

Reithmayer, Corrinna; Danne, Michael; Mußhoff, Oliver

**Working Paper**

## Look at that! - The effect pictures have on consumer preferences for in ovo gender determination as an alternative to culling male chicks

Diskussionsbeitrag, No. 1907

**Provided in Cooperation with:**

Department for Agricultural Economics and Rural Development, University of Goettingen

*Suggested Citation:* Reithmayer, Corrinna; Danne, Michael; Mußhoff, Oliver (2019) : Look at that! - The effect pictures have on consumer preferences for in ovo gender determination as an alternative to culling male chicks, Diskussionsbeitrag, No. 1907, Georg-August-Universität Göttingen, Department für Agrarökonomie und Rurale Entwicklung (DARE), Göttingen

This Version is available at:

<https://hdl.handle.net/10419/206719>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



2019

## **Diskussionspapiere**

Discussion Papers

### **Look at that! – The effect pictures have on consumer preferences for in ovo gender determination as an alternative to culling male chicks**

Corrina Reithmayer

Michael Danne

Oliver Mußhoff

Department für Agrarökonomie und  
Rurale Entwicklung  
Universität Göttingen  
D 37073 Göttingen  
**ISSN 1865-2697**

## **Look at that! – The effect pictures have on consumer preferences for in ovo gender determination as an alternative to culling male chicks**

### **Abstract**

Gender determination in incubated eggs (in ovo) has the potential to substitute the highly discussed practice of culling male layer chicks. The aim of this study is to investigate the effect pictures have on peoples' preferences towards in ovo sexing at different stages of embryonic development as an alternative to chick culling. For this purpose, an online survey was conducted with a representative sample of 482 respondents in Germany. A within-subject design with two choice experiments was used to investigate the influence pictures have on respondents' preferences and willingness to pay (WTP). The first choice experiment contained plain text only; the second contained also pictures of a chick or the incubated eggs at the corresponding stages of development. Findings reveal that in ovo gender determination at each proposed day of incubation (days 1, 4 and 9) was preferred to chick culling. In ovo screening on days 1 and 4 was significantly preferred to day 9. This preference for early gender determination increased significantly as a consequence to the provision of pictures. Results furthermore reveal that a high error rate of gender determination or the lack of a meaningful utilisation of incubated eggs can decrease approval for in ovo gender determination to an extent, where no positive WTP remains. Findings of this study are useful for stakeholders in poultry production when considering the implementation of in ovo gender determination as a morally admissible substitute to chick culling.

**Keywords** chick; choice experiment; egg; gender determination; in ovo; picture

## 1. Introduction

Pictures say more than words – besides providing information, they can evoke associations and feelings in the wink of an eye. The “picture-superiority-effect” describes the fact that pictures are remembered longer and better compared to text (Childers & Houston, 1984). Furthermore, pictures are considered to be more credible (Graber, 2016) and to trigger stronger emotions in comparison to written words, especially when they have an unpleasant content (Hajcak & Olvet, 2008).

In an environment of mass media, pictures are readily available and fast moving through digital channels, which makes them drivers of societal debates. This applies especially for the agricultural context, where mass media has become an important source of information (Mayfield et al., 2007; Wunderlich & Gatto, 2015). Debates about farm animal welfare have been shown to be strongly influenced by pictures in the last couple of years. One example is the debate about cage housing for layer hens, which was driven by NGOs who provided pictures and videos of confined hens in cages (Busch & Spiller, 2018). The debate led to the ban of the husbandry system in 2012 (EC, 1999).

A topic which is currently present in the media and debated in a number of western societies, for example the Netherlands and Germany (Woelders et al., 2007; BMEL, 2017) is the culling of millions of male layer chicks. These do not serve an economic purpose and are therefore culled after hatching. The topic is causing public resonance and also the awareness among stakeholders in egg production rose (United Egg Producers, 2016; Unilever, 2018). Alternatives came under consideration. The technical alternative which has the potential to substitute chick culling at an industrial scale is gender determination in incubated eggs, called “in ovo”. The technology enables detecting eggs with male chicken embryos during incubation in hatcheries. Eggs with male embryos are then removed from the incubator and can be used as animal feed or in the chemical industry under limitations (EC, 2009).

Two in ovo technologies are expected to reach market maturity in the near future. They are executed at different stages of embryonic development. The first is a method determining the gender on day 4 of incubation by a spectroscopic analysis of extraembryonic blood vessels (Galli et al., 2017). The second method analyses the estradiol content of allantoic fluid on day 9 of incubation (Weissmann et al., 2013). A third possibility is currently under discussion, which is aiming to analyse the gender through magnetic resonance. It might offer the possibility to sex eggs within the first day of incubation, but it is currently not clear on which level of precision or when it will reach market maturity (TUM Press statement, 2018). A

technology for gender determination at day 14 has already been developed (Göhler et al., 2017). However, currently it has not been pursued further as the chicken embryo is already at an advanced stage of development.

There is evidence that the societal acceptance for in ovo screening will largely depend on the point of time during embryonic development, when screening is performed (Leenstra et al., 2011; Brunijs et al., 2015). It can be assumed that the moral value given to the chicken embryo increases with embryonic development (for a discussion on moral status of embryos see Strong, 1997). To be a meaningful alternative to the current practice, destruction of embryos should be performed at an early stage of development, before conscious pain perception is possible. It is still under discussion, when this is the case in chicken embryos. Before day 7 of incubation, no synaptic connection with the dorsal horn exists. The possibility to perceive pain is assumed to develop stepwise from day 7 on (Aleksandrowicz & Herr, 2015). At day 13, the brain is fully developed. To which degree pain perception is experienced between day 7 and day 13 is not certain yet (Eide & Glover, 1995; Bjørnstad et al., 2015). Mellor and Diesch (2007) argue that chicks are unconscious, being in a sleep-like state until at least day 17. In contrast the Guidelines of the American Veterinary Association (Leary, 2013) presume consciousness at 50% of incubation time, therefore from day 10.5 on. Based on the aforementioned, it can be assumed that pictures of developing chicken embryos might hold a considerable potential for social resonance, which could have a lasting effect on the public opinion about in ovo gender determination.

The influence of pictures on consumer attitudes and product choices has been analysed in former studies. Hollands et al. (2011) found that communicating “images of energy-dense snack foods paired with aversive images of the potential health consequences of unhealthy eating” significantly decreased respondents’ choice probability for corresponding snacks, as a consequence of an adverse effect on consumer attitudes towards these products. Germain et al. (2010) found that brand elements significantly increased adolescents’ appeal for cigarette packs, while increasing the size of images with health warnings had the opposite effect. Pearl et al. (2012) analysed the impact of positive or stigmatizing pictures on respondents’ attitudes towards obese persons. The authors found that the manner in which the person was portrayed in the pictures had an influence on the participants' desire for social distance towards the depicted person, which stresses the influence pictures have on social attitudes.

While the impacts of pictures were analysed experimentally in different areas, as far as we are aware, the use of pictures in discrete choice experiments (DCE) was very limited. Rizzi et al.

(2012) investigated the impact of written descriptions and images of traffic on the respondents' evaluation of travel time savings in a choice experiment; the authors found a statistically significant difference between the treatment with and without pictures. A similar approach was used by Patterson et al. (2017), comparing two choice experiments with text-only descriptions and virtual reality images in the context of neighborhood choice. Findings reveal that respondents were more focused in the virtual reality setting. Furthermore the relevance of an exact pictorial representation of the alternative is emphasized. To the best of our knowledge, the impact of images on attitudes regarding animal welfare has not been tested before using a DCE.

The objective of this study is to investigate the effect pictures have on consumers' choice behaviour regarding the context of in ovo gender determination and chick culling. Furthermore, consumers' attitudes and WTP for in ovo screening at different stages of embryonic development are analysed. For this purpose, a DCE with 482 consumers was conducted between December 2018 and March 2019 in Germany. A within-subject design with two experiments was used for the purpose of this study.

To the best of our knowledge this study is the first that investigates the influence of pictures in a DCE concerning animal welfare and the context of chick culling. The study provides furthermore comprehensive insights about consumers' attitudes and acceptance of the in ovo technology. As German citizens will likely be among the first to be confronted with poultry products from systems with in ovo gender determination, the study gives valuable insights to consumer attitudes in a market, where the debate about chick culling is highly topical. Findings are beneficial for stakeholders in egg production, as well as politicians.

## **2. Materials and Methods**

### *Design of the discrete choice experiment*

By employing the stated preference approach, DCEs allow for conclusions to be drawn from previously unarticulated preferences about real choice decisions (Louviere et al., 2000). The attribute-based measure of respondents' preferences is thereby possible through a series of hypothetical decision-making situations (List et al., 2006). These decision situations are called choice sets, each consisting of different alternatives. Participants are asked to select one of the given alternatives. Each presented alternative is characterised by pre-defined attributes and

their associated levels. By systematically varying the attributes and their levels, the respective influence on the choice decision can be determined (Louviere et al., 2000).

The DCE utilised in this investigation presented the following decision situation to the participating consumers: based on an unlabelled design, the consumers had to choose between two generic alternatives A and B or could decide whether or not to use either of these alternatives (opt-out).<sup>1</sup> The opt-out alternative was included so that the choice for one of the proposed alternatives remained voluntary. A forced choice could lead to inaccuracy and inconsistency with demand theory (Hanley et al., 2001). The attributes and their levels were chosen based on the premises of relevance and complexity of the experiment. Both were addressed by reviewing the literature and seeking expert advice.

The following four attributes were employed to describe the alternatives in the DCE: (1) the day of gender determination, (2) the later use of incubated eggs or – for the current practice – male chicks, (3) the error rate, including incorrect gender determination and lower hatchability, (4) extra cost of in ovo sexing compared to the current practice described as price increase per box of 10 eggs.<sup>2</sup> An overview of attributes and levels used in the experiment is presented in Table 1; furthermore they are described subsequently.

The feasible days of gender determination, as derived from the literature and the current political discussion, are prospectively day 4 of incubation (Galli et al. 2017) or day 9 of incubation (Weissmann et al. 2013). An approach aiming for gender determination at day 1 is furthermore discussed (TUM Press statement, 2018). In the DCE, the in ovo gender determination is compared to the current practice of culling male chicks at the day of hatch (day 21). These four possibilities are defined as the levels of the first attribute.

The later use of incubated eggs depends on the preceding incubation time. Eggs can be used as pet feed, livestock fodder component or in the chemical industry (e.g. for shampoo), whereas male chicks are currently mainly used as pet feed (EC, 2009). Depending on the current market situation, it might occur that male chicks or eggs would also be thrown away as waste. The four levels of the second attribute are defined accordingly.

In ovo gender determination can influence hatchability negatively. Furthermore, an error rate in gender determination remains. In this way, also eggs with female embryos could be sorted

---

<sup>1</sup> The opt-out option can be chosen by consumers if both other alternatives do not meet their preferences, for instance if they prefer other alternatives for handling male chicks or if the combination of levels does not meet their preferences.

<sup>2</sup> Boxes of 10 eggs are a common package size in Germany.

out by mistake, leading to an increase of incubated eggs and animals needed in layer hen production. These factors are summarised to the attribute “error rate”, its levels are defined in a range between 1% and 15%, according to the gender determination process error rate which was found in the literature (Weissmann et al., 2013; Galli et al., 2017; Krautwald-Junghanns et al., 2018).

The price increase incurred per box of 10 fresh consumption eggs is defined in a range of €0 to €1.70, following the findings of Leenstra et al. (2011). Conducting an online survey, Leenstra et al. (2011) found positive willingness to pay (WTP) for alternatives to chick culling for the majority of respondents, ranging from the statement to be willing to pay an additional €0.50 - €1.00 per box of 10 eggs to “double the price or more”.<sup>3</sup> The study derives the levels of the price attribute on the basis of these statements.

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

Attributes	Levels
Day of gender determination	day 1   day 4   day 9   day 21 (chick)
Usage of eggs or male chicks	waste (no use)   chemical industry   pet food   fodder
Error rate	1%   5%   10%   15%
Price increase per box of 10 fresh eggs	€0   €0.30   €1.00   €1.70

The design of the DCE was comprised of two alternatives and four attributes with four levels each, thus resulting in a full-factorial design of  $[(4 \cdot 4 \cdot 4 \cdot 4)_{\text{Alternative A}} \cdot (4 \cdot 4 \cdot 4 \cdot 4)_{\text{Alternative B}}] = 65,536$  possible choice sets. However, for the sake of practicability, this design was determined to be too extensive and therefore, the number of choice sets was reduced. To minimise the simultaneous and unavoidable loss of information when reducing the full factorial design, a so-called “efficient design” was applied. Efficient designs (Rose & Bliemer, 2009) aim to minimise the standard errors of the utility parameters for the estimation process. These designs therefore require ex-ante information regarding the population’s utility parameters. Thus, a pretest was conducted with 38 consumers in order to obtain the required

<sup>3</sup> The price of a box of fresh eggs in German supermarkets at the time of the study ranged from a minimum of €1.10 for conventional barn eggs to about €5.00 for organic eggs with additional production claims (e.g. DU poultry, regional agriculture, ect.).



information for the final experiment. This pilot study furthermore served to examine the comprehensibility of the questionnaire.

A D-optimal design (Scarpa & Rose, 2008; Rose & Bliemer, 2009) with eight choice sets was found to be appropriate for the purpose of this study and was computed using the software *ngene* (ChoiceMetrics, 2014). An overview of all choice sets is given in Appendix A.

### *Data collection*

For the empirical analysis, primary data was collected from German consumers. An anonymous online survey was developed and available for participants from December 2018 to March 2019. Consumers were invited to participate in the survey by the data panelist “respondi” (respondi AG, Cologne, Germany). In order to obtain a representative picture of the German population, quotas on the variables age and education (highest educational attainment) were implemented. Furthermore, emphasis was made to achieve a sample which is geographically well distributed over Germany by implementing quotas on participants’ postcode.

The questionnaire was structured as follows: First, consumers were asked to provide socioeconomic data. Furthermore, to understand whether participants were already aware that male chicks were culled, this information was requested through a multiple-choice question. Second, informational texts about the practice of chick culling and the *in ovo* technique were provided to participants. Participants’ understanding of the information was verified through control questions, which were integrated after the informational texts. If respondents repeatedly failed to give the correct answer, they were excluded from the survey. Informational texts and control questions are provided in Appendix B.

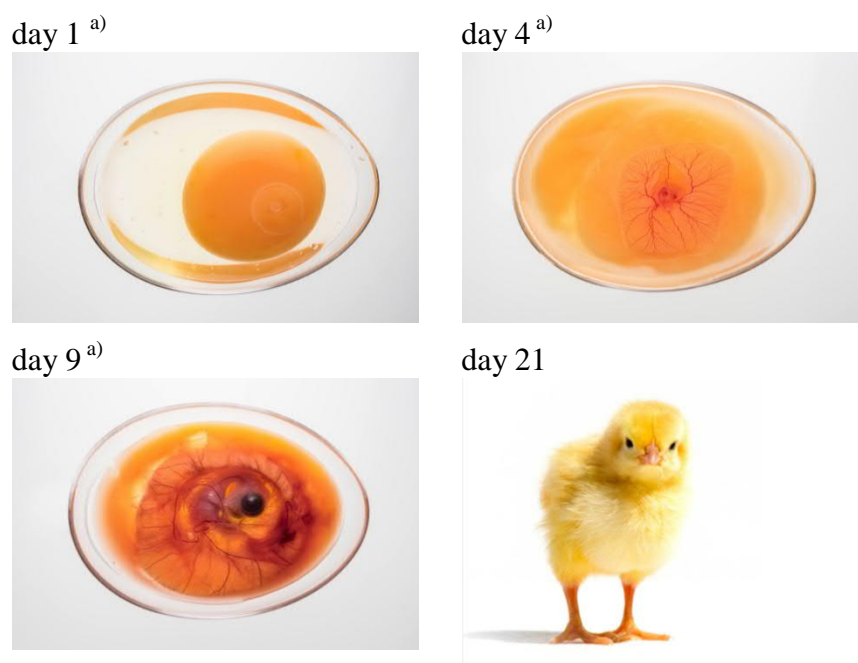
Third, the DCE was conducted. To ensure participants’ understanding of the offered alternatives, a description of the attributes and levels remained available throughout the experiment by placing “mouse over buttons” in each choice set. By moving the cursor over the buttons, information became visible. In order to analyse the effect of pictures in the DCE, all participants were confronted with two DCE rounds. In the first round, the eight choice sets were given as plain text; an example is depicted in Figure 1. Then, four pictures of incubated eggs and a chick were shown to participants, depicting the proposed levels of the attribute “Day of gender determination”. They are presented in Figure 2.

The pictures were then integrated into the choice sets; the picture corresponding to the level of the attribute “Day of gender determination” was added to the former text which was

describing the alternative. An example of a choice set with pictures is shown in Figure 3. All choice sets, now with pictures, were presented to participants a second time. A mouse over zoom was integrated so that the details of the pictures became more visible to consumers. In both DCE rounds, the eight choice sets were randomised.



	Alternative 1	Alternative 2	I do not support any of the given alternatives
Day of gender determination ?	Day 4	Day 1	
Price increase per 10 eggs ?	€1,00	€1,00	
Usage of screened out eggs or chicks ?	Processing in the chemical industry	Pet food	
Percentage of wrongly sorted eggs or chicks ?	10%	5%	
Which alternative do you choose?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure 1.** Example of a choice set (first choice experiment with text only)



**Figure 2.** Pictures utilised in the choice sets of the second choice experiment

<sup>a)</sup> Source: Agri Advanced Technologies GmbH, Visbeck, Germany.

	Alternative 1	Alternative 2	I do not support any of the given alternatives
Day of gender determination ?	 Day 4	 Day 1	
Price increase per 10 eggs ?	€1,00	€1,00	
Usage of screened out eggs or chicks ?	Processing in the chemical industry	Pet food	
Percentage of wrongly sorted eggs or chicks ?	10%	5%	
Which alternative do you choose?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure 3.** Example of a choice set (second choice experiment with text and pictures)

### *Econometric approach*

In the Random Utility Theory (Luce, 1959; McFadden, 1974; Manski, 1977), which is the underlying framework for DCEs, the estimation of respondents' preferences is based on the assumption that the respondents' choice is dependent on specific attributes which characterise an alternative. Under the assumption of utility maximisation, respondents choose the alternative for which they have the highest utility.

In discrete choice models, the utility of alternative  $j$  perceived by respondent  $n$  in the choice situation  $t$  is denoted  $U_{ntj}$ . Moreover,  $U_{ntj}$  is divided into two components with a deterministic component  $V_{ntj}$  and an unobserved component  $\varepsilon_{ntj}$ :

$$U_{ntj} = V_{ntj} + \varepsilon_{ntj} \quad (1)$$

Focusing on the estimation of the WTP, the deterministic component can be described by the price component  $p_{ntj}$  and the vector of non-price attributes  $x_{ntj}$ , which are weighted by the respondent-specific, random parameters  $\alpha_n$  and  $\beta_n$ :

$$U_{ntj} = -\alpha_n p_{ntj} + \beta_n' x_{ntj} + \varepsilon_{ntj} \quad (2)$$

Thereby,  $\varepsilon_{ntj}$  is assumed to be an independent and identically distributed (i.i.d.) error term following an extreme value distribution Type 1. The variance of the error term is respondent-

specific and therefore defined as  $Var(\varepsilon_{ntj}) = k_n^2(\pi^2/6)$ , with  $k_n$  as scale parameter of respondent  $n$ . Since the utility is ordinal scaled, equation (2) may be divided by  $k_n$  without having an impact on  $U_{ntj}$  (Train, 2009). This results in:

$$U_{ntj} = -(\alpha_n/k_n)p_{ntj} + (\beta_n/k_n)'x_{ntj} + \varepsilon_{ntj} \quad (3)$$

Thereby, the variance of the error term is identical or rather constant for all respondents. By the standardization of  $k_n$  to 1, the variance is therefore redefined as  $Var(\varepsilon_{ntj}) = \pi^2/6$ . Defining the utility coefficients as  $\lambda_n = (\alpha_n/k_n)$  and  $\varphi_n = (\beta_n/k_n)$ , utility can be written as:

$$U_{ntj} = -\lambda_n p_{ntj} + \varphi_n' x_{ntj} + \varepsilon_{ntj} \quad (4)$$

which is referred to as a model in *preference space*. In preference space, WTP for attribute levels is obtained by calculating the marginal rates of substitution between the attribute levels and the price parameter. Literature indicates that models in preference space seem to be the current standard method for estimating the WTP of individuals (see Sauter et al., 2016).

However, a main assumption of these models is that the price coefficient is fixed across individuals. This is necessary because otherwise the WTP is derived by calculating the ratio of two randomly distributed terms, namely the ratio of the distribution of the non-monetary attribute and the distribution of the price coefficient ( $WTP = \omega_n = \varphi_n/\lambda_n = \beta_n/\alpha_n$ ). Unfortunately, this procedure often results in unrealistic and invalid distributions for the WTP (Scarpa et al., 2008; Hensher and Greene, 2011). Handling the price coefficient to be fixed is an unnecessarily restrictive assumption as it does not allow to account for heterogeneity in the price coefficient, and furthermore assumes that the scale parameter and therefore the variance in the error term is identical for all individuals. Consequently, this unidentified scale heterogeneity can be erroneously attributed to a variation of the WTP (Train and Weeks, 2005). Considering this, models in so-called *WTP space* are able to overcome this problem by directly estimating WTP coefficients through a re-formulation of the model to

$$U_{ntj} = -\lambda_n p_{ntj} + (\lambda_n \omega_n)' x_{ntj} + \varepsilon_{ntj} \quad (5)$$

where  $\omega_n$  is directly calculated in the estimation process. In this case, assumptions regarding the distributions of the WTP are made directly rather than on the attribute coefficients.

In the case of this study, to test for differences between the single WTP estimates derived from the experiments with and without pictures, two approaches were used. First, the variable “treatment” was designed to describe the DCE round with pictures; interaction terms of all

attributes with this variable were then included in the model estimation (Model 1). Second, the two DCE rounds were estimated separately (Model 2 and Model 3) and a complete combinatorial method proposed by Poe et al. (2005) was applied subsequently. This so called Poe test has become a standard for measuring the difference of independent empirical distributions in the context of DCEs in recent years. It is widely applied in the literature (Carlsson et al., 2005; Liebe et al., 2012; Glenk & Colombo, 2013; Colombo et al., 2015; Liebe et al., 2015). In all three models, random parameter logit models (RPL) in WTP space were employed, which were estimated by using 1,000 Halton draws.

### 3. Results

#### *Socioeconomic characteristics*

A total of 544 respondents completed the survey. The average answering time was 26 minutes. Data from respondents who always chose the same alternative in the DCE or attitudinal questions were excluded from the dataset, as inaccurate answering behaviour must be assumed in these cases. Thus, 482 respondents remained in the dataset. The socioeconomic characteristics of the respondents are depicted in Table 2. Through the implementation of quotas, the sample was achieved to be almost representative for the German population regarding the variables average age and education (highest educational attainment). The sample is furthermore representative for the German population regarding respondents' residence (rural or urban) and occupation group, as can also be seen in Table 2.

Evidence shows that participants were already widely aware of the culling of male chicks. A total of 79% of participants chose the correct answer in the multiple-choice question "What happens to male chicks from layer hen production?" (79% "they are culled"; 17% "I do not know"; 4% "they become broilers").

#### *Examination of the impact pictures have*

The choice experiment data was analysed using the software Stata 14. First, an effects coded<sup>4</sup> variable "treatment" which is coded as -1 for the DCE without pictures and as 1 for the DCE with pictures was created. Then, interaction terms of this variable with all attributes were

---

<sup>4</sup> Effects and dummy coding differ in the handling of the attribute level which describes the base level. With dummy coding, all non-omitted levels are coded as 0 when the base level is present. With effects coding, all non-omitted levels are coded as -1 when the base level is present (Hauber et al., 2016). The latter avoids confounding with the opt-out alternative. For a discussion on effects coding in DCE see Bech and Gyrd-Hansen (2005).

included in the model estimation (Model 1). Results of the interaction terms are presented in Table 3.

**Table 2.** Socioeconomic characteristics of the sample (N=482)

Variable		Mean (SD)	Percentage %
Average age		49 [50] <sup>a), b)</sup> (17.6)	
Gender male			44 [50] <sup>b)</sup>
Education	Apprenticeship		51 [56] <sup>b)</sup>
	University degree		19 [18] <sup>b)</sup>
	School leaving certificate or none		30 [26] <sup>b)</sup>
Residence	Rural residence (town <20,000 inhabitants)		48 [41] <sup>c)</sup>
	Urban residence (town > 500,000 inhabitants)		19 [17] <sup>c)</sup>
Occupation	Students		4 [3] <sup>d)</sup>
	Employees		50 [50] <sup>d)</sup>
	Pensioners		35 [26] <sup>d)</sup>
	Other		11 [21]

<sup>a)</sup> German average given in brackets []

<sup>b)</sup> Destatis (2017)

<sup>c)</sup> Destatis (2018)

<sup>d)</sup> Destatis (2019)

As can be seen in Table 3, statistically significant coefficients of the interaction terms give evidence for differences in respondents' answering behaviour between the with-pictures and without-pictures setting. A statistically significant negative alternative specific constant (ASC) demonstrates that respondents were more inclined to opt out when pictures of incubated eggs and chicks were included in the choice sets, in comparison to plain text. Choice probabilities for the two in ovo alternatives executed on days 1 and 4 of incubation significantly increased when respondents were provided with the pictures of incubated eggs.

In contrast, a statistically significant decrease of choice probability can be observed for in ovo gender determination at day 9. Regarding the attribute "usage", no statistically significant changes in preferences between the two DCEs are observed. Also, regarding the preferences for the attribute "error rate", no statistically significant difference in preferences can be found between the two experimental settings.

In the next step, two separate RPL models in WTP space were estimated for the two DCE rounds with and without pictures. Differences in the distributions of coefficients were subsequently investigated using Poe test. The results of both models are presented in Table 4. Both models reveal statistically significant coefficients for all attribute levels and for the ASC. In ovo gender determination at all of the given days is preferred over the culling of chicks in both models. Wald test was used to test for differences in WTP between the coefficients of the attribute “Day of gender determination”. Gender determination at day 1 and at day 4 do both generate a statistically significantly higher WTP compared to day 9 in the without pictures alternative. No statistically significant difference can be found between the coefficients of day 1 and day 4.

**Table 3.** Model 1: RPL model in WTP space with interaction terms (N=482)<sup>a)</sup>

Variables	Mean
ASC x treatment	-0.40 ***
Day 1 x treatment	0.85 ***
Day 4 x treatment	0.19 **
Day 9 x treatment	-0.36 ***
Day 21 x treatment	[-0.68]
Error rate x treatment	-0.01
Chemical industry x treatment	0.11
Pet food x treatment	-0.03
Waste x treatment	0.02
Fodder x treatment	[-0.10]

Notes:

<sup>a)</sup>\* p < 0.1; \*\* p < 0.05; \*\*\* p < 0.001; Coefficients estimated using 1,000 Halton draws. Base levels of effect coded attributes in brackets []. For clarity, only coefficients for the interactions are shown. Complete results are displayed in Appendix C.

However, Poe test reveals statistically significant differences in the choice behaviour between the two DCE rounds, indicated in bold font in Table 4. Whereas a positive WTP for gender determination at day 9 of incubation is found in the without-pictures model, this changes in the with-pictures setting. Choice probability significantly decreases for day 9, rendering even a negative WTP for this alternative. In opposition, WTP for the two early gender determination points day 1 and 4 increases statistically significantly.

Preferences for the attribute “usage” are similar in both models. The use of the by-products, namely screened out eggs or male chicks as pet food is the preferred utilisation, followed by the use as fodder. Throwing by-products away as waste is the least preferred option and

considerably reducing WTP for the associated alternative in both DCE rounds. The use of by-products in the chemical industry is also reducing WTP, though less strongly than the attribute level “waste”. For the attribute level “chemical industry” we find a statistically significant change in choice behaviour between the two DCE rounds. The attribute level is evaluated less negatively in the with-pictures scenario. For the other attribute levels, as well as the attribute “error rate”, no statistically significant difference in choice behaviour can be found between the two models.

**Table 4.** Comparison of Models 2 and 3 by means of Poe test (N=482)

Variables	Model 2 - without pictures				Model 3 - with pictures			
	Mean		SD		Mean		SD	
ASC	1.98	***	3.12	***	1.41	***	3.86	***
Day 1	<b>1.47<sup>b)</sup></b>	***	1.48	***	<b>3.66</b>	***	1.84	***
Day 4	<b>1.45</b>	***	0.54	**	<b>2.22</b>	***	0.49	***
Day 9	<b>0.25</b>	**	0.28		<b>-0.81</b>	***	1.40	***
Day 21	[-3.17]				[-5.07]			
Error rate	-0.17	***	0.09	***	-0.22	***	0.10	***
Chemical industry	<b>-0.89</b>	***	0.04		<b>-0.44</b>	***	0.16	
Pet food	1.58	***	0.02		1.42	***	0.02	
Waste	-1.69	***	1.69	***	-1.86	***	0.64	***
Fodder	[1.00]				[0.88]			
Log Likelihood	-3,273				-2,883			
AIC	6,581				5,801			
BIC	6,713				5,934			

Notes:

<sup>a)</sup>\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.001$ ; <sup>b)</sup>in bold: differences in mean WTP between the first DCE without pictures and the second DCE with pictures significant at 10% level based on Poe et al. (2005) test; Coefficients estimated using 1,000 Halton draws. Base levels of effect coded attributes in brackets[].

Both approaches, which were used for the comparison between the two experimental settings, show statistically significant changes in WTP for all levels of the attribute “Day of gender determination”, whereas preferences for the other attributes remain equal (with exception for the attribute level “chemical industry” of the attribute “usage”). This gives evidence that changes in choice behaviour can be assigned to the treatment, namely the provision of pictures.



The change in WTP for the attribute level “day 9” is particularly interesting. In the setting with pictures, in ovo gender determination is still preferred to chick culling (also when executed at day 9 of incubation). Nonetheless, this attribute level *decreases* choice probability in the with-pictures scenario, whereas it *increases* choice probability in the scenario with plain text. On day 9 of incubation, the shape of the embryo already gives an idea of the future shape of the chick. As well as this, the eyes are already developed. In contrast, on days 1 and 4 of incubation, no shape of a chick is visible yet, only the yolk. The association with a chick might be the reason for the disapproval of the attribute level “day 9” when accompanied with a picture. This could be an open flank of the in ovo technology which determines the gender on day 9, as the images of the embryo are able to trigger emotional resonance.

Findings furthermore reveal that a meaningful utilisation of the by-products of layer-hen production, screened out eggs or male chicks, is considered as a crucial characteristic and almost equally important as the day of gender determination. Surprisingly, the use of screened out eggs in the chemical industry is not considered desirable. In practice, this type of use could represent the main utilisation of eggs. In this study, the use as pet food and fodder were preferred. This could either be due to the fact that these utilisations are more common to consumers, or due to the fact that the utilisation as a nutrient is considered superior to the utilisation as an industry product. However, all three possible utilisations were considered an improvement compared to “waste” / no use. The error rate in gender determination, associated with an increase of animals and incubated eggs needed, is considered a disadvantage and was penalised by respondents through a decrease in WTP. Respondents’ WTP for a box of 10 eggs decreased by €0.17 when the error rate increased by one percent. Therefore, high error rates or the lack of a meaningful utilisation of incubated eggs can decrease approval for in ovo gender determination to an extent, where no positive WTP remains.

#### **4. Conclusion**

The presented study provides insights to consumer preferences for a highly topical subject regarding poultry production: gender determination of male layer chicks in incubated eggs. The aim of this study was to investigate consumers’ preferences for in ovo gender determination at different stages of embryonic development as an alternative to chick culling, and to analyse the effect pictures have on these preferences. The study therefore contributes to the limited literature on the effect of pictures in DCE. Using a within-subject design, two identical DCEs were presented to respondents, providing choice situations between egg

alternatives with different production attributes. In the first DCE round, alternatives were described through text only. In the second DCE round, pictures of incubated eggs or a chick – depending on the attribute levels given in the choice set’s alternatives – were added. Findings reveal that all proposed in ovo alternatives are preferred over the current practice of chick culling. Results show that gender determination at earlier stages of development, namely day 1 and day 4, is statistically significantly preferred over day 9. Pictures influenced respondents’ choice behaviour significantly. When respondents were confronted with pictures, gender determination at day 9 of incubation actually decreased choice probability.

Results have important implications for stakeholders in egg production in Germany, and also in other countries where the practice of chick culling is debated due to moral concern. The development of a technology enabling the sexing of chicken embryos at an early stage of development is in line with consumer expectations. Considerable WTP can be found for these in ovo alternatives. This preference becomes clearer, when consumers are confronted with pictures of incubated eggs or a chick. Furthermore, a low rate of failure and meaningful usage of screened out eggs should be communicated clearly to consumers, as they are crucial attributes for the acceptance of in ovo gender determination as a morally admissible alternative to chick culling. The results demonstrate that as long as chick culling remains the industry standard, communication of “in ovo” production claims could be a way for producers to differentiate from the market. Knowledge of societal expectations and a profound communication with consumers is able to increase WTP and acceptance for the in ovo technique significantly. However, gender determination at advanced stages of embryonic development is seen critical, especially when respective pictures of incubated eggs are provided. This offers a potential for social criticism, which should be kept in mind by stakeholders in poultry production when implementing the in ovo technique on a large scale.

## **Acknowledgements**

This work was supported by the “Ministry for Science and Culture” of Lower Saxony, Germany. The authors are grateful to Agri Advanced Technologies GmbH, Visbeck, Germany, for providing the pictures of incubated eggs.

## References

- Aleksandrowicz, E., & Herr, I. (2015). Ethical euthanasia and short-term anesthesia of the chick embryo. *ALTEX*, 32(2), 143–147. <https://doi.org/10.14573/altex.1410031>.
- Bech, M., & Gyrd-Hansen, D. (2005). Effects coding in discrete choice experiments. *Health economics*, 14(10), 1079–1083. <https://doi.org/10.1002/hec.984>.
- Bjørnstad, S., Austdal, L. P. E., Roald, B., Glover, J. C., & Paulsen, R. E. (2015). Cracking the Egg: Potential of the Developing Chicken as a Model System for Nonclinical Safety Studies of Pharmaceuticals. *The Journal of pharmacology and experimental therapeutics*, 355(3), 386–396. <https://doi.org/10.1124/jpet.115.227025>.
- BMEL. (2017). Alternativen zum Töten männlicher Küken. Retrieved from [https://www.bmel.de/DE/Tier/Tierwohl/\\_texte/Tierwohl-Forschung-In-Ovo.html](https://www.bmel.de/DE/Tier/Tierwohl/_texte/Tierwohl-Forschung-In-Ovo.html). Accessed 09.07.2019.
- Brujinis, M. R. N., Blok, V., Stassen, E. N., & Gremmen, H. G. J. (2015). Moral “Lock-In” in Responsible Innovation: The Ethical and Social Aspects of Killing Day-Old Chicks and Its Alternatives. *Journal of Agricultural and Environmental Ethics*, 28(5), 939–960. <https://doi.org/10.1007/s10806-015-9566-7>.
- Busch, G., & Spiller, A. (2018). Pictures in public communications about livestock farming. *Animal Frontiers*, 8(1), 27–33. <https://doi.org/10.1093/af/vfx003>.
- Carlsson, F., Frykblom, P., & Lagerkvist, C. J. (2005). Using cheap talk as a test of validity in choice experiments. *Economics letters*, 89(2), 147–152. <https://doi.org/10.1016/j.econlet.2005.03.010>.
- Colombo, S., Glenk, K., & Rocamora-Montiel, B. (2015). Analysis of choice inconsistencies in on-line choice experiments: impact on welfare measures. *European Review of Agricultural Economics*, 43(2), 271–302. <https://doi.org/10.1093/erae/jbv016>.
- Childers, T. L., & Houston, M. J. (1984). Conditions for a picture-superiority effect on consumer memory. *Journal of consumer research*, 11(2), 643–654. <https://doi.org/10.1086/209001>.
- ChoiceMetrics. (2014). Ngene 1.1.2 User Manual & Reference Guide, Australia.
- EC. (1999). COUNCIL DIRECTIVE 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens. *Official Journal of the European Communities*, L 203/53.

- EC. (2009). Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation). *Official Journal of the European Union* L300:1-33.
- Eide, A. L., & Glover, J. C. (1995). Development of the longitudinal projection patterns of lumbar primary sensory afferents in the chicken embryo. *The Journal of comparative neurology*, 353(2), 247–259. <https://doi.org/10.1002/cne.903530207>.
- Galli, R., Preusse, G., Uckermann, O., Bartels, T., Krautwald-Junghanns, M.-E., Koch, E., & Steiner, G. (2017). In ovo sexing of chicken eggs by fluorescence spectroscopy. *Analytical and bioanalytical chemistry*, 409(5), 1185–1194. <https://doi.org/10.1007/s00216-016-0116-6>.
- Germain, D., Wakefield, M. A., & Durkin, S. J. (2010). Adolescents' perceptions of cigarette brand image: does plain packaging make a difference?. *Journal of Adolescent health*, 46(4), 385-392. <https://doi.org/10.1016/j.jadohealth.2009.08.009>.
- Glenk, K., & Colombo, S. (2013). Modelling outcome-related risk in choice experiments. *Australian Journal of Agricultural and Resource Economics*, 57(4), 559-578. <https://doi.org/10.1111/1467-8489.12012>.
- Göhler, D., Fischer, B., & Meissner, S. (2017). In-ovo sexing of 14-day-old chicken embryos by pattern analysis in hyperspectral images (VIS/NIR spectra): A non-destructive method for layer lines with gender-specific down feather color. *Poultry science*, 96(1), 1–4. <https://doi.org/10.3382/ps/pew282>.
- Graber, D. A. (2016). Say it with Pictures. *The ANNALS of the American Academy of Political and Social Science*, 546(1), 85–96. <https://doi.org/10.1177/0002716296546001008>.
- Hajcak, G., & Olvet, D. M. (2008). The persistence of attention to emotion: Brain potentials during and after picture presentation. *Emotion* (Washington, D.C.), 8(2), 250–255. <https://doi.org/10.1037/1528-3542.8.2.250>.
- Hanley, N., Mourato, S., & Wright, R. E. (2001). Choice Modelling Approaches: A Superior Alternative for Environmental Valuation?. *Journal of Economic Surveys*, 15(3), 435–462. <https://doi.org/10.1111/1467-6419.00145>.

- Hauber, A. B., González, J. M., Groothuis-Oudshoorn, C. G. M., Prior, T., Marshall, D. A., Cunningham, C., . . . Bridges, J. F. P. (2016). Statistical Methods for the Analysis of Discrete Choice Experiments: A Report of the ISPOR Conjoint Analysis Good Research Practices Task Force. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research*, 19(4), 300–315. <https://doi.org/10.1016/j.jval.2016.04.004>.
- Hensher, D. A., & Greene, W. H. (2011). Valuation of travel time savings in WTP and preference space in the presence of taste and scale heterogeneity. *Journal of Transport Economics and Policy* (JTEP) 45(3): 505–525.
- Hollands, G. J., Prestwich, A., & Marteau, T. M. (2011). Using aversive images to enhance healthy food choices and implicit attitudes: An experimental test of evaluative conditioning. *Health Psychology*, 30(2), 195. <http://dx.doi.org/10.1037/a0022261>.
- Krautwald-Junghanns, M.-E., Cramer, K., Fischer, B., Förster, A., Galli, R., Kremer, F., Mapesa, E. U., Meissner, S., Preisinger, R., Preusse, G., Schnabel, C., Steiner, G., & Bartels, T. (2018). Current approaches to avoid the culling of day-old male chicks in the layer industry, with special reference to spectroscopic methods. *Poultry science*, 97(3), 749–757. <https://doi.org/10.3382/ps/pex389>.
- Leary, S. L. (2013). AVMA guidelines for the euthanasia of animals: 2013 edition (2013 edition). Schaumburg, IL: American Veterinary Medical Association.
- Leenstra, F., Munnichs, G., Beekman, V., van den Heuvel-Vromans, E., Aramyan, L., & Woelders, H. (2011). Killing day-old chicks? Public opinion regarding potential alternatives. *Animal Welfare*, 20(1), 37–45.
- Liebe, U., Meyerhoff, J., & Hartje, V. (2012). Test–retest reliability of choice experiments in environmental valuation. *Environmental and Resource Economics*, 53(3), 389–407. <https://doi.org/10.1007/s10640-012-9567-1>.
- Liebe, U., Glenk, K., Oehlmann, M., & Meyerhoff, J. (2015). Does the use of mobile devices (tablets and smartphones) affect survey quality and choice behaviour in web surveys?. *Journal of choice modelling*, 14, 17–31. <https://doi.org/10.1016/j.jocm.2015.02.002>.
- List, J. A., Sinha, P., & Taylor, M. H. (2006). Using Choice Experiments to Value Non-Market Goods and Services: Evidence from Field Experiments. *Advances in Economic Analysis & Policy*, 5(2). <https://doi.org/10.2202/1538-0637.1132>.

- Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). Stated choice methods: analysis and applications. *Cambridge university press*.
- Luce, R. D. (1959). Decision Making; an Experimental Approach. *The Journal of Philosophy*, 56(4), 173-177. <https://doi.org/10.2307/2022058>.
- Manski, C. F. (1977). The structure of random utility models. *Theory and decision*, 8(3), 229-254.
- Mayfield, L. E., Bennett, R. M., Tranter, R. B., & Wooldridge, M. J. (2007). Consumption of welfare-friendly food products in Great Britain, Italy and Sweden, and how it may be influenced by consumer attitudes to, and behaviour towards, animal welfare attributes, *International Journal of Sociology of Food and Agriculture*, 15(3), 59–73.
- McFadden, D. (1974). The measurement of urban travel demand. *Journal of public economics*, 3(4), 303-328. [https://doi.org/10.1016/0047-2727\(74\)90003-6](https://doi.org/10.1016/0047-2727(74)90003-6).
- Mellor, D. J., & Diesch, T. J. (2007). Birth and hatching: Key events in the onset of awareness in the lamb and chick. *New Zealand veterinary journal*, 55(2), 51–60. <https://doi.org/10.1080/00480169.2007.36742>.
- Patterson, Z., Darbani, J. M., Rezaei, A., Zacharias, J., & Yazdizadeh, A. (2017). Comparing text-only and virtual reality discrete choice experiments of neighbourhood choice. *Landscape and Urban Planning*, 157, 63-74. <https://doi.org/10.1016/j.landurbplan.2016.05.024>.
- Pearl, R. L., Puhl, R. M., & Brownell, K. D. (2012). Positive media portrayals of obese persons: Impact on attitudes and image preferences. *Health Psychology*, 31(6), 821. <http://dx.doi.org/10.1037/a0027189>.
- Poe, G. L., Giraud, K. L., & Loomis, J. B. (2005). Computational methods for measuring the difference of empirical distributions. *American Journal of Agricultural Economics*, 87(2), 353-365. <https://doi.org/10.1111/j.1467-8276.2005.00727.x>.
- Rose, J. M., & Bliemer, M. C. J. (2009). Constructing efficient stated choice experimental designs. *Transport Reviews*, 29(5), 587–617. <https://doi.org/10.1080/01441640902827623>.
- Rizzi, L. I., Limonado, J. P., & Steimetz, S. S. (2012). The impact of traffic images on travel time valuation in stated-preference choice experiments. *Transportmetrica*, 8(6), 427-442. <https://doi.org/10.1080/18128602.2010.551524>.

- Sauter, P. A., Möllmann, T. B., Anastassiadis, F., Mußhoff, O., & Möhring, B. (2016). To insure or not to insure? Analysis of foresters' willingness-to-pay for fire and storm insurance. *Forest Policy and Economics*, 73, 78-89.  
<https://doi.org/10.1016/j.forpol.2016.08.005>.
- Scarpa, R., & Rose, J. M. (2008). Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why. *Australian journal of agricultural and resource economics*, 52(3), 253-282. <https://doi.org/10.1111/j.1467-8489.2007.00436.x>.
- Scarpa, R., Thiene, M., & Train, K. (2008). Utility in willingness to pay space: a tool to address confounding random scale effects in destination choice to the Alps. *American Journal of Agricultural Economics*, 90(4), 994–1010. <https://doi.org/10.1111/j.1467-8276.2008.01155.x>.
- Strong, C. (1997). The moral status of preembryos, embryos, fetuses, and infants. *The Journal of medicine and philosophy*, 22(5), 457–478. <https://doi.org/10.1093/jmp/22.5.457>.
- Train, K. (2009). Discrete choice methods with simulation (2nd edition). Cambridge: Cambridge University Press.
- Train, K., & Weeks, M. (2005). Discrete choice models in preference space and willingness-to-pay space. In *Applications of simulation methods in environmental and resource economics* (pp. 1-16). Springer, Dordrecht.
- TUM Press statement. (2018). Durchbruch bei Suche nach Alternative zum Kükentöten [Breakthrough in the search for an alternative to chick culling]. Retrieved from <https://www.tum.de/die-tum/aktuelles/pressemitteilungen/detail/article/34775/>. Accessed 19.08.2019.
- Unilever. (2018). Farm animal welfare statement. Retrieved from <https://www.unilever.com/sustainable-living/what-matters-to-you/farm-animal-welfare.html>. Accessed 09.07.2019.
- United Egg Producers. (2016). Statement on Eliminating Male Chick Culling. Retrieved from <https://uepcertified.com/united-egg-producers-statement-eliminating-male-chick-culling/>. Accessed 09.07.2019.

- Weissmann, A., Reitemeier, S., Hahn, A., Gottschalk, J., & Einspanier, A. (2013). Sexing domestic chicken before hatch: a new method for in ovo gender identification. *Theriogenology*, 80(3), 199–205. <https://doi.org/10.1016/j.theriogenology.2013.04.014>.
- Woelders, H., Brom, F., & Hopster, H. (2007). Alternatieven voor doding van eendagskuikens: technologische perspectieven en ethische consequenties. [Title translation: Alternatives to killing day-old chicks: technological perspectives and ethical consequences. Retrieved from <http://edepot.wur.nl/45674>. Accessed 19.08.2019.
- Wunderlich, S., & Gatto, K. A. (2015). Consumer perception of genetically modified organisms and sources of information. *Advances in nutrition* (Bethesda, Md.), 6(6), 842–851. <https://doi.org/10.3945/an.115.008870>.



## Appendix A

**Table A-1.** Overview of all choice sets

Choice Set		1		2		3		4		5		6		7		8	
Alternative		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Attribute	Level																
Day of gender determination	Day 1		✓	✓						✓		✓					✓
	Day 4	✓			✓				✓							✓	
	Day 9					✓		✓			✓		✓				
	Day 21 (chick)						✓							✓	✓		
Usage	Waste (no use)					✓						✓		✓	✓	✓	
	Chemical industry	✓		✓									✓				
	Pet food		✓				✓		✓					✓			
	Fodder				✓			✓		✓	✓						✓
Error rate (%)		10	5	10	5	5	10	5	10	1	15	15	1	5	10	1	15
Price (€)		1.00	1.00	0.30	0.30	1.70	-	-	1.70	1.00	0.30	-	1.00	1.70	-	0.30	1.70

## **Appendix B**

### Information about poultry production

In poultry production, egg and meat production are separated. For the production of chicken meat such as chicken fillets or chicken thighs, there are special breeds that grow very quickly, put on a lot of meat and can be slaughtered after 5-6 weeks. For the production of eggs, specialised breeds are used which lay over 300 eggs per year. They are called layer breeds. The hens and cockerels of these breeds have a narrow, thin physique and put on very little meat, even when they are fully grown.

Only the females of these layer breeds can lay eggs. However, as male and female chicks hatch when breeding the laying hens, there is a problem: Cockerels do not lay eggs and they grow very slowly and put on very little meat. They are therefore neither useful for the production of eggs nor for the production of meat. Therefore, they are killed on the first day of life, shortly after they hatch. This happens in the EU mostly by suffocation with CO<sub>2</sub> gas. Slaughtered chicks can partly be used as feed for zoo animals or pets. This practice is very widespread, both in conventional and organic farming. In Germany, between 45 and 50 million male chicks are killed every year on the first day of life.

### A technical solution to determine the gender in the egg (1)

Chicken eggs are usually incubated for 21 days. On the 21<sup>st</sup> day the chick hatches. In laying hen production, the chicks are sorted after hatching by hand into female and male chicks. The male chicks are then killed. Currently, research is underway to develop a technique for determining the gender in the egg. This method is called "in-ovo", i.e. "in the egg". Eggs with male embryos would as a consequence be sorted out before hatching. Male chicks would therefore not have to be killed on the first day of life and eggs with female embryos would be incubated until hatching. The future laying hens hatch from these eggs. Determining the gender of a chick before hatching is technically complex. Alternatives include the examination of the egg on days 1, 4 or 9 of incubation. On the 1<sup>st</sup> and 4<sup>th</sup> day of incubation the pain sensation of the chick embryo is not yet developed. On the 9<sup>th</sup> day of incubation, perception of pain might already be present to a certain degree.

### *Control question*

Why should the ovo technique be introduced?

- The eggs can already be sorted into future broilers and laying hens during incubation
- The health of the chicks can be determined before hatching, so that unhealthy embryos can be sorted out.
- Male chicks from layer hen production can be identified and sorted out during incubation. This prevents the killing of male chicks after hatching.

*A technical solution to determine the gender in the egg (2)*

Half of the fertilised eggs in the incubator contain male embryos, the other half is female. It is possible that the gender is not determined correctly in all eggs with the in ovo technique. It can happen that eggs with female embryos are destroyed by mistake.

Due to different errors, to obtain 100 healthy laying hens, more than 200 fertilised eggs must therefore be incubated.

*Control question*

Due to errors in gender determination, it is possible that eggs with female embryos are also unintentionally rejected.

- True
- False

## Appendix C

**Table A-2.** Interaction model, full table of results<sup>a)</sup>

Variables	Mean	statistical significance
ASC <sup>b)</sup>	1.55	***
Day 1	2.34	***
Day 4	1.69	***
Day 9	-0.24	**
Day 21	[-3.79]	
Error rate	-0.20	***
Chemical industry	-0.72	***
Pet food	1.53	***
Waste	-1.74	***
Fodder	[0.93]	
Price	-0.22	**
ASC x treatment	-0.40	***
Day 1 x treatment	0.85	***
Day 4 x treatment	0.19	**
Day 9 x treatment	-0.36	***
Day 21 x treatment	[-0.68]	
Error rate x treatment	-0.01	
Chemical industry x treatment	0.11	
Pet food x treatment	-0.03	
Waste x treatment	0.02	
Fodder x treatment	[-0.10]	

Notes:

<sup>a)</sup>\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.001$ ; Coefficients estimated using 1,000 Halton draws. Base levels of effect coded attributes in [brackets].

<sup>b)</sup>Alternative specific constant (ASC)



**Diskussionspapiere**

2000 bis 31. Mai 2006

Institut für Agrarökonomie

Georg-August-Universität, Göttingen

<u><b>2000</b></u>		
<b>0001</b>	Brandes, W.	Über Selbstorganisation in Planspielen: ein Erfahrungsbericht, 2000
<b>0002</b>	von Cramon-Taubadel, S. u. J. Meyer	Asymmetric Price Transmission: Factor Artefact?, 2000
<u><b>2001</b></u>		
<b>0101</b>	Leserer, M.	Zur Stochastik sequentieller Entscheidungen, 2001
<b>0102</b>	Molua, E.	The Economic Impacts of Global Climate Change on African Agriculture, 2001
<b>0103</b>	Birner, R. et al.	„Ich kaufe, also will ich?“: eine interdisziplinäre Analyse der Entscheidung für oder gegen den Kauf besonders tier- u. umweltfreundlich erzeugter Lebensmittel, 2001
<b>0104</b>	Wilkens, I.	Wertschöpfung von Großschutzgebieten: Befragung von Besuchern des Nationalparks Unteres Odertal als Baustein einer Kosten-Nutzen-Analyse, 2001
<u><b>2002</b></u>		
<b>0201</b>	Grethe, H.	Optionen für die Verlagerung von Haushaltsmitteln aus der ersten in die zweite Säule der EU-Agrarpolitik, 2002
<b>0202</b>	Spiller, A. u. M. Schramm	Farm Audit als Element des Midterm-Review : zugleich ein Beitrag zur Ökonomie von Qualitätssicherungssystemen, 2002
<u><b>2003</b></u>		
<b>0301</b>	Lüth, M. et al.	Qualitätssignaling in der Gastronomie, 2003
<b>0302</b>	Jahn, G., M. Peupert u. A. Spiller	Einstellungen deutscher Landwirte zum QS-System: Ergebnisse einer ersten Sondierungsstudie, 2003
<b>0303</b>	Theuvsen, L.	Kooperationen in der Landwirtschaft: Formen, Wirkungen und aktuelle Bedeutung, 2003
<b>0304</b>	Jahn, G.	Zur Glaubwürdigkeit von Zertifizierungssystemen: eine ökonomische Analyse der Kontrollvalidität, 2003
<u><b>2004</b></u>		
<b>0401</b>	Meyer, J. u. S. von Cramon-Taubadel	Asymmetric Price Transmission: a Survey, 2004
<b>0402</b>	Barkmann, J. u. R. Marggraf	The Long-Term Protection of Biological Diversity: Lessons from Market Ethics, 2004

<b>0403</b>	Bahrs, E.	VAT as an Impediment to Implementing Efficient Agricultural Marketing Structures in Transition Countries, 2004
<b>0404</b>	Spiller, A., T. Staack u. A. Zühlsdorf	Absatzwege für landwirtschaftliche Spezialitäten: Potenziale des Mehrkanalvertriebs, 2004
<b>0405</b>	Spiller, A. u. T. Staack	Brand Orientation in der deutschen Ernährungswirtschaft: Ergebnisse einer explorativen Online-Befragung, 2004
<b>0406</b>	Gerlach, S. u. B. Köhler	Supplier Relationship Management im Agribusiness: ein Konzept zur Messung der Geschäftsbeziehungsqualität, 2004
<b>0407</b>	Inderhees, P. et al.	Determinanten der Kundenzufriedenheit im Fleischerfachhandel
<b>0408</b>	Lüth, M. et al.	Köche als Kunden: Direktvermarktung landwirtschaftlicher Spezialitäten an die Gastronomie, 2004
<b><u>2005</u></b>		
<b>0501</b>	Spiller, A., J. Engelken u. S. Gerlach	Zur Zukunft des Bio-Fachhandels: eine Befragung von Bio-Intensivkäufern, 2005
<b>0502</b>	Groth, M.	Verpackungsabgaben und Verpackungslizenzen als Alternative für ökologisch nachteilige Einweggetränkeverpackungen? Eine umweltökonomische Diskussion, 2005
<b>0503</b>	Freese, J. u. H. Steinmann	Ergebnisse des Projektes 'Randstreifen als Strukturelemente in der intensiv genutzten Agrarlandschaft Wolfenbüttels', Nichtteilnehmerbefragung NAU 2003, 2005
<b>0504</b>	Jahn, G., M. Schramm u. A. Spiller	Institutional Change in Quality Assurance: the Case of Organic Farming in Germany, 2005
<b>0505</b>	Gerlach, S., R. Kennerknecht u. A. Spiller	Die Zukunft des Großhandels in der Bio-Wertschöpfungskette, 2005
<b><u>2006</u></b>		
<b>0601</b>	Heß, S., H. Bergmann u. L. Sudmann	Die Förderung alternativer Energien: eine kritische Bestandsaufnahme, 2006
<b>0602</b>	Gerlach, S. u. A. Spiller	Anwohnerkonflikte bei landwirtschaftlichen Stallbauten: Hintergründe und Einflussfaktoren; Ergebnisse einer empirischen Analyse, 2006
<b>0603</b>	Glenk, K.	Design and Application of Choice Experiment Surveys in So-Called Developing Countries: Issues and Challenges,
<b>0604</b>	Bolten, J., R. Kennerknecht u. A. Spiller	Erfolgsfaktoren im Naturkostfachhandel: Ergebnisse einer empirischen Analyse, 2006 (entfällt)
<b>0605</b>	Hasan, Y.	Einkaufsverhalten und Kundengruppen bei Direktvermarktern in Deutschland: Ergebnisse einer empirischen Analyse, 2006

<b>0606</b>	Lülf, F. u. A. Spiller	Kunden(un-)zufriedenheit in der Schulverpflegung: Ergebnisse einer vergleichenden Schulbefragung, 2006
<b>0607</b>	Schulze, H., F. Albersmeier u. A. Spiller	Risikoorientierte Prüfung in Zertifizierungssystemen der Land- und Ernährungswirtschaft, 2006
<b><u>2007</u></b>		
<b>0701</b>	Buchs, A. K. u. J. Jasper	For whose Benefit? Benefit-Sharing within Contractual ABC-Agreements from an Economic Perspective: the Example of Pharmaceutical Bioprospection, 2007
<b>0702</b>	Böhm, J. et al.	Preis-Qualitäts-Relationen im Lebensmittelmarkt: eine Analyse auf Basis der Testergebnisse Stiftung Warentest, 2007
<b>0703</b>	Hurlin, J. u. H. Schulze	Möglichkeiten und Grenzen der Qualitäts-sicherung in der Wildfleischvermarktung, 2007
<b>Ab Heft 4, 2007:</b>		<b>Diskussionspapiere (Discussion Papers), Department für Agrarökonomie und Rurale Entwicklung Georg-August-Universität, Göttingen (ISSN 1865-2697)</b>
<b>0704</b>	Stockebrand, N. u. A. Spiller	Agrarstudium in Göttingen: Fakultätsimage und Studienwahlentscheidungen; Erstsemesterbefragung im WS 2006/2007
<b>0705</b>	Bahrs, E., J.-H. Held u. J. Thiering	Auswirkungen der Bioenergieproduktion auf die Agrarpolitik sowie auf Anreizstrukturen in der Landwirtschaft: eine partielle Analyse bedeutender Fragestellungen anhand der Beispielregion Niedersachsen
<b>0706</b>	Yan, J., J. Barkmann u. R. Marggraf	Chinese tourist preferences for nature based destinations – a choice experiment analysis
<b><u>2008</u></b>		
<b>0801</b>	Joswig, A. u. A. Zühlsdorf	Marketing für Reformhäuser: Senioren als Zielgruppe
<b>0802</b>	Schulze, H. u. A. Spiller	Qualitätssicherungssysteme in der europäischen Agri-Food Chain: Ein Rückblick auf das letzte Jahrzehnt
<b>0803</b>	Gille, C. u. A. Spiller	Kundenzufriedenheit in der Pensionspferdehaltung: eine empirische Studie
<b>0804</b>	Voss, J. u. A. Spiller	Die Wahl des richtigen Vertriebswegs in den Vorleistungsindustrien der Landwirtschaft – Konzeptionelle Überlegungen und empirische Ergebnisse
<b>0805</b>	Gille, C. u. A. Spiller	Agrarstudium in Göttingen. Erstsemester- und Studienverlaufsbefragung im WS 2007/2008
<b>0806</b>	Schulze, B., C. Wocken u. A. Spiller	(Dis)loyalty in the German dairy industry. A supplier relationship management view Empirical evidence and management implications
<b>0807</b>	Brümmer, B., U. Köster u. J.-P. Loy	Tendenzen auf dem Weltgetreidemarkt: Anhaltender Boom oder kurzfristige Spekulationsblase?

<b>0808</b>	Schlecht, S., F. Albersmeier u. A. Spiller	Konflikte bei landwirtschaftlichen Stallbauprojekten: Eine empirische Untersuchung zum Bedrohungspotential kritischer Stakeholder
<b>0809</b>	Lülfes-Baden, F. u. A. Spiller	Steuerungsmechanismen im deutschen Schulverpflegungsmarkt: eine institutionenökonomische Analyse
<b>0810</b>	Deimel, M., L. Theuvsen u. C. Ebbeskotte	Von der Wertschöpfungskette zum Netzwerk: Methodische Ansätze zur Analyse des Verbundsystems der Veredelungswirtschaft Nordwestdeutschlands
<b>0811</b>	Albersmeier, F. u. A. Spiller	Supply Chain Reputation in der Fleischwirtschaft
<b><u>2009</u></b>		
<b>0901</b>	Bahlmann, J., A. Spiller u. C.-H. Plumeyer	Status quo und Akzeptanz von Internet-basierten Informationssystemen: Ergebnisse einer empirischen Analyse in der deutschen Veredelungswirtschaft
<b>0902</b>	Gille, C. u. A. Spiller	Agrarstudium in Göttingen. Eine vergleichende Untersuchung der Erstsemester der Jahre 2006-2009
<b>0903</b>	Gawron, J.-C. u. L. Theuvsen	„Zertifizierungssysteme des Agribusiness im interkulturellen Kontext – Forschungsstand und Darstellung der kulturellen Unterschiede“
<b>0904</b>	Raupach, K. u. R. Marggraf	Verbraucherschutz vor dem Schimmelpilzgift Deoxynivalenol in Getreideprodukten Aktuelle Situation und Verbesserungsmöglichkeiten
<b>0905</b>	Busch, A. u. R. Marggraf	Analyse der deutschen globalen Waldpolitik im Kontext der Klimarahmenkonvention und des Übereinkommens über die Biologische Vielfalt
<b>0906</b>	Zschache, U., S. von Cramon-Taubadel u. L. Theuvsen	Die öffentliche Auseinandersetzung über Bioenergie in den Massenmedien - Diskursanalytische Grundlagen und erste Ergebnisse
<b>0907</b>	Onumah, E. E., G. Hoerstgen-Schwark u. B. Brümmer	Productivity of hired and family labour and determinants of technical inefficiency in Ghana's fish farms
<b>0908</b>	Onumah, E. E., S. Wessels, N. Wildenhayn, G. Hoerstgen-Schwark u. B. Brümmer	Effects of stocking density and photoperiod manipulation in relation to estradiol profile to enhance spawning activity in female Nile tilapia
<b>0909</b>	Steffen, N., S. Schlecht u. A. Spiller	Ausgestaltung von Milchlieferverträgen nach der Quote
<b>0910</b>	Steffen, N., S. Schlecht u. A. Spiller	Das Preisfindungssystem von Genossenschaftsmolkereien
<b>0911</b>	Granoszewski, K., C. Reise, A. Spiller u. O. Mußhoff	Entscheidungsverhalten landwirtschaftlicher Betriebsleiter bei Bioenergie-Investitionen - Erste Ergebnisse einer empirischen Untersuchung -



<b>0912</b>	Albersmeier, F., D. Mörlein u. A. Spiller	Zur Wahrnehmung der Qualität von Schweinefleisch beim Kunden
<b>0913</b>	Ihle, R., B. Brümmer u. S. R. Thompson	Spatial Market Integration in the EU Beef and Veal Sector: Policy Decoupling and Export Bans
<b><u>2010</u></b>		
<b>1001</b>	Heß, S., S. von Cramon-Taubadel u. S. Sperlich	Numbers for Pascal: Explaining differences in the estimated Benefits of the Doha Development Agenda
<b>1002</b>	Deimel, I., J. Böhm u. B. Schulze	Low Meat Consumption als Vorstufe zum Vegetarismus? Eine qualitative Studie zu den Motivstrukturen geringen Fleischkonsums
<b>1003</b>	Franz, A. u. B. Nowak	Functional food consumption in Germany: A lifestyle segmentation study
<b>1004</b>	Deimel, M. u. L. Theuvsen	Standortvorteil Nordwestdeutschland? Eine Untersuchung zum Einfluss von Netzwerk- und Clusterstrukturen in der Schweinefleischerzeugung
<b>1005</b>	Niens, C. u. R. Marggraf	Ökonomische Bewertung von Kindergesundheit in der Umweltpolitik - Aktuelle Ansätze und ihre Grenzen
<b>1006</b>	Hellberg-Bahr, A., M. Pfeuffer, N. Steffen, A. Spiller u. B. Brümmer	Preisbildungssysteme in der Milchwirtschaft -Ein Überblick über die Supply Chain Milch
<b>1007</b>	Steffen, N., S. Schlecht, H-C. Müller u. A. Spiller	Wie viel Vertrag braucht die deutsche Milchwirtschaft?- Erste Überlegungen zur Ausgestaltung des Contract Designs nach der Quote aus Sicht der Molkereien
<b>1008</b>	Prehn, S., B. Brümmer u. S. R. Thompson	Payment Decoupling and the Intra – European Calf Trade
<b>1009</b>	Maza, B., J. Barkmann, F. von Walter u. R. Marggraf	Modelling smallholders production and agricultural income in the area of the Biosphere reserve “Podocarpus - El Cónдор”, Ecuador
<b>1010</b>	Busse, S., B. Brümmer u. R. Ihle	Interdependencies between Fossil Fuel and Renewable Energy Markets: The German Biodiesel Market
<b><u>2011</u></b>		
<b>1101</b>	Mylus, D., S. Küest, C. Klapp u. L. Theuvsen	Der Großvieheinheitenschlüssel im Stallbaurecht - Überblick und vergleichende Analyse der Abstandsregelungen in der TA Luft und in den VDI-Richtlinien
<b>1102</b>	Klapp, C., L. Obermeyer u. F. Thoms	Der Vieheinheitenschlüssel im Steuerrecht - Rechtliche Aspekte und betriebswirtschaftliche Konsequenzen der Gewerblichkeit in der Tierhaltung
<b>1103</b>	Göser, T., L. Schroeder u. C. Klapp	Agrarumweltprogramme: (Wann) lohnt sich die Teilnahme für landwirtschaftliche Betriebe?

<b>1104</b>	Plumeyer, C.-H., F. Albersmeier, M. Freiherr von Oer, C. H. Emmann u. L. Theuvsen	Der niedersächsische Landpachtmarkt: Eine empirische Analyse aus Pächtersicht
<b>1105</b>	Voss, A. u. L. Theuvsen	Geschäftsmodelle im deutschen Viehhandel: Konzeptionelle Grundlagen und empirische Ergebnisse
<b>1106</b>	Wendler, C., S. von Cramon- Taubadel, H. de Haen, C. A. Padilla Bravo u. S. Jrad	Food security in Syria: Preliminary results based on the 2006/07 expenditure survey
<b>1107</b>	Prehn, S. u. B. Brümmer	Estimation Issues in Disaggregate Gravity Trade Models
<b>1108</b>	Recke, G., L. Theuvsen, N. Venhaus u. A. Voss	Der Viehhandel in den Wertschöpfungsketten der Fleischwirtschaft: Entwicklungstendenzen und Perspektiven
<b>1109</b>	Prehn, S. u. B. Brümmer	“Distorted Gravity: The Intensive and Extensive Margins of International Trade”, revisited: An Application to an Intermediate Melitz Model
<b><u>2012</u></b>		
<b>1201</b>	Kayser, M., C. Gille, K. Suttorp u. A. Spiller	Lack of pupils in German riding schools? – A causal- analytical consideration of customer satisfaction in children and adolescents
<b>1202</b>	Prehn, S. u. B. Brümmer	Bimodality & the Performance of PPML
<b>1203</b>	Tangermann, S.	Preisanstieg am EU-Zuckermarkt: Bestimmungsgründe und Handlungsmöglichkeiten der Marktpolitik
<b>1204</b>	Würriehausen, N., S. Lakner u. Rico Ihle	Market integration of conventional and organic wheat in Germany
<b>1205</b>	Heinrich, B.	Calculating the Greening Effect – a case study approach to predict the gross margin losses in different farm types in Germany due to the reform of the CAP
<b>1206</b>	Prehn, S. u. B. Brümmer	A Critical Judgement of the Applicability of ‘New New Trade Theory’ to Agricultural: Structural Change, Productivity, and Trade
<b>1207</b>	Marggraf, R., P. Masius u. C. Rumpf	Zur Integration von Tieren in wohlfahrtsökonomischen Analysen
<b>1208</b>	S. Lakner, B. Brümmer, S. von Cramon-Taubadel J. Heß, J. Isselstein, U. Liebe, R. Marggraf, O. Mußhoff, L. Theuvsen, T. Tschardtke, C. Westphal u. G. Wiese	Der Kommissionsvorschlag zur GAP-Reform 2013 - aus Sicht von Göttinger und Witzenhäuser Agrarwissenschaftler(inne)n
<b>1209</b>	Prehn, S., B. Brümmer u. T. Glauben	Structural Gravity Estimation & Agriculture

<b>1210</b>	Prehn, S., B. Brümmer u. T. Glauben	An Extended Viner Model: Trade Creation, Diversion & Reduction
<b>1211</b>	Salidas, R. u. S. von Cramon-Taubadel	Access to Credit and the Determinants of Technical Inefficiency among Specialized Small Farmers in Chile
<b>1212</b>	Steffen, N. u. A. Spiller	Effizienzsteigerung in der Wertschöpfungskette Milch ? -Potentiale in der Zusammenarbeit zwischen Milcherzeugern und Molkereien aus Landwirtssicht
<b>1213</b>	Mußhoff, O., A. Tegtmeier u. N. Hirschauer	Attraktivität einer landwirtschaftlichen Tätigkeit - Einflussfaktoren und Gestaltungsmöglichkeiten
<b><u>2013</u></b>		
<b>1301</b>	Lakner, S., C. Holst u. B. Heinrich	Reform der Gemeinsamen Agrarpolitik der EU 2014 - mögliche Folgen des Greenings für die niedersächsische Landwirtschaft
<b>1302</b>	Tangermann, S. u. S. von Cramon-Taubadel	Agricultural Policy in the European Union : An Overview
<b>1303</b>	Granoszewski, K. u. A. Spiller	Langfristige Rohstoffsicherung in der Supply Chain Biogas : Status Quo und Potenziale vertraglicher Zusammenarbeit
<b>1304</b>	Lakner, S., C. Holst, B. Brümmer, S. von Cramon-Taubadel, L. Theuvsen, O. Mußhoff u. T. Tschardtke	Zahlungen für Landwirte an gesellschaftliche Leistungen koppeln! - Ein Kommentar zum aktuellen Stand der EU-Agrarreform
<b>1305</b>	Prechtel, B., M. Kayser u. L. Theuvsen	Organisation von Wertschöpfungsketten in der Gemüseproduktion : das Beispiel Spargel
<b>1306</b>	Anastassiadis, F., J.-H. Feil, O. Musshoff u. P. Schilling	Analysing farmers' use of price hedging instruments : an experimental approach
<b>1307</b>	Holst, C. u. S. von Cramon-Taubadel	Trade, Market Integration and Spatial Price Transmission on EU Pork Markets following Eastern Enlargement
<b>1308</b>	Granoszewski, K., S. Sander, V. M. Aufmkolk u. A. Spiller	Die Erzeugung regenerativer Energien unter gesellschaftlicher Kritik : Akzeptanz von Anwohnern gegenüber der Errichtung von Biogas- und Windenergieanlagen
<b><u>2014</u></b>		
<b>1401</b>	Lakner, S., C. Holst, J. Barkmann, J. Isselstein u. A. Spiller	Perspektiven der Niedersächsischen Agrarpolitik nach 2013 : Empfehlungen Göttinger Agrarwissenschaftler für die Landespolitik
<b>1402</b>	Müller, K., Mußhoff, O. u. R. Weber	The More the Better? How Collateral Levels Affect Credit Risk in Agricultural Microfinance
<b>1403</b>	März, A., N. Klein, T. Kneib u. O. Mußhoff	Analysing farmland rental rates using Bayesian geospatial quantile regression

<b>1404</b>	Weber, R., O. Mußhoff u. M. Petrick	How flexible repayment schedules affect credit risk in agricultural microfinance
<b>1405</b>	Haverkamp, M., S. Henke, C., Kleinschmitt, B. Möhring, H., Müller, O. Mußhoff, L., Rosenkranz, B. Seintsch, K. Schlosser u. L. Theuvsen	Vergleichende Bewertung der Nutzung von Biomasse : Ergebnisse aus den Bioenergieregionen Göttingen und BERTA
<b>1406</b>	Wolbert-Haverkamp, M. u. O. Musshoff	Die Bewertung der Umstellung einer einjährigen Ackerkultur auf den Anbau von Miscanthus – Eine Anwendung des Realoptionsansatzes
<b>1407</b>	Wolbert-Haverkamp, M., J.-H. Feil u. O. Musshoff	The value chain of heat production from woody biomass under market competition and different incentive systems: An agent-based real options model
<b>1408</b>	Ikinger, C., A. Spiller u. K. Wiegand	Reiter und Pferdebesitzer in Deutschland (Facts and Figures on German Equestrians)
<b>1409</b>	Mußhoff, O., N. Hirschauer, S. Grüner u. S. Pielsticker	Der Einfluss begrenzter Rationalität auf die Verbreitung von Wetterindexversicherungen : Ergebnisse eines internetbasierten Experiments mit Landwirten
<b>1410</b>	Spiller, A. u. B. Goetzke	Zur Zukunft des Geschäftsmodells Markenartikel im Lebensmittelmarkt
<b>1411</b>	Wille, M.	„Manche haben es satt, andere werden nicht satt“ : Anmerkungen zur polarisierten Auseinandersetzung um Fragen des globalen Handels und der Welternährung
<b>1412</b>	Müller, J., J. Oehmen, I. Janssen u. L. Theuvsen	Sportlermarkt Galopprennsport : Zucht und Besitz des Englischen Vollbluts

<b><u>2015</u></b>		
<b>1501</b>	Hartmann, L. u. A. Spiller	Luxusaffinität deutscher Reitsportler : Implikationen für das Marketing im Reitsportsegment
<b>1502</b>	Schneider, T., L. Hartmann u. A. Spiller	Luxusmarketing bei Lebensmitteln : eine empirische Studie zu Dimensionen des Luxuskonsums in der Bundesrepublik Deutschland
<b>1503</b>	Würriehausen, N. u. S. Lakner	Stand des ökologischen Strukturwandels in der ökologischen Landwirtschaft
<b>1504</b>	Emmann, C. H., D. Surmann u. L. Theuvsen	Charakterisierung und Bedeutung außerlandwirt- schaftlicher Investoren : empirische Ergebnisse aus Sicht des landwirtschaftlichen Berufsstandes
<b>1505</b>	Buchholz, M., G. Host u. Oliver Mußhoff	Water and Irrigation Policy Impact Assessment Using Business Simulation Games : Evidence from Northern Germany

<b>1506</b>	Hermann, D., O. Mußhoff u. D. Rüter	Measuring farmers' time preference : A comparison of methods
<b>1507</b>	Riechers, M., J. Barkmann u. T. Tschardtke	Bewertung kultureller Ökosystemleistungen von Berliner Stadtgrün entlang eines urbanen-periurbanen Gradienten
<b>1508</b>	Lakner, S., S. Kirchweber, D. Hopp, B. Brümmer u. J. Kantelhardt	Impact of Diversification on Technical Efficiency of Organic Farming in Switzerland, Austria and Southern Germany
<b>1509</b>	Sauthoff, S., F. Anastassiadis u. O. Mußhoff	Analyzing farmers' preferences for substrate supply contracts for sugar beets
<b>1510</b>	Feil, J.-H., F. Anastassiadis, O. Mußhoff u. P. Kasten	Analyzing farmers' preferences for collaborative arrangements : an experimental approach
<b>1511</b>	Weinrich, R., u. A. Spiller	Developing food labelling strategies with the help of extremeness aversion
<b>1512</b>	Weinrich, R., A. Franz u. A. Spiller	Multi-level labelling : too complex for consumers?
<b>1513</b>	Niens, C., R. Marggraf u. F. Hoffmeister	Ambulante Pflege im ländlichen Raum : Überlegungen zur effizienten Sicherstellung von Bedarfsgerechtigkeit
<b>1514</b>	Sauter, P., D. Hermann u. O. Mußhoff	Risk attitudes of foresters, farmers and students : An experimental multimethod comparison
<b><u>2016</u></b>		
<b>1601</b>	Magrini, E., J. Balie u. C. Morales Opazo	Price signals and supply responses for staple food crops in SSAS countries
<b>1602</b>	Feil, J.-H.	Analyzing investment and disinvestment decisions under uncertainty, firm-heterogeneity and tradable output permits
<b>1603</b>	Sonntag, W. u. A. Spiller	Prozessqualitäten in der WTO : Ein Vorschlag für die reliable Messung von moralischen Bedenken
<b>1604</b>	Wiegand, K.	Marktorientierung von Reitschulen – zwischen Vereinsmanagement und Dienstleistungsmarketing
<b>1605</b>	Iking, C. M. u. A. Spiller	Tierwohlbewusstsein und –verhalten von Reitern : Die Entwicklung eines Modells für das Tierwohlbewusstsein und –verhalten im Reitsport
<b>1606</b>	Zinngrebe, Yves	Incorporating Biodiversity Conservation in Peruvian Development : A history with different episodes
<b>1607</b>	Balié, J., E. Magrini u. C. Morales Opazo	Cereal Price Shocks and Volatility in Sub-Saharan Africa : what does really matter for Farmers' Welfare?
<b>1608</b>	Spiller, A., M. von Meyer- Höfer u. W. Sonntag	Gibt es eine Zukunft für die moderne konventionelle Tierhaltung in Nordwesteuropa?

<b>1609</b>	Gollisch, S., B. Hedderich u. L. Theuvsen	Reference points and risky decision-making in agricultural trade firms : A case study in Germany
<b>1610</b>	Cárcamo, J. u. S. von Cramon-Taubadel	Assessing small-scale raspberry producers' risk and ambiguity preferences : evidence from field-experiment data in rural Chile
<b>1611</b>	García-Germán, S., A. Romeo, E. Magrini u. J. Balié	The impact of food price shocks on weight loss : Evidence from the adult population of Tanzania
<b><u>2017</u></b>		
<b>1701</b>	Vollmer, E. u. D. Hermann, O. Mußhoff	The disposition effect in farmers' selling behavior – an experimental investigation
<b>1702</b>	Römer, U., O. Mußhoff, R. Weber u. C. G. Turvey	Truth and consequences : Bogus pipeline experiment in informal small business lending
<b>1703</b>	Römer, U. u. O. Mußhoff	Can agricultural credit scoring for microfinance institutions be implemented and improved by weather data?
<b>1704</b>	Gauly, S., S. Kühl u. A. Spiller	Uncovering strategies of hidden intention in multi-stakeholder initiatives : the case of pasture-raised milk
<b>1705</b>	Gauly, S., A. Müller u. A. Spiller	New methods of increasing transparency : Does viewing webcam pictures change peoples' opinions towards modern pig farming?
<b>1706</b>	Bauermeister, G.-F. u. O. Mußhoff	Multiple switching behavior in different display formats of multiple price lists
<b>1707</b>	Sauthoff, S., M. Danne u. O. Mußhoff	To switch or not to switch? – Understanding German consumers' willingness to pay for green electricity tariff attributes
<b>1708</b>	Bilal, M., J. Barkmann u. T. Jamali Jaghdani	To analyse the suitability of a set of social and economic indicators that assesses the impact on SI enhancing advanced technological inputs by farming households in Punjab Pakistan
<b>1709</b>	Heyking, C.-A. von u. T. Jamali Jaghdani	Expansion of photovoltaic technology (PV) as a solution for water energy nexus in rural areas of Iran; comparative case study between Germany and Iran
<b>1710</b>	Schueler, S. u. E. M. Noack	Naturschutz und Erholung im Stadtwald Göttingen: Darstellung von Interessenskonflikten anhand des Konzeptes der Ökosystemleistungen
<b><u>2018</u></b>		
<b>1801</b>	Danne, M. u. O. Mußhoff	Producers' valuation of animal welfare practices: Does herd size matter?
<b>1802</b>	Danne, M., O. Mußhoff u. M. Schulte	Analysing the importance of glyphosate as part of agricultural strategies – a discrete choice experiment

<b>1803</b>	Fecke, W., M. Danne u. O. Mußhoff	E-commerce in agriculture – The case of crop protection product purchases in a discrete choice experiment
<b>1804</b>	Viergutz, Tim u. B. Schulze-Ehlers	The use of hybrid scientometric clustering for systematic literature reviews in business and economics
<b>1805</b>	Schulze Schwering, D. u. A. Spiller	Das Online-Einkaufsverhalten von Landwirten im Bereich landwirtschaftlicher Betriebsmittel
<b>1806</b>	Hänke, H. et al.	Socio-economic, land use and value chain perspectives on vanilla farming in the SAVA Region (north-eastern Madagascar) : The Diversity Turn Baseline Study (DTBS)
<b>1807</b>	Wille, S. C., B. Barklage, A. Spiller u. M. von Meyer-Höfer	Challenging Factors of Farmer-to-Consumer Direct Marketing : An Empirical Analysis of German Livestock Owners
<b>1808</b>	Wille, S. C., A. Spiller u. M. von Meyer-Höfer	Lage, Lage, Lage? : Welche Rolle spielt der Standort für die landwirtschaftliche Direktvermarktung?
<b>1809</b>	Peth, D. u. O.. Mußhoff	Comparing Compliance Behaviour of Students and Farmers : Implications for Agricultural Policy Impact Analysis
<b>1810</b>	Lakner, S.	Integration von Ökosystemleistungen in die I. Säule der Gemeinsamen Agrarpolitik der EU (GAP) – die Wirkung der ökologischen Vorrangfläche als privates oder öffentliches Gut?
<b>1811</b>	Fecke, W.	Online-Einkauf von Pflanzenschutzmitteln: Ein Discrete Choice Experiment mit landwirtschaftlichen Unternehmen in Deutschland
<b>1812</b>	Schulze-Ehlers, B.	Schlussbericht des Projekts „TransKoll“ - „Transparenz und Transformation in der regionalen Ernährungswirtschaft. Kollaborative Ansätze für mehr Nachhaltigkeit vom Rohstoff bis zum Endkonsumenten
<b>1813</b>	Buchholz, M., D. Peth u. O. Mußhoff	Tax or Green Nudge? An Experimental Analysis of Pesticide Policies in Germany
<b><u>2019</u></b>		
<b>1901</b>	Schaak, H. u. O. Mußhoff	Public preferences for livestock presence in pasture landscapes – A Latent Class Analysis of a Discrete Choice Experiment in Germany
<b>1902</b>	Möllmann, J., M. Buchholz, W. Kölle u. O. Mußhoff	Do remotely-sensed vegetation health indices explain credit risk in agricultural microfinance?
<b>1903</b>	Schütz, A., W. Sonntag u. Achim Spiller	Environmental Enrichment in pig husbandry – Consumer comparative assessment of different housing elements based on a pictorial survey
<b>1904</b>	Vollmer, T. u. S. von Cramon-Taubadel	The influence of Brazilian exports on price transmission processes in the coffee sector: a Markov-switching approach

<b>1905</b>	Michels, M., V. Bonke u. O. Mußhoff	Understanding the adoption of crop protection smartphone apps - An application of the Unified Theory of Acceptance and Use of Technology
<b>1906</b>	Reithmayer, C., M. Danne u. O. Mußhoff	Societal attitudes towards in ovo gender determination as an alternative to chick culling



### Diskussionspapiere

2000 bis 31. Mai 2006:

Institut für Rurale Entwicklung

Georg-August-Universität, Göttingen)

Ed. Winfried Manig (ISSN 1433-2868)

32	Dirks, Jörg J.	Einflüsse auf die Beschäftigung in nahrungsmittelverarbeitenden ländlichen Kleinindustrien in West-Java/Indonesien, 2000
33	Keil, Alwin	Adoption of Leguminous Tree Fallows in Zambia, 2001
34	Schott, Johanna	Women's Savings and Credit Co-operatives in Madagascar, 2001
35	Seeberg-Elberfeldt, Christina	Production Systems and Livelihood Strategies in Southern Bolivia, 2002
36	Molua, Ernest L.	Rural Development and Agricultural Progress: Challenges, Strategies and the Cameroonian Experience, 2002
37	Demeke, Abera Birhanu	Factors Influencing the Adoption of Soil Conservation Practices in Northwestern Ethiopia, 2003
38	Zeller, Manfred u. Julia Johannsen	Entwicklungshemmnisse im afrikanischen Agrarsektor: Erklärungsansätze und empirische Ergebnisse, 2004
39	Yustika, Ahmad Erani	Institutional Arrangements of Sugar Cane Farmers in East Java – Indonesia: Preliminary Results, 2004
40	Manig, Winfried	Lehre und Forschung in der Sozialökonomie der Ruralen Entwicklung, 2004
41	Hebel, Jutta	Transformation des chinesischen Arbeitsmarktes: gesellschaftliche Herausforderungen des Beschäftigungswandels, 2004
42	Khan, Mohammad Asif	Patterns of Rural Non-Farm Activities and Household Access to Informal Economy in Northwest Pakistan, 2005
43	Yustika, Ahmad Erani	Transaction Costs and Corporate Governance of Sugar Mills in East Java, Indonesia, 2005
44	Feulefack, Joseph Florent, Manfred Zeller u. Stefan Schwarze	Accuracy Analysis of Participatory Wealth Ranking (PWR) in Socio-economic Poverty Comparisons, 2006