaintance with the potential collaboration partner	1 year	5 years	
Age of the potential collaboration partner	30 years	45 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 2]

	CA A	CA B	No CA
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 30,000	€ 10,000	
Production activities of the potential collaboration partner	Arable farming and animal husbandry	Arable farming and biogas production	
Years of positive acquaintance with the potential collaboration partner	5 years	10 years	
Age of the potential collaboration partner	30 years	45 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 3]

	CA A	CA B	No CA
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 20,000	€ 30,000	
Production activities of the potential collaboration partner	Arable farming and biogas production	Arable farming	
Years of positive acquaintance with the potential collaboration partner	10 years	1 year	
Age of the potential collaboration partner	30 years	45 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 4]

	CA A	CA B	No CA
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 20,000	€ 30,000	
Production activities of the potential collaboration partner	Arable farming and animal husbandry	Arable farming and biogas production	
Years of positive acquaintance with the potential collaboration partner	1 year	5 years	
Age of the potential collaboration partner	45 years	60 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 5]

	CA A	CA B	No CA
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 10,000	€ 20,000	
Production activities of the potential collaboration partner	Arable farming and biogas production	Arable farming	
Years of positive acquaintance with the potential collaboration partner	5 years	10 years	
Age of the potential collaboration partner	45 years	60 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 6]

	CA A	CA B	No CA
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 30,000	€ 10,000	
Production activities of the potential collaboration partner	Arable farming	Arable farming and animal husbandry	
Years of positive acquaintance with the potential collaboration partner	10 years	1 year	
Age of the potential collaboration partner	45 years	60 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 7]

	CA A	**CA B**	**No CA**
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 30,000	€ 10,000	
Production activities of the potential collaboration partner	Arable farming and biogas production	Arable farming	
Years of positive acquaintance with the potential collaboration partner	1 year	5 years	
Age of the potential collaboration partner	60 years	30 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 8]

	CA A	**CA B**	**No CA**
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 20,000	€ 30,000	
Production activities of the potential collaboration partner	Arable farming	Arable farming and animal husbandry	
Years of positive acquaintance with the potential collaboration partner	5 years	10 years	
Age of the potential collaboration partner	60 years	30 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

[Choice set 9]

	CA A	**CA B**	**No CA**
Average annual expected increase in your farm's profit in the first 10 years of collaboration	€ 10,000	€ 20,000	
Production activities of the potential collaboration partner	Arable farming and animal husbandry	Arable farming and biogas production	
Years of positive acquaintance with the potential collaboration partner	10 years	1 year	
Age of the potential collaboration partner	60 years	30 years	
Which CA would you choose? (Please select and mark only one alternative)	◯	◯	◯

Appendix 2: STATA code

In the folowing the STATA codes used for the calculation of the models are presented. Table A.2 holds information regarding the variables and their coding. For more information regarding the abovementioned STATA-commands 'mixlogit', 'gmnl' and 'gmnlbeta' readers are referred to the respective STATA help-files.

Code for ML model

```
mixlogit
    choice
          partner acquaintance 1year
          partner acquaintance 10years
          partner's age 30years,
    rand( asc
          profit
          partner arable
          partner biogas
          partner's age60years)
    group(occasion) id(number) nrep(10000)

estat ic, n(963)
```

Code for GMNL model

```
gmnllogit
    choice
          partner acquaintance 1year
          partner acquaintance 10years
          partner's age 30years,
    rand( asc
          profit
          partner arable
          partner biogas
          partner's age60years)
    group(occasion) id(number) nrep(10000)

estat ic, n(963)
```

Table A2. Variables and their coding

Variables	Coding	Hypotheses
ASC	Binary coded alternative-specific constant takes on the value one for a CA and the value zero for the status-quo alternative 'no CA'.	
Profit	Average annual expected increase in profit of the first ten years of collaboration in €	H1
Partner arable	Effect coded attribute variable that takes on the value 1 if the potential collaboration partner runs a farm with the production activity 'arable farming', (-1) if he/she runs a farm with the production activity 'animal husbandry' and 0 if he/she runs a farm with the production activity 'biogas production'.	
Partner biogas	Effect coded attribute variable that takes on the value 1 if the potential collaboration partner runs a farm with the production activity 'biogas production', (-1) if he/she runs a farm with the production activity 'animal husbandry' and 0 if he/she runs a farm with the production activity 'arable farming'.	H2
Farmer husbandry	Effect coded respondent specific variable that takes on the value 1 if the participating farmer runs a farm inter alia with the production activity 'animal husbandry', (-1) if he/she runs a farm inter alia with the production activity 'arable farming' and 0 otherwise.	
Farmer renewable	Effect coded respondent specific variable that takes on the value 1 if the participating farmer runs a farm inter alia with the production activity 'renewable', (-1) the he/she runs a farm inter alia with the production activity 'arable farming' and 0 otherwise.	
Partner acquaintance 1years	Effect coded attribute variable that takes on the value 1 if the potential collaboration partners know each other with positive acquaintance of 1 year, (-1) if they know each other with positive acquaintance of 5 years and 0 if they know each other with positive acquaintance of 10 years.	H3
Partner acquaintance 10years	Effect coded attribute variable that takes on the value 1 if the potential collaboration partners know each other with positive acquaintance of 10 years, (-1) if they know each other with positive acquaintance of 5 years and 0 if they know each other with positive acquaintance of 1 year.	
Partner's age 30years	Effect coded attribute variable that takes on the value 1 if the potential collaboration partner is 30 years old, (-1) if he/she is 45 years old and 0 if he/she is 60 years old.	
Partner's age 60years	Effect coded attribute variable that takes on the value 1 if the potential collaboration partner is 60 years old, (-1) if he/she is 45 years old and 0 if he/she is 30 years old.	H4
Farmer's age	Age of the participating farmer is centered around the mean (38.38).	

Choice	Dummy coded dependent variable that depicts the choice made by a farmer in a specific choice occasion. The variable takes on the value 1 if the alternative is chosen and the value zero if the alternative is not chosen.
Occasion	Numeric identifier for the choice occasions that ranges from1 to 9.
Number	Numeric identifier for the participating farmers that ranges from 1 to 107. In this way it is taken into account that the farmer answer nine choice sets.

Source: Author's own illustration.

Code for GMNL model with interactions

To integrate independent variables which do not vary over alternatives into the model it is necessary to generate interaction terms with the alternative specific constant or the attributes.

```
gmnl
    choice
        partner arable · farmer renewable
        partner arable · farmer husbandry
        partner biogas · farmer renewable
        partner biogas · farmer husbandry
        partner acquaintance 1year
        partner acquaintance 10years
        partner's age 30years
        partner's age 30years · farmer's age
        partner's age 60years · farmer's age,
    rand(  asc
        profit
        partner arable
        partner biogas
        partner's age60years)
    group(occasion) id(number) nrep(10000)

estat ic, n(963)

gmnlbeta
        partner arable · farmer renewable
        partner arable · farmer husbandry
        partner biogas · farmer renewable
        partner biogas · farmer husbandry
        partner acquaintance 1year
        partner acquaintance 10years
        partner's age 30years
        partner's age 30years · farmer's age
        partner's age 60years · farmer's age,
    nrep(10000) noscale sav("file name")
```

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Institut für Agrarökonomie

Georg-August-Universität, Göttingen

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Georg-August-Universität Göttingen
Department für Agrarökonomie und Rurale Entwicklung

Diskussionspapiere

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44	Feulefack, Joseph Florent, Manfred Zeller u. Stefan Schwarze	Accuracy Analysis of Participatory Wealth Ranking (PWR) in Socio-economic Poverty Comparisons, 2006

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

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

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

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

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

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