Financial flexibility in agricultural investment decisions: A discrete choice experiment

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Abstract

Using a discrete choice experiment we examine the role of financial flexibility in agricultural investment decisions. The data is analyzed with a mixed logit model and reveals that financial flexibility is an important decision-making factor. Every third participant indicates that, compared to the criteria profitability and risk, financial flexibility is even determining his/her investment decision. Furthermore, it was possible to quantify an economic value for the financial flexibility that is significantly different from zero.

Keywords: *Financial flexibility, investment decision, discrete choice experiment, mixed logit model*

I. Introduction

European farmers are constantly faced with changing framework conditions. In order to stay competitive, entrepreneurial adaptations are imperative. The associated investments predominantly are of increasing volumes and, consequently, farms' capital intensity increases. Therefore, comprehensive internal financing is hardly possible. In several European countries, this results in decreasing equity ratios for farms (Myrrä et al., 2011). For example, the average equity ratio of the test farms of the German BMEL, which generate their income mainly from agricultural activity, was 84.3% in the financial year 2000/2001 (BMEL, 2001) and 79.6% in the financial year 2010/2011 (BMEL, 2011a). On average, the equity ratio of the test farms of the German BMEL owned by legal persons in the East of Germany is with 64.6% (58.8%) below the national average in the financial year 2000/2001 (2010/2011) (BMEL, 2001, 2011a). Especially farms, which invested in livestock rearing, have occasionally an equity ratio of only 20% to 40 % (Bahrs et al., 2004: 12-13). In contrast, the average equity ratio of German small and medium-sized enterprises was 15% in 2004 (Deutsche Bundesbank, 2006: 55). As a consequence of low equity ratios, the farms' financial flexibility may become limited. In this context, financial flexibility is referred to as "the degree of capacity and speed at

which the firm can mobilize its financial resources in order to take reactive, preventive and exploitive actions to maximize the firm value" (Byoun, 2007: 2).

Baker (1968), Barry and Baker (1971) as well as Baker and Bhargava (1974) investigate the role of credits in the liquidity management of farms. These authors came to the conclusion that credit raising is associated with a loss in liquidity which involves opportunity costs and must be considered for operational decisions. Barry et al. (1981) ask agricultural bankers to decide about several hypothetical credit inquiries while the farm's financial situation varies. The authors show that credit costs — the sum of the credit interest rate and the opportunity costs for reduced credit reserves — negatively correlate with the farm's income situation. In other words, if the farm's maximum debt limit decreases due to a negative income situation of the farm, the remaining credit reserve diminishes, and the resulting opportunity costs increase. Sonka et al. (1980) carried out a similar simulation experiment with agricultural bankers as well. The authors examined the correlation between the financial situation of a potential borrower and the credit amount offered by a bank. From the results of the experiment, they derived that farms which had nearly reached their maximum debt limit jeopardize their access to bank credits and, thus, their credit reserves. Furthermore, agricultural bankers consider the debt equity ratio and, therefore, the farm's risk-bearing capacity, as an important and decisive factor for lending. However, in the context of investment decisions, the opportunity costs of the debt capital or the term 'financial flexibility' have not been discussed in recent agricultural economic publications.

Relevant literature to the aforementioned subject can primarily be found in the field of economic sciences. Qualitative studies, for example by Graham and Harvey (2001), highlight the maintenance of the financial flexibility as an important decision-making factor for investment decisions. Gamba and Triantis (2008) develop a model and show by means of a simulation that the value of a firm's financial flexibility can be measured. Here, the costs of external financing of the firm are influential for the value as well as the expectations regarding the future financial needs and investment options. DeAngelo et al. (2011) develop a capital structure theory which is based on financial flexibility. They consider debt capital as a scarce resource that involves increasing costs the more frequently it is used. If firms make an investment with a high share of debt capital, this may lead to a reduction of their credit reserves and also their financial flexibility. As a consequence, the firm can only cover its future financial needs at worse terms than the present ones or even not at all (DeAngelo et al., 2011: 236). If this is the case, the opportunity costs of raising debt capital must be considered for the investment decision (DeAngelo et al., 2011: 258). But the classical investment theory does not explicitly take into account these opportunity costs of the debt capital. A few empirical studies regarding financial flexibility also exist. For example, Marchica and Mura (2010) analyze data from several British firms. They show that financially flexible firms (with below target leverage) are able to make larger and more profitable investments than financially inflexible firms. Further empirical studies are from Minton and Wruck (2001), Daniel et al. (2010), Denis and McKeon (2012), and De Jong et al. (2012).

The described literature reveals two research gaps. First, there are no recent studies on financial flexibility in the agricultural context. Due to the aforementioned development towards lower equity ratios, the farms' capital structure is only starting to change now. Consequently, the financial flexibility becomes increasingly relevant in agricul-

ture. Second, the studies described mainly focus both on the role of financial flexibility in capital structure decisions as well as the effect of the financial flexibility on the firms' future investment ability. However, they do not provide any explanation about how and to which extent a decision maker explicitly considers the financial flexibility in his/her investment decisions. With these research gaps in mind, we conduct a discrete choice experiment (DCE) with students from the field of agricultural sciences to examine the role of financial flexibility in agricultural investment decisions.

The present study is structured as follows: The experiment as well as the data basis will be described in section II, while the results will be analyzed and explained in section III. Finally, the article ends with conclusions and future prospects (section IV).

II. The experiment

The experiment consists of three parts: The first part contains of the DCE, while, in the second part, the participants answer questions regarding the decisions they made in the DCE. Finally, in the third part they are asked for personal information. Inter alia, data about the participants' risk attitudes is collected using a variant of the Holt and Laury task (H&L task; Holt and Laury, 2002; Viscusi et al., 2011). Here, participants are asked to decide ten times between the alternatives A and B which differ regarding the risk involved. In alternative A, participants can win either €200 or €160 with a given probability, while, in alternative B, they can earn €385 and €10 with a given probability. The probabilities are systematically varied so that the expected value changes each time. The more often a participant chooses lottery A, the higher the H&L-value (number of safe choices) and the more risk averse the person. For an application of the H&L task in an agricultural context, we refer to Brick et al. (2012). A critical discussion of probability weighting in the H&L task context could be found by Drichoutis and Lusk (2012).

In the DCE, participants are introduced to a scenario, in which they act as farm managers and have liquid assets in the amount of €100,000 available. The participants are to decide about their preferred use of the money. The decision situation comprises each time two different and mutually exclusive investment alternatives A and B. Moreover, also a status-quo alternative is available by depositing the money in a bank instead of investing it.

The selectable investment alternatives are described by the three attributes 'financial flexibility', 'profitability', and 'risk' and are depicted by common operating numbers whose levels comprise possible present and future values (Adamowicz et al., 1998: 13; cf., table 1). The DCE depicts inter alia which equity ratio (= 1 - debt capital/total capital) will arise for the farm after the implementation of one investment alternative. In this way, it is possible to vary the amount of debt capital needed for the investment alternatives by taking into account the following principles: The more debt capital is borrowed, the lower is the expected equity ratio after the investment implementation and the lower is the future financial flexibility of the farm. In the DCE, the farm's expected equity ratio after investment implementation varies based on the development of the equity ratio in the agricultural sector between 25%, 55%, and 80% that has already been described in section I.

The experimental design of the DCE with two generic alternatives and three attrib-

***Table 1**. Attributes and levels in the DCE*

Attributes and operating numbers		**Levels** [a]
Financial flexibility	Expected equity ratio of the farm after investment	25%; 55%; 80%; **100%**
Profitability [b]	Expected return on equity of the investment	**3%**; 4%; 6%; 8%
Risk [c]	Possible levels of the annual cash flow of the investment (with a probability of 50%, respectively)	**no fluctuations**; €10,000 or €20,000; €0 or €30,000; minus €10,000 or €40,000

Source: Author's own illustration.

Notes: [a] Text written in bold indicates the levels of the status-quo alternative 'depositing the money in a bank'.

[b] A commonly used operating number for profitability, which is also well known in practice, is the return on equity. The accounting results of the BMEL test farms reveal that test farms with a positive income gap (gap between the profit of the settlement and the sum of settlement approaches according to the fourth paragraph of the German agricultural law) between 0% and 20% (>50%) could earn an average return on equity of 2.6% (9.7%) in the financial year 2009/2010.

[c] To depict the risk involved in the investment, we assume an uncertain cash flow of the investment that is subject to annual fluctuations. Within the DCE, the expectation value of the annual cash flows is kept constant at €15,000 in order to arrange a less complex decision situation. The range in which the cash flow fluctuates around the expectation value varies between €10,000, €30,000 and €50,000. For simplicity reasons, we assume the occurrence of either the highest or the lowest cash flow with a probability of 50%. This results in the abovementioned levels of the attribute 'Risk'. Note, that the several investment alternatives involve different amounts of investment costs. Therefore and as a result of the leverage effect, different returns on equity may arise despite the expected cash flow that is kept constant throughout all investment alternatives.

utes with three levels respectively results in a full factorial design of ($3^3_{\text{Investment A}} \cdot 3^3_{\text{Investment B}}$=) 729 possible choice sets. To minimize the concomitant and unavoidable loss of information when reducing the full factorial design, an experimental design is used that aims for 'orthogonality' and 'level-balance' and controls for dominant alternatives[1] (see Kuhfeld 2010 for more details on the %MktEx Macro Algorithm employed in this study and implemented in SAS). Thus, the number of choice sets presented to the participants is reduced to 18. Such a design has a D-efficiency of 93%. Table 2 shows one of these 18 choice sets as well as additional information regarding the status-quo alternative.

The experiment was conducted in writing with students from the field of agricultural sciences at the University of Göttingen in June 2011 and took approximately 20 minutes in total[2]. The participants' average age is 24 years (standard deviation (SD)=2.2; min 20;

[1] One alternative is dominant over another if, for this alternative, the return on equity is higher and simultaneously the cash flow fluctuations are lower than for the other alternative.

[2] All participants received an expense allowance of €10 per person in order to increase the students' willingness to participate and motivation. In addition, each participant took part in a lottery and had

max 30) and 50% of them are female. A majority of 86% of the participants has an agricultural background and 39% even indicated to be farm managers, farm successors, or employees of a farm. Furthermore, 18% of the participants have completed an agricultural training. On average, the participants are slightly risk averse H&L-value (number of safe choices) 5.2; SD=2.1; assumption: participants maximize their expected utility in accordance with the Expected Utility Theory.). Thus, the participants' risk attitude differs only marginally from those of German farmers determined by Mußhoff et al. (2012) (H&L-value 5.0; SD=1.8). With this in mind, participants with a high affinity and practical access to agriculture can be assumed. All in all, 1,833 choice sets were analyzed and in 87% of the decision situations, participants decided for one investment alternative.

Table 2. *Choice set with status-quo alternative specification* [a]

Investment alternative	**Investment A**	**Investment B**	**Status-quo**
Expected equity ratio of the farm after investment	25%	80%	100%
Expected return on equity of the investment	4%	8%	3%
Cash flow of the investment (with a probability of 50%, respectively)	€0 or €30,000	minus €10,000 or €40,000	no fluctuations
Which investment alternative would you choose? (Please select and mark only one alternative)	☐	☐	no investment ☐

Source: Author's own illustration.

Notes: [a] Information in a dotted frame were not depicted in the choice sets of the experiment but were explained to participants in preparation text for the experiment.

III. Analysis of the DCE

According to the random utility theory (McFadden, 1974), it is possible to determine an indirect utility function U_{in} for each selectable individual n and each alternative i (cf., for the following Louviere et al., 2000: 37-51):

$$U_{in} = \boldsymbol{\beta}_{kn}' \boldsymbol{x}_{ik} + \boldsymbol{\varepsilon}_{in} \tag{1}$$

U_{in} can be described by k utile attributes $\boldsymbol{x}_i$. Non-observable individual preferences are considered in the unexplained component $\boldsymbol{\varepsilon}_{in}$, for which we assume an iid extreme value distribution. Being a utility maximizer, individual n chooses alternative i instead of j from a given set of alternatives C_n if the following applies: $U_i > U_j \quad \forall \; j \in C_n, \; i \neq j$.

The starting point of the analysis is the conditional logit (CL) model:

therefore the chance to win between €10 and €385. The winner was randomly drawn by lot. The amount of the cash reward was dependent on the preference indicated by the selected participant in the Holt and Laury task (cf., Holt and Laury, 2002).

$$L_{in}(\boldsymbol{\beta}_{kn}) = \frac{\exp(\boldsymbol{\beta}_{kn}'\boldsymbol{x}_{ik})}{\sum_j \exp(\boldsymbol{\beta}_{kn}'\boldsymbol{x}_{jk})} \tag{2}$$

The results of a Hausman–McFadden test (cf., Hausman and McFadden, 1984: 1221-26) reveal that the assumption of the CL model regarding the independence of irrelevant alternatives is violated for the present data. This supports the application of the mixed logit (ML) model, which does not require this assumption. In the ML model, the utility parameters are considered as random variables and are varied over individuals with a density distribution $f(\boldsymbol{\beta}_{kn} \mid \boldsymbol{M})$, where $\boldsymbol{M}$ indicates the moments of distribution (Hensher and Greene, 2003: 136):

$$P_{in}(\boldsymbol{M}) = \int_{\boldsymbol{\beta}_{kn}} L_{in}(\boldsymbol{\beta}_{kn})\, f(\boldsymbol{\beta}_{kn} \mid \boldsymbol{M})\, d\boldsymbol{\beta}_{kn} \tag{3}$$

The integral of the conditional probability of selection of all values for $\boldsymbol{\beta}_{kn}$ does not have a closed form, so that the unconditional probability of selection is approximated using a simulated log likelihood function for each given value of $\boldsymbol{M}$. In the ML models the alternative specific constant (ASC) as well as the utility parameters of the attributes 'equity ratio' and 'cash flow fluctuations' are specified as random parameters, and normal distributions are taken as a basis (cf., ML in table 3). However, the utility parameter of the price attribute 'return on equity' is not estimated as a random parameter. In ML models, the utility parameter estimates as well as the utility parameters themselves are random variables with underlying distributions. The problem arising when calculating the willingness to pay as the ratio of two random utility parameters of a ML model is that the resulting distribution of this ratio is not clear. We refer to Sillano and de Dios Ortúzar (2005) who explain this problem in detail. One solution method offered by the authors is to model the cost utility parameter as non-random. As depicted in table 3, the SD of all random parameters in the all ML models are highly significant, indicating the estimation of the random parameters (Hensher and Greene, 2003: 145). To be able to explain the preference heterogeneity, the individual-specific characteristic 'H&L-value' as well as 'farm manager' are included in the model estimations. As individual-specific characteristics do not vary over alternatives, they are included in the model by using interaction terms (Hanley et al., 2001: 440).

In order to examine the assumption that the utility in the utility parameters is linear, a test of linearity is carried out. To do so, the attributes are dummy-coded (cf., Hensher et al., 2005: 344-351; ML model to test for linearity in table 3). 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. A Wald test for linear restriction confirms the linearity for the utility parameters of the attributes 'equity ratio' (p-value<0.000) and 'return on equity' (p-value<0.000). Thus, the attribute variables 'return on equity' and 'equity ratio' are included in all other ML models. Furthermore,

Table 3. *Results of different ML models* [a]

Variable	ML model to test for linearity	Simple ML model	ML model with the inter-action term 'H&L-value'	ML model with the inter-action term 'farm manager'
ASC [b]	2.591***	3.886***	3.953***	3.899***
Equity ratio (in %)		0.047***	0.075***	0.043***
Equity ratio · H&L-value [c]			-0.005	
Equity ratio · farm manager [d]				0.010
Equity ratio–low [e]	-1.567***			
Equity ratio–high [e]	1.052***			
Return on equity (in %)		0.225***	0.216***	0.160***
Return on equity · farm manager [d]				0.176 **
Return on equity–low [f]	-0.492***			
Return on equity–high [f]	0.418***			
Cash flow fluctuation–low [g]	0.167	0.159	0.019	0.211
Cash flow fluctuation–low [g] · farm manager [d]			0.026	-0.140
Cash flow fluctuation–high [g]	-2.040***	-2.022***	-1.831***	-2.063***
Cash flow fluctuation–high [g] · farm manager [d]			0.033	0.092
SD ASC [b]	1.619***	1.493***	1.414***	1.521***
SD equity ratio		0.027***	0.026***	0.027***
SD equity ratio–low [e]	1.207***			
SD Equity ratio–high [e]	0.785***			
SD cash flow fluctuation–low [g]	0.958***	0.933***	0.935***	0.938***
SD cash flow fluctuation–high [g]	1.535***	1.493***	1.356***	1.521***
Participants / observations	102 / 1833			
(simulated) Log Likelihood	-1412.81	-1404.96	-1377.56	-1399.11
AIC	2849.61	2827.92	2779.13	2824.22

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

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

[a] 500 Halton Draws; panel structure of the data was taken into account.

[b] Binary coded; reference: Status-quo alternative.

[c] Interaction term; reference: H&L-value of 0.

[d] Interaction term; dummy coded; reference: participant is not a farm manager, farm successor or employee of a farm.

[e] Dummy coded; reference: The middle value of the three equity ratios indicated in the decision alternatives; low=25%, middle=55%, high=80%.

[f] Dummy coded; reference: The middle value of the three returns on equity indicated in the decision alternatives; low=4%, middle=6%, high=8%.

[g] Dummy coded; reference: The middle value of the three cash flow fluctuations indicated in the decision alternatives; low=€10,000; middle=€30,000, high=€50,000.

the attribute 'return on equity' can be used as price attribute in a later willingness to pay analysis. In contrast, for the attribute 'cash flow fluctuations', it is not possible to assume a linear relationship as one dummy coded variable of the attribute is not significant (cf., ML model to test for linearity). Therefore, the dummy-coded variables instead of the attribute variable are included in all other ML models.

The random parameter of the attribute 'equity ratio' is significantly positive in the simple ML model in table 3. The average participant considers a high equity ratio after investment implementation as positive. If an investment alternative has a higher equity ratio after investment and, therefore, also shows a higher financial flexibility of the farm than another investment alternative, this has a positive effect on the utility of the investment and thus on its probability of selection. Participants evaluate the attribute 'equity ratio' and thus the effect on the financial flexibility heterogeneously (significant SD of the attribute 'equity ratio'). However, this preference heterogeneity cannot be explained by the participants' risk attitude (cf., ML with interaction term H&L-value' in table 3: interaction term 'equity ratio · H&L-value' is not significant). Whether the participant is a farm manager or not does not explain either the heterogeneity (cf., ML with interaction term 'farm manager' in table 3: interaction term 'equity ratio · farm manager' is not significant).

The attribute 'return on equity' has a significantly positive utility parameter (cf., simple ML model and ML with interaction term 'H&L-value' in table 3). Thus, on average, a high profitability has a positive effect on the investment's utility and, therefore, on its selection probability. The ML model with the interaction term 'farm manager' shows that this positive effect on the utility will be stronger if the participant is a farm manager (significant positive parameter of the interaction term 'return on equity · farm manager').

The willingness to pay for the attribute 'equity ratio' is calculated as the quotient of the utility parameter of the attribute 'equity ratio' and the utility parameter of the price attribute 'return on equity'. On the basis of the results of the simple ML model, the average participant is prepared to waive 2.08 percentage points of his/her return on equity in order to maintain a higher financial flexibility in the form of an equity ratio that is 10 percentage points higher. The confidence interval of 95%, which is estimated by means of the Krinsky and Robb method using 1,000 replications, ranges from 1.67 to 2.69 percentage points (cf., Krinsky and Robb, 1986). From an assumed equity investment of €100,000 (cf., section II) results a willingness to pay for maintaining the financial flexibility in the form of an equity ratio that is 10 percentage points higher of €2,080 (€1,670-€2,690). Using the utility parameters of the ML model with interaction term 'farm manager' to calculate the willingness to pay, the different decision behavior between the students who are farm managers and students who are not becomes obvious. Students who are not farm managers are prepared to waive 2.71 (1.92-4.56) percentage points of their return on equity resulting in a willingness to pay for maintaining the financial flexibility in the form of an equity ratio that is 10 percentage points higher of €2,710 (€1,920-€4,560). Contrary to this, students who are farm managers are only prepared to waive 1.29 (1.00-1.82) percentage points of their return on equity, resulting in a willingness to pay of €1,290 (€1,000-€1,820).

The results of the DCE are also supported by the results of a survey, which was carried out with the participants subsequent to the DCE. In this survey, participants were asked to indicate to what extent the given statements about the attributes' relevance to

decision making are applicable for them using a four-stage Likert scale (ranging from 1='does not apply at all' to 4='applies completely'). For 78% of the participants, the expected equity ratio after investment played an important role in their decision (mean value=2.91). Sixty-four percent of the participants indicate that they consider the equity ratio as more important for their decision for and against an investment alternative than the return on equity (mean value=2.39 on the Likert scale ranging from 1='does not apply at all' to 4='applies completely').

IV. Conclusions and future research prospects

The global structural change in the agricultural sector entails adaptation processes, which often involve mainly leveraged investments resulting in decreasing equity ratios for farms. Hence, it can be expected that a farm's financial flexibility will be become more and more important in the agricultural sector in the future. Therefore the aim of the present study is to investigate the current role of the financial flexibility in agricultural investment decisions using a DCE.

The majority of the agricultural students interviewed, who predominantly have an agricultural background, indicate that the farm's future financial flexibility is an important aspect that they consider for the decision regarding an investment alternative. Even the results of the DCE support these conclusions. It becomes apparent that the expected equity ratio after investment is an important measure for a farm's future financial flexibility and thus is very relevant for investment decisions. Consequently, it can also be stated that agricultural students take the opportunity costs of leverage into account when making investment decisions. For some participants, the financial flexibility is even more relevant for their decision than the profitability or the risk of the investment. According to Sonka et al. (1980), not only bankers take into consideration the farm's debt-equity ratio for a lending decision, but also the 'opposite party' knows about the relevance of the financial flexibility for investment decisions. By means of the DCE, an economic value for the financial flexibility was determined. On average, participants are prepared to waive a share of the return on equity in favor of financial flexibility.

Our study leaves room for extensions: First, a convenience sample of students is used in our study. It is often argued that using convenience samples are accompanied by non-representative results (Levitt and List, 2007; Loomis, 2011). Contrary to this, results of Falk et al. (2013) show that student samples behave similarly to non-student samples. With this in mind, we have to be careful in setting the decision behavior exhibited by the students in our experiment equal with the decision behavior of farmers. This is confirmed by the significantly different willingness to pay for an increased financial flexibility between students who are farm managers and students who are not. As the external validity is therefore low, the results have to be interpreted with caution and can only be tentatively generalized to other populations and contexts. Nevertheless, our study shows first important findings regarding the financial flexibility in agricultural investment decisions.

Second, the participants' risk attitude is measured using the number of safe choices made in a H&L task. As previously mentioned, for this, it is necessary to assume that participants are expected to be utility maximizers. However, Drichoutis and Lusk (2012) demonstrate what happens if this assumption is violated. In addition, they argue

that using the simple number of safe choices of the H&L task as an index for risk-aversion is incorrect in the case of probability weighting. Therefore, in future experiments, it has to be taken into account how participants weight the probabilities used in the H&L task when measuring the risk attitude on the basis of a H&L task.

Third, future expectations and developments are not modeled in the DCE. However, as pointed out by Gamba and Triantis (2008), investment options as well as financial requirements expected for the future influence the value of the financial flexibility. In subsequent experiments, the impact on the value of the financial flexibility should be analyzed. In addition, it would be necessary to carry out the DCE with farm managers. Only in this way, it would be possible to obtain more reliable results about the role of financial flexibility in agricultural investment decision. In this context, it is also important to collect farm-specific data in order to be able to examine the preference heterogeneity regarding the financial flexibility more in detail.

Fourth, it might be interesting to include an agricultural context in the DCE for analyzing the framing effect (cf., e.g., Bettman and Sujan, 1987; Swait et al., 2002) when comparing the results to these of the present neutrally-framed DCE.

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