Farmers' Willingness to Accept Animal Welfare Practices: A Discrete Choice Experiment with German Pig Producers

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Abstract

Improving the welfare of animals is an important aim in livestock farming. Thereby, farmers' willingness to implement animal welfare practices directly influences the welfare of animals. Therefore, this paper investigates pig farmers' preferences and willingness to accept the implementation of animal welfare practices. We study individual preferences for specific animal welfare measures that are part of a hypothetical animal welfare program. The data are analyzed with a mixed logit model in WTA space and show that German pig farmers require statistically significant compensations for implementing animal welfare practices. We find evidence that farmers' choices are driven by their trust in the consumers' willingness to pay, their evaluation of the efficiency of specific animal welfare practices and farm characteristics. Our results further reveal that accounting for farmers' preferences aids in understanding their willingness to implement specific animal welfare practices. Regarding the improvement of animal welfare these findings are highly relevant for politicians, food industry and producers in order to support animal welfare program design and to identify the costs of welfare improvements on the meat supply chain and future profitability.

Keywords

animal welfare; pig production; farmers' preferences; willingness to accept

1 Introduction

In recent years, the discussion on animal welfare has been an important issue in public debates in a variety of countries, including several nations in Europe and North America (CORNISH et al., 2016; KARPENSTEIN et al., 2021). Many different animal welfare assurance programs, such the so called "Initiative Tierwohl" (ITW) (INITIATIVE TIERWOHL, 2020) have emerged in food production and were initiated by various players such as animal producers, retailers, civil organizations or governments in order to ensure higher animal welfare standards in the meat supply chain (FRASER, 2005; ROCHA et al., 2016; PURWINS and SCHULZE-EHLERS, 2018).

Implementing animal welfare practices results in additional costs for farmers and the whole meat supply chain. Simultaneously, the additional costs increase product prices (ORTEGA and WOLF, 2018; DEBLITZ et al., 2021). Consequently, there must be a demand and willingness to pay (WTP) from consumers for more animal friendly practices (LILJENSTOLPE, 2008; CLARK et al., 2017). A number of studies have analyzed the WTP of consumers for more animal friendly products in Europe and North America (NOCELLA et al., 2010; LAGERKVIST and HESS, 2011; TONSOR, 2011; McKENDREE et al., 2013; HEID and HAMM, 2013; CLARK et al., 2017). They find that consumers are willing to pay a price premium for animal friendly products. There are many studies analyzing the WTP of consumers. However, we are not aware of any study analyzing the willingness to accept (WTA) of farmers to implement animal welfare practices, even though farmers certainly play a key role in improving the welfare of animals in meat production (AUSTIN et al., 2005; BOCK and VAN HUIK, 2007). While normative calculations of the additional costs associated with the implementation of animal welfare practices as conducted by BORNETT et al., 2003; WEISS et al., 2013; ACHILLES and FRITZSCHE, 2013, or SCHUKAT et al., 2020) only focus on forgone income of farmers, the consideration of WTA allows to account for individual preferences of farmers affecting the choice of an animal welfare practice (SCHULZ et al., 2014). To the best of our knowledge there are no studies that investigate the willingness of farmers to implement animal welfare practices. Against this backdrop, the objective of this paper is to analyze farmers' preferences and WTA for implementing specific animal welfare practices.

To achieve this, we conduct a discrete choice experiment (DCE) with German pig farmers who are faced with the choice to participate in hypothetical animal welfare programs. Analyzing the impact of higher animal welfare standards is especially relevant for German pig farmers because of several reasons. First, Germany is the biggest pig producer in the European Union and therefore highly affected by stricter animal welfare

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requirements (MARQUER et al., 2014). Second, they are sensitized to participate in an animal welfare program: indeed at the time our survey took place, farmers had to decide whether to participate in an animal welfare program initiated by the German food sector (i.e. the ITW) (SCHULZE, 2014; HEISE and SCHWARZE, 2019; WELLNER et al., 2019; INITIATIVE TIERWOHL, 2020).

Farmers' preferences and WTA to implement animal welfare practices are estimated by a Mixed Logit Model (MLM). The most important criterion for the choice of the MLM is the aim of the study to investigate the specific preference for certain animal welfare measures and the corresponding influencing factors. In our opinion, the use of interactions in the MLM is suitable for this purpose, as it allows concrete statements to be made about the relationship between an animal welfare measure and the influencing factors. In fact, the MLM has been successfully used in previous studies that estimate the farmers' WTA to participate in voluntary environmental payment schemes (ESPINOSA-GODED et al., 2010; CHRISTENSEN et al., 2011; BROCH et al., 2013; BEHARRY-BORG et al., 2013; KACZAN et al., 2013; GREINER et al., 2014) and the WTA to accept greening as part of the Common Agricultural Policy (SCHULZ et al., 2014).

Evaluating farmers' choices enables us to determine their required monetary trade-offs for the implementation of specific animal welfare attributes and characteristics which influence the implementation of animal welfare practices. Knowledge of these trade-offs and characteristics can support animal welfare program and policy design. Therefore, budgetary costs of such programs can be derived. Lastly, it is important for politicians, food industry and producers to identify the costs of welfare improvements in order to evaluate the impact on the meat supply chain and future profitability.

The remainder of this paper is organized as follows. Section 2 comprises of a literature review and the development of the hypotheses. In Section 3 we describe the survey design. The econometric methodology of discrete choice analysis is presented in Section 4. The results are discussed in Section 5. The paper concludes with a short summary and avenues for future research.

2 Generation of Hypotheses

High animal welfare has a positive effect on productivity and subsequently on farm revenues (MCINERNEY, 2004; BOCK and VAN HUIK, 2007). Thus, it is important for farmers to maintain and enhance the welfare of animals (HUBBARD et al., 2007; KAUPPINEN et al., 2010) by integrating more animal friendly practices in the production system. However, these practices are often associated with farmers' concerns about the economic feasibility (BOCK and VAN HUIK, 2007). Although systems with high welfare standards – such as more space per pig or bedding material – are found to lower the housing costs when compared to conventional systems, these systems are still associated with higher costs for labor and production factors (MCINERNEY, 1991; DEN OUDEN et al., 1997; GOURMELEN et al., 2000; DEBLITZ et al., 2021). More particularly, animal welfare practices requiring investments in new production facilities, like new barns, warehouses for straw or the reconstruction of old buildings result in higher and potentially sunk costs for farmers (HUBBARD et al., 2007; GOCSIK et al., 2015). Therefore, the implementation of additional animal welfare practices is associated with an unclear income effect for farmers. Qualitative analyses indicate that these interrelationships are critical for farmers as they worry about a lack of knowledge of consumers about animal welfare standards. Thus, farmers may be concerned that consumers' lack of knowledge about regulatory standards will not result in an appropriate reward for the implementation of animal welfare measures (NOCELLA et al., 2010) Accordingly, farmers doubt the WTP of consumers for more animal welfare practices (NOCELLA et al., 2010; GRUNERT et al., 2018; BORGES et al., 2019). According to these studies farmers are not convinced that higher costs of animal welfare result in higher product prices and thus fear an increase of their economic risk (BOCK and VAN HUIK, 2007; HUBBARD et al., 2007; KAUPPINEN et al., 2010; SCHUKAT et al., 2019). To prove whether the farmers' concerns about the distrust in the consumers' WTP affect the implementation of specific animal welfare practices, we state the following:

> **Hypothesis 1:** Farmers' WTA for specific animal welfare practices is influenced by their trust in consumers' WTP for incremental costs associated with these measures.

Some farmers are skeptical about the efficiency of various measures that should improve the welfare of animals (BOCK and VAN HUIK, 2007). They criticize that some measures fail to bring a benefit for the well-being of animals (HUBBARD et al., 2007) and worry about the associated quality of animal welfare products (NOCELLA et al., 2010). More precisely, farmers fear negative effects on animal health, hygiene, food safety,

investment costs, production efficiency and increased stress on the animals (BOCK and VAN HUIK, 2007). However, BOCK and VAN HUIK (2007) identified also a group of farmers who have no doubt about the efficiency of animal welfare measures, but who associate it with a reduction in production efficiency. KJÆRNES et al. (2007) found that farmers also evaluate the improvement of housing conditions rnesa benefit of animal welfare practices. Furthermore, they might be beneficial for animal health and thus for their individual performance (KAUPPINEN, 2013). Therefore, we hypothesize the following:

> **Hypothesis 2:** A presumed positive effect of animal welfare practices on the well-being of animals lowers ceteris paribus the required compensation payments of farmers.

In the analysis of farmers' preferences, the existence of disparities in the structure of farms has to be considered. The farm structure is characterized by the farm size and the characteristics of the farm and the household (AHEARN et al., 2005) which have an influence on the cost level and the economic performance of a farm. Following HESS et al., 2014, larger farms tend to save costs, reduce the working time per animal and have lower weights for non-use values regarding the welfare of animals. With a higher number of pigs, the costs and working time requirement for implementing animal welfare practices increases. Against the background that consumers have concerns about large scale pig production (HEISE and THEUVESEN, 2017), the assumption that larger farms are, due to their larger profit incentive, less willing to implement animal welfare practices may cause a conflict with consumer interests. This is relevant not at least because the additional costs for animal welfare measures have to be covered, among other things, by consumers' WTP (CLARK et al., 2017). Especially, if larger farms are less willing to implement animal welfare measures that are demanded by consumers, a gap between the farmers and consumers interests will occur. For example, DENVER et al. (2017) found in their study with 395 Danish consumers the following ranking for those respondents who found that the attributes have a positive effect for the animals: more space for pigs (73%), access to outdoor areas (70%) and supply of straw (68%). Based on GOCSIK et al. (2016) who found a low preference of pig producers for adopting free-range access and GOURMELEN et al. (2000) who estimated higher production costs for bedding material, we assume that larger farms are less willing to implement these measures. This points at a potential disparity between consumers interest and the willingness of larger farms to implement specific animal welfare practices. To analyze if the number of pigs kept on farm has an influence on the farmers acceptance to implement animal welfare measures, we state the following hypothesis:

> **Hypothesis 3:** The more pigs are kept on a farm, the higher, ceteris paribus, are the relative compensation payments required by farmers for the implementation of animal welfare measures.

3 Survey Design

To test our hypotheses, we conduct an online-based survey with German pig farmers was conducted in 2014. The survey comprises of three parts. First, the survey includes questions about the farm characteristics, the housing system and the pig farmer's attitudes towards different parts of animal welfare. The second part of the survey comprises the DCE regarding animal welfare decisions. Third, sociodemographic data are collected.

3.1 Selection of Choice Attributes and Levels

Prior to the main survey, we conducted expert interviews with farmers, farm consultants and animal researchers to select the attributes and levels for the DCE. This resulted in the animal welfare attributes and their levels which are shown in Table 1.

Table 1. Animal welfare attributes and their levels in the DCE

Animal welfare attributes	Levels
More space per pig	+10 %; +20%; +30%; +40%
Roughage	No roughage Roughage
Manipulable material	No manipulable material Manipulable material
Outdoor yard	No outdoor yard Outdoor yard
Lying area	Fully slatted floor Partially slatted floor Soft mat Bedding
Bonus payment per pig	€5; €10; €15; €20

Source: authors own illustration

More space per pig has a positive impact on the activity and rest behavior of pigs and therefore constitutes an important aspect of animal welfare. Moreover, it

enhances social behavior and reduces risks of disease (MEUNIER-SALAUN et al., 1987). Additional space allowance is also associated with decreasing skin lesion scores and less aggressive behavior (WENG et al., 1998).

The supply of *roughage* and *manipulable material* is an important element of an animal-friendly housing system. Hence, pigs are able to satisfy their behavioral needs and show fewer behavioral disorders, e.g. tail or ear biting. These injuries can result in a decrease of the productivity or lead to death in extreme cases (ZWICKER et al., 2013).

In housing systems with an *outdoor yard,* pigs have the possibility to leave the barn. Consumers often perceive that these systems are providing higher animal welfare than systems without a free area (BORNETT et al., 2003). An *outdoor yard* increases the space allowance for the pigs. They also suffer fewer health problems, spend more time in locomotion and show less behavioral disorders (GUY et al., 2002). However, pigs in an *outdoor yard* can be compromised by atmospheric conditions and parasite infections (BORNETT et al., 2003).

The quality of the lying area has an influence on the lying comfort and the welfare of pigs. *Soft mats* significantly reduce the likelihood of lesions and injuries (CARVALHO et al., 2009; TUYTTENS et al., 2011). If adequate *bedding* (like straw) is provided, pigs are significantly more active than in *fully slatted floor* systems. Furthermore, it significantly reduces behavioral disorders and lameness (FRASER et al., 1991; MORGAN et al., 1998; SCOTT et al., 2005). Thus, the attribute *lying area* enables pig farmers to increase the animal welfare by offering a more animal-friendly lying area.

If pig farmers choose an animal welfare package, they get a *bonus payment* in euro per produced pig. Based on normative cost calculations (BORNETT et al., 2003; ACHILLES and FRITZSCHE, 2013; WEISS et al., 2013) and expert opinions the attribute levels for *bonus payments* are set at €5, €10, €15 and €20 per pig.[1]

3.2 Experimental Design and Choice Tasks

The software Ngene 1.1.2. (CHOICE METRICS, 2016) was used to produce the experimental design for this study. As recommended by SANDOR and WEDEL, 2001, and SCARPA et al., 2008, an efficient Bayesian design was generated. This design makes allows to account for preliminary information about the utility parameters of the sample and the associated uncertainty in terms of random distributions for the proceeded utility parameters. These preliminary data was collected in a pilot study with 21 pig farmers using a D-optimal choice design (BLIEMER et al., 2009). The Ngene code for producing the design is available in Appendix A2. As a result, each farmer had to answer 12 choice sets in the final experiment. Considering task complexity, this number of choice situations is feasible for farmers (Lancsar and Louviere, 2008; Bech et al., 2011). One of those choice sets is shown in Table 2. Choice sets in the pilot study, as well as in the final experiment, consist of two generic alternatives[2] and one status quo alternative. The status quo alternative is included because respondents should not be forced to choose an animal welfare package. A forced choice could lead to inaccuracy and inconsistency with demand theory (HANLEY et al., 2001).

Table 2. Sample choice set of animal welfare packages

Animal welfare package	Animal welfare package A	Animal welfare package B	No animal welfare package
More space per pig	+10%	+30%	Unchanged housing conditions and no bonus payments
Roughage	No roughage	Roughage	
Manipulable material	Manipulable material	No manipulable material	
Outdoor yard	No outdoor yard	No outdoor yard	
Lying area	Soft mat	Fully slatted floor	
Bonus payment per pig	€10	€15	
Which alternative do you choose?	O	O	O

Source: authors own illustration

[1] To classify the bonus payments, it should be mentioned that according to MÜLLER (2014), a farmer receives 155.06€ for a fattening pig with 93.41 kg slaughter weight (SG) and a price of 1.66 €/SG. In addition, a manure value of 3.61€ is calculated, resulting in a revenue of 158.68€.

[2] Attributes and levels are the same for all alternatives.

Before starting the experiment, we presented an introduction text consisting of the description of the experimental procedure and a cheap talk script as suggested by CUMMINGS and TAYLOR, 1999, and CARLSSON et al., 2005 (available in Appendix A1), to reduce the hypothetical bias that the choices in hypothetical choice situations differ significantly from real choices.[3]

4 Econometric Analysis of the Choice Model

In order to derive WTA values for the attributes of the DCE and, thus, be able to give recommendations for practical use, an approach that produces realistic WTA estimates had to be found. In this context, models "in preference space" are the current state of the art method for estimating individuals' WTA. A main assumption of these models is that the price coefficient is fixed across farmers. This is necessary because otherwise the WTA 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. Unfortunately, this procedure often results in unrealistic and invalid distributions for WTA (SCARPA et al., 2008; HENSHER and GREENE, 2011). However, models in WTA space are able to overcome this problem since coefficients for WTA are directly estimated by re-formulating the model. In this case, assumptions regarding the distributions of WTA are made directly rather than on the attribute coefficients. It has been shown that this approach produces more realistic WTA estimations than those produced in preference space (TRAIN and WEEKS, 2005) and thus we opt for this approach. A further advantage of the MLM framework is that it allows to treat preference heterogeneity across farmers. As we aim for realistic estimations of farmers' preferences for participation in a pasture grazing program we allow for correlations of the random attributes (BALCOMBE et al., 2009; BALCOMBE et al., 2010; BALOGH et al., 2016).

Following Random Utility Theory (LUCE, 1959; MCFADDEN, 1974), the estimation of farmers' valuation of pasture grazing attributes assumes that farmers' choices depend on the specific requirements of the pasture grazing program. Under the assumption of utility maximization, a farmer chooses the alternative generating the highest utility. A farmer will only participate in a pasture grazing program if the perceived utility is higher than the utility of status quo production.

In discrete choice models, the utility of alternative j perceived by respondent n in the choice situation is denoted by U_{ntj}. Moreover, U_{ntj} is divided into a deterministic component V_{ntj} and an unobserved component ε_{ntj} so that

$$U_{ntj} = V_{ntj} + \varepsilon_{ntj} \tag{1}$$

Focusing on the estimation of the willingness to accept (WTA), the deterministic component can be described by the price component p_{ntj} and non-price attributes x_{ntj}, which are weighted by the respondent-specific, random parameters α_n and β_n:

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

ε_{ntj} was assumed to follow a type I extreme value distribution with variance $\mu_n^2(\pi^2/6)$, which can be adjusted to each individual by the specific scale parameter μ_n (TRAIN and WEEKS, 2005). Dividing Equation (2) by μ_n results in an independently and identically extreme value distributed error term with a variance $(\pi^2/6)$:

$$U_{ntj} = -\omega_n p_{ntj} + \varphi_n' x_{ntj} + \varepsilon_{ntj} \tag{3}$$

with $-\omega_n = -\alpha_n / \mu_n$ and $-\varphi_n = -\beta_n / \mu_n$. Equation (3) represents the model in preference space (TRAIN and WEEKS, 2005). As we are interested in estimating models in WTA space, it is necessary to convert the model in preference space into WTA space. As the WTA for the non-monetary attributes is defined as $\gamma_n = \varphi_n / \omega_n$ Equation (3) can be converted as follows:

$$U_{ntj} = -\omega_n (p_{ntj} + \gamma_n' x_{ntj}) + \varepsilon_{ntj} \tag{4}$$

TRAIN AND WEEKS (2005) describe this specification as a model in WTA space where the calculation of the WTA for the non-price attributes is directly integrated in the estimation process.

[3] For a detailed discussion of cheap talk scripts see CUMMINGS and TAYLOR (1999) and CARLSSON et al. (2005).

Table 3. Summary statistics of pig farmers

Variable	Mean	SD
Average age in years	32	13
Gender (%)		
Female	7	
Male	93	
High school education (%)	35	
Full time farmer (%)	93	
Arable land in hectare	177	194
Average number of pigs	1,760	1,487
More space increases animal welfare b)	0.39	0.78
Outdoor yard increases animal welfare b)	-0.04	1.28
Bedding increases animal welfare b)	0.22	1.30
Soft mat increases animal welfare b)	0.14	1.24
Partly slatted floor increases animal welfare b)	0.31	1.19
Roughage increases animal welfare b)	0.45	1.09
Manipulable material increases animal welfare b)	0.70	1.04
Trust in the WTP of consumers b)	0.36	1.08

a) N = 109
b) Mean value measured on a Likert scale: -2 = "I completely disagree."; 2 = "I completely agree."; standard deviation in brackets.
Source: authors own illustration

5 Results and Discussion

5.1 Descriptive Statistics

Table 3 presents the descriptive statistics of our sample of 109 pig farmers, who are asked to participate in an online based computer survey. Each pig farmer completed 12 choice situations, leading to a total of 1,308 observations for the subsequent analysis.

The average pig farmer in this study is 32 years old and therefore younger than the average farmer in Germany who was 53 in 2013 (AGRIDIRECT, 2013; GERMAN FEDERAL STATISTICAL OFFICE, 2013). The average farm size in the sample is 177 hectares of agricultural area and 1,760 pigs per farm, which exceeds the German average of 55.8 hectares agricultural land (GERMAN FEDERAL STATISTICAL OFFICE, 2015a) and 544 pigs per farm (GERMAN FEDERAL STATISTICAL OFFICE, 2015b).

Farmers were asked to evaluate specific animal welfare practices regarding their improvement for the welfare of animals. On the viewpoint of farmers, manipulable material has the highest benefit for the well-being of animals, followed by roughage, more space per pig and partly slatted floors. Further positive but less higher values are associated with bedding and soft mats. Outdoor yard is associated with a slight negative effect on the well-being of animals. Furthermore, the average farmer has a light tendency to trust that the WTP of consumers will cover the costs of implementing animal welfare practices.

5.2 Impact of Farmers Preferences on the Choice of Animal Welfare Practices

To test our hypotheses, we estimated a MLM in WTA space. The estimation results are shown in Table 4. The resulting coefficients can be interpreted as the monetary mark-up of farmers for implementing the required animal welfare attributes. We estimated one model without interaction terms (Model 1) and a second model including interaction terms with farm individual characteristics (Model 2).

The attributes *more space per pig, outdoor yard*, *bedding, soft mat, partly slatted floor* and *ASC* enter the model as random parameters.[4] The coefficients for *roughage* and *manipulable material* are fixed. The coefficient for *bonus payment* is normalized to -1 (cf HENSHER and GREENER, 2011). In both models, the parameters for the attributes *more space per pig*, *outdoor yard*, *partly slatted floor*, *bedding* and *soft mat* have significant negative effects on choices. The attributes *manipulable material* and *roughage* have not a statistically significant influence on the farmers' decision to choose an animal welfare package or not. Furthermore, the *bonus payment* coefficient is significantly positive indicating a positive effect on choosing an alternative. Therefore, the average farmer evaluates

[4] A parameter is treated as random if its derived standard deviation is statistically different from zero. It suggests, therefore, heterogeneity around the mean of the estimated parameters (HENSHER et al., 2005).

Table 4. Results of the mixed logit model in WTA space[a)]

Variable	Mean (SD)	
	Model 1 (no interaction)	**Model 2 (with interactions)**
Animal welfare attributes		
ASC	2.458 (13.051***)	3.560 (13.396***)
More space per pig (plus 1%)	-0.360*** (0.242***)	-0.399*** (0.204**)
Outdoor yard	-17.950*** (10.459***)	-18.763*** (9.932***)
Bedding	-15.303*** (4.330***)	-16.110*** (6.959***)
Soft mat	-8.305*** (3.458***)	-7.381*** (2.774***)
Partly slatted floor	-5.233*** (2.924***)	-4.777*** (4.806**)
Roughage	0.901	0.911
Manipulable material	-0.555	-0.458
Bonus payment per pig	0.325*** (0.329**)	0.229*** (0.137*)
Interaction terms		
Trust in consumers' WTP [d)] × bedding		4.347***
Trust in consumers' WTP [d)] × soft mat		3.436**
Trust in consumers' WTP [d] × partly slatted floor		2.969***
Welfare improvement [e)] × more space per pig (plus 1%)		0.105**
Welfare improvement [e)] × outdoor yard		2.764**
Number of pigs (per 100 pigs) × outdoor yard		-0.216**
Number of pigs (per 100 pigs) × bedding		-0.226**

a) ***p < 0.01; **p < 0.05.; *p < 0.10. The model was estimated with Stata 15, using Halton draws with 500 replications. Number of respondents: 109; number of scenarios per respondent: 12; number of total observations: 1,308; AIC = 1,697.77 (Model 1) / 1,688.45 (Model 2)
b) Dummy variable; reference: no outdoor yard
c) Dummy-variable; reference: fully slatted floor.
d) The costs of animal welfare will be covered by the WTP of consumers; Likert scale: -2 = "I completely disagree."; 2 = "I completely agree."
e) More space per pig/Outdoor yard improves the welfare of pigs; Likert scale: -2 = "I completely disagree."; 2 = "I completely agree."
Source: authors own illustration

bonus payments in general as suitable tool to compensate the costs of implementing animal welfare practices.

Significant standard deviations of the random parameters indicate heterogeneity in how farmers value the attributes. To explain the heterogeneity and to prove our generated hypothesis, we include interaction terms in the model estimation process (Model 2). As suggested by HENSHER et al. (2015) insignificant interaction terms were excluded from the estimation process as they would have had an effect on all other parameter estimates of the model.

The coefficients for the interaction terms trust in consumers' WTP × bedding, trust in consumers' WTP × soft mat and trust in consumers' WTP × partly slatted floor as well as the coefficients for the interaction terms welfare improvement × more space per pig and welfare improvement × outdoor yard have a positive sign. Significant negative interactions are estimated for the attributes outdoor yard and bedding with the number of pigs.

In the following, the results of the MLM in WTA space will be presented and discussed. First, based on Model 1, the WTA of the average farmer for the animal welfare attributes is presented and classified based on the literature about additional costs for these measures. Second, the hypotheses derived in Section 2 will be evaluated.

5.3 WTA for Animal Welfare Attributes

The variable *ASC*, which takes on a value of 1 if an animal welfare package is chosen and 0 if a farmer chooses the opt-out alternative, gives information about the general preference of a farmer for implementing an animal welfare package. Furthermore, the coefficient captures unobserved effects that are important for farmers` decisions to choose an animal welfare package. For example, other animal welfare attributes or the origin of bonus payments. Without regarding an *ASC* in the analysis, the unobserved effects may be confounded with the WTA estimates for the animal welfare attributes analyzed in the DCE. The *ASC* in Table 4 is positive but not statistically significant meaning that there is no statistical evidence that farmers rather choose an animal welfare package than the opt out. However, the standard deviation has a value of 13 and is statistically significant. Following this, farmers in the sample have a very heterogenous preference to choose an animal welfare package or not.[5]

In the following, we will first present the WTA estimates for the single animal welfare measures and relate them to the additional costs of these measures available in the literature. Second, we will discuss potential reasons for differences between the estimated WTA and the real calculated costs. As shown by Model 1, farmers demand a bonus payment of €0.36 per percent *more space per pig*. A meta-analysis about costs of specific animal welfare measures by SCHUKAT et al. (2020) quantifies the additional costs for a one percent increase in the space for pigs between €0.22 and €0.28. Apparently, the WTA of farmers exceeds the real costs. For implementing an *outdoor yard*, farmers demand a bonus payment of €17.95. FRITSCHE et al. (2007) calculated the cost for an *outdoor yard* to be €13. This large gap shows that the average farmer in this sample is less willing to implement *outdoor yards*. For the supply of *bedding material*, farmers demand a mark-up of €15.30 per pig. Following WEIß (2013) the additional cost for *bedding* are €13 and therefore lower than the estimated WTA. The same holds for the WTA for soft mats which is €8.31 compared to the calculated costs of €4 (WEIß, 2013). For accepting a *partly slatted floor* instead a *fully slatted floor*, farmers demand a bonus payment of €5.23. For *manipulable material* and *roughage* farmers have no statistically significant WTA which means that no clear conclusions can be drawn about the preferences of the population for these attributes. However, these measures are comparatively easy to implement and may therefore be especially suitable to effectively increasing the welfare of animals (LATACZ-LOHMANN and SCHREINER, 2019). Furthermore, as shown in Table 3, these measures are rated to be most valuable for animal welfare which might be a further reason that farmers implement these measures without having a significant WTA.

One reason why the WTA in this study exceeds the real additional costs of the animal welfare measures might be the so called WTP/WTA bias which is described in a meta-analysis by SCHMIDT and BIJMOLT (2020). For example, uncertainty about a product might increase the hypothetical bias. A potential bias may be caused by the fact that farmers had little to no experience with participation in animal welfare programs at the time of the survey. For example, uncertainties about the duration of an animal welfare program and thus the total amount of possible bonus payments may influence decision-making behavior. This uncertainty could, for example, lead farmers to consciously or unconsciously express a high WTA for implementing animal welfare measures in order to influence the amount of bonus payments. A hypothetical measure of WTA does not impose any consequences for farmers'decisions, because they are not forced to really implement the chosen animal welfare measures. Related to this, the chance to reveal a preference for an animal welfare program per se could lead to a higher WTA. In this context, a potential social desirability may motivate farmers to choose an animal welfare package as they desire to present themselves in a favorable light (SMITH et al., 2017). Furthermore, a potential hypothetical bias may arise for high investments (SCHMIDT and BIJMOLT, 2020). Our study this pertains to cost intensive animal welfare measures as *outdoor yard* or *bedding*. By stating a high WTA for this measures farmers may express concerns about the economics of high investments, which increases the hypothetical bias. A further reason why the estimated WTA is higher than the calculated costs might be that the WTA includes a mark-up for the additional effort associated with the animal welfare practices. SCHUKAT et al. (2019) found that the effort to implement animal welfare practices is critically

[5] For MLM models, a high standard deviation is also an indication that a latent class model might have been appropriate to possibly also explain the identified heterogeneity.

assessed by many farmers. For example, they stressed by documentation and bureaucracy (KJÆRNES et al., 2007). Also, implementation efforts may a reason why farmers' WTA exceeds the real additional costs of animal welfare practices, for example, a modification of housing facilities such as replacing the housing floor or to get access to straw to fulfill the bedding requirements. A further argument for a hypothetical bias is that respondents answer strategically to gain advantages for themselves (MEGINNIS et al., 2021). In this study the motivation might be to achieve higher bonus payments. To identify potential biases, the results of this study should be validated by analyzing the farmers WTA by regarding real participation behavior in animal welfare programs.

6 Discussion

In what follows the results of Model 2 are presented and discussed. Based on that, the hypotheses derived in section 2 are evaluated.

Hypothesis 1, which states that the farmers' WTA for specific animal welfare practices is influenced by their trust in consumers' WTP for incremental costs associated with these measures can be confirmed for the attributes *bedding*, *soft mat and partly slatted floor*.

The farmers' trust in the consumers' WTP exert an important influence on the WTA for *bedding*. The WTA estimate for the statement "The costs for the implementation of animal welfare practices will be covered by the WTP of consumers", measured on a Likert scale that ranges from "I completely disagree (-2)" to "I completely agree (+2)", is €4.35. This means that, ceteris paribus, an increase in the strength of agreement by one point lowers the WTA for *bedding* by €4.35. The same relationship exists for the attributes *soft mat* and *partly slatted floor* where the average WTA decreases by €3.44 respectively €2.97 if the strength of agreement increases by one point. Consequently, the probability that a farmer implements *bedding*, *soft mats* and *partly slatted floors* increases if they trust in the WTP of consumers. Therefore, the results of previous studies (BOCK and VAN HUIK, 2007; HUBBARD et al., 2007; KAUPPINEN et al., 2010), which indicate that farmers have a general distrust against the consumers' WTP, cannot be confirmed by our findings. We cannot identify a significant influence of the farmers' trust in the consumers' WTP on the choice of other analyzed animal welfare practices. This may be due to two main reasons: first, farmers do not believe that consumers have a WTP for these measures, potentially because it has been found that consumers evaluate measures as *more space per pig* or *outdoor yards* as minimum requirements for the welfare of animals without having a sufficient WTP (ZANDER et al., 2013). DENVER et al. (2017) found that consumers are willing to pay 0.10-0.16 € for a one percent increase in the space for pigs. This is below the WTA measured in this study and also lower than the additional costs for a one percent increase that is between 0.22 and 0.28€ per percent (SCHUKAT et al., 2020). Second, farmers may doubt that the additional costs of these measures may be covered by the WTP of consumers. LATACZ-LOHMANN and SCHREINER (2018) compared the WTP of consumers with the WTA of farmers and found statistically significant WTP estimates *for more space per pig*, *bedding* and *manipulable material*. However, this WTP is lower than their estimated WTA of farmers for *more space per pig* and *bedding*. In contrast, LAGERKVIST et al. (2006) found in their study with Swedish consumers a WTP that is 46% higher than the reference price for pigs with bedding material in the barn. Thus ist appears necessary to consider the WTP of consumers in the discussion of paying bonus payments to farmers and evaluating farmers trust in consumers WTP. This holds particularly for a high increase in the *space per pig*, *outdoor yards and bedding* which result in lower revenues or in high investment and labor costs for farmers (BORNETT et al., 2003; ACHILLES and FRITZSCHE, 2013). Hence, our results underline the necessity to identify the WTP of consumers for specific animal welfare practices. Knowledge of specific WTP values helps to improve the efficiency of animal welfare design as it enables to include only those measures which first, meet the consumers' expectations of animal welfare and second, increase the trust of farmers in the WTP and therefore the probability that farmers will implement more animal welfare practices.[6]

Hypothesis 2, stating that a presumed positive effect of animal welfare practices on the well-being of animals lowers ceteris paribus the required compensation payments of farmers can be accepted for *more*

[6] As discussed for the WTA, also the WTP of consumers might be influenced by hypothetical biases. Therefore, also the results of WTP studies have to be interpreted with having differences between revealed and stated preferences in mind.

space per pig and *outdoor yard*. The WTA estimates for the statements "*More space per pig*/*Outdoor yard improves the welfare of pigs*" measured on a -2 to 2 Likert scale ranging from "I completely disagree (-2)" to "I completely agree (+2)", are €0.10 for the attribute *more space per pig* and €2.76 for *outdoor yard*. That means, that the WTA for one percent *more space per pig* decreases, ceteris paribus, by €0.10 if the strength of agreement for the improvement in the welfare of animals increases by one point. That means, farmers with a positive evaluation of *more space per pig* are more likely to implement this practice than farmers who do not believe in a welfare improvement. Similarly, the WTA for implementing an *outdoor yard* decreases by €2.76 if the strength of agreement increases by one point. This reveals that the implementation of an *outdoor yard* is highly dependent on whether the farmer evaluates the practice as improvement for the welfare of animals or not. Also, consumers evaluate these measures as important for animal welfare. In this context it might be promising to analyze the welfare effect of these measures in more detail as consumers demand their implementation and farmers who are convinced of a positive animal welfare effect are more willing to implement these measures.

Interestingly, our results reveal that the farmers' willingness to implement *more space per pig* and *outdoor yard* are not influenced by their trust in the consumers' WTP but by their trust in a beneficial animal welfare effect of these measures. As the well-being of animals seems to be the crucial factor for the implementation of these measures, rather than monetary aspects, our results show that the intrinsic motivation of farmers affects the implementation of these animal welfare practices. For policy and animal welfare program design our results indicate the necessity to analyze and emphasize the animal related benefit of animal welfare practices. Scientifically proved efficiencies of animal welfare practices might increase the acceptance and willingness of farmers to implement animal welfare practices.

Hypothesis 3, which supposes that the more pigs are kept on a farm, the higher are the relative compensation payments required by farmers for the implementation of animal welfare measures, can be accepted for the attributes *outdoor yard* and *bedding*. The WTA for *outdoor yard* increases, ceteris paribus, by €0.20 if the number of pigs increases by 100. The increase in the WTA of *bedding* is €0.23 per 100 pigs.

An increasing number of pigs has a negative influence on the pig producers' willingness to adopt an *outdoor yard* and *bedding material*. Conversely, the preferences for the remaining AWS were unaffected by the number of pigs. An *outdoor yard* had the highest negative coefficient and was therefore the most important attribute for the pig producers' decision to participate in an animal welfare program (Model 1). This result is in line with a study by GOCSIK et al. (2015), who also found a low preference of pig producers for adopting free-range access. Following VANHONACKER et al. (2008), producers evaluated an *outdoor yard* as less important for the welfare of animals, although research has shown that *outdoor yards* extend the space allowance, reduce health problems, allow more time to be spent in motion, and reduce behavioral disorders (GUY et al., 2002). Even though the health of pigs in an outdoor yard may be compromised by atmospheric conditions and parasite infections, BORNETT et al. (2003) drew the conclusion that *outdoor yards* improve the welfare of animals. This raises the question of why large pig farms, in particular, reject *outdoor yards*. According to HESS et al. (2014), larger farms tend to save costs, reduce the working time per animal, and give lower weight to the importance of non-use values regarding the welfare of animals. BOCK and VAN HUIK (2007) state that investments in cost-intensive AWS are often associated with producers' concerns about the economic feasibility. More specifically, such investments potentially result in sunk costs and are associated with an unclear income effect, resulting in rejection by producers (HUBBARD et al., 2007). Our finding that increasing herd sizes reduced the producers' willingness to adopt an *outdoor yard* could therefore stem from the increasing investment and labor costs for realizing an *outdoor yard* with increasing herd size (BORNETT et al., 2003) and the fact that producers do not believe their expenses will amortize over time.

GOURMELEN et al. (2000) found that high welfare systems with *bedding material* have lower housing costs than conventional systems. However, they state that these benefits are outweighed by higher labor and straw costs, resulting in higher production costs. In this context, the availability of labor and straw as *bedding material* may become critical, especially on large farms, which explains the negative interaction between herd size and the attribute *bedding material*. In geographic areas with less arable crops, the provision of straw in substantial quantities may be cost intensive due to purchase prices and transport costs. This also applies to the availability of straw on the farm level for farms with less arable crops. Even if farms have enough arable land to provide bedding material, they

are confronted with opportunity costs resulting from the loss of positive effects gained by leaving straw on the arable land. More over, the need for storage capacities for *bedding material* is higher on large farms.

The willingness to implement animal welfare practices as *more space per pig* is unaffected by the number of pigs kept on farm. This measure can be easily implemented by reducing the number of pigs kept in a barn and requires neither investments in new buildings nor material costs. However, implementing this measure also reduces farm revenues and needs a compensation via bonus payments which become obvious in Model 1. The evaluation of other measures, like *soft mats* and *roughage*, is unaffected by the herd size, i.e., these measures may be implemented regardless of the herd size.

Our results reveal that policy and animal welfare program design have to consider differences in the structure of farms. To achieve this, farmers should have the possibility to choose farm individual animal welfare measures which improve the welfare of animals on farm without increasing the costs or working time significantly.

7 Conclusion

Farmers' willingness to implement animal welfare practices directly influences the welfare of animals. Therefore, the objective of this paper was to investigate the preferences and WTA of German pig farmers for implementing animal welfare practices by conducting a discrete choice experiment with German pig farmers. Analyzing farmers' willingness to implement specific animal welfare practices results in negative utility for the investigated practices. However, bonus payments as compensation for the implementation of animal welfare practices are connected with a positive utility. Therefore, bonus payments are in general a suitable tool to compensate the costs of implementing animal welfare practices.

We find evidence that farmers' choices are driven by their trust in the consumers' WTP, their evaluation of the efficiency of specific animal welfare practices and farm characteristics. For improving the effectiveness of animal welfare politics and program design policy makers as well as scientific research have to consider the WTP of consumers for specific animal welfare practices instead of the WTP for animal welfare products in general. Identifying the WTP of consumers for specific animal welfare practices may increase the farmers' acceptance of these measures.

The preferences of farmers for *outdoor yards* and *more space per pig* are influenced by their evaluation of the welfare improvement of these practices. To clarify whether an animal welfare practice improves the well-being of animals, more scientific research is needed. Including animal welfare practices in an animal welfare program with a scientifically proved benefit for the welfare of animals will increase the implementation rates of these practices. Policy is, therefore, advised to support studies about the animal welfare benefit of specific measures. Furthermore, the number of pigs has an influence on the preferences of farmers for *outdoor yards* and *bedding*. In fact, a large number of pigs results in more negative preferences for these practices due to the increasing marginal investment and labor costs associated. However, for some measures where the preferences of farmers are unaffected by the herd size and hence, also large farms have the opportunity to increase animal welfare by participating in animal welfare programs. Accordingly, animal welfare programs should regard different farm characteristics to efficiently design programs where each farm has a chance to participate.

Our results support the cost estimation of welfare improvements on farm level. The results are useful to evaluate the impact on the meat supply chain and future profitability. Animal welfare program design is advised to focus on measures that are less cost intensive and valued by farmers as improvement to the welfare of animals. This is advantageous to improve the welfare of animals without influencing the competitiveness of pig production. Furthermore, we suggest to offer farmers a list of animal welfare practices with the possibility to select farm individual measures. This approach accounts best for farmers' individual preferences and farm characteristics and might be therefore the most efficient way to improve the welfare of animals.

Our study focusses on the evaluation of specific animal welfare practices. Future studies should analyze farmers' attitudes towards the contractual arrangements of animal welfare programs. The duration of program participation, control procedures and the flexibility of choice for animal welfare features in such programs are relevant attributes to analyze.

A limitation of this study is the small sample size. Small sample sizes may affect the power of statistical tests and, in turn, the reliability of the results. Therefore, the results of this study should be seen as explorative. However, because of the DCE setting, we were able to analyze 3,924 observations which is a sufficient number to provide insights into the willingness of

farmers to implement animal welfare practices. Nevertheless, future research is advised to validate our results with a larger sample size. More over, our sample is not representative for pig producers in Germany meaning that the results of this study have to be evaluated tentatively. The sample was based on a survey with voluntary participation. The characteristics of the survey method as a survey at an agricultural fair also led to limited accessibility. A further limitation occurred in the discussion of the potential hypothetical bias. To analyze this, the results of this study should be validated with real data about the implementation of animal welfare practices for example from participants of the ITW. Furthermore, the analysis is focused on German pig producers. To consider whether country-specific effects occur, the DCE should be conducted in other countries.

References

ACHILLES, W. and S. FRITZSCHE (2013): Cost and benefits of a welfare label in pig feeding. In: Landtechnik 68 (4): 235-241.

AGRIDIRECT DENUTSCHLAND GMBH (2013): Jahresübersicht: Pressemitteilung 2013. https://issuu.com/agridirect/docs/pressemitteilungen_2013, accessed February 1, 2021.

AHEARN, M.C., J. YEE and P. KORB (2005): Effects of differing farm policies on farm structure and dynamics. In: American Journal of Agricultural Economics 87 (5): 1182-1189.

AUSTIN, E.J., I.J. DEARY, G. EDWARDS-JONES and D. AREY (2005): Attitudes to farm animal welfare: factor structure and personality correlates in farmers and agriculture students. In: Journal of Individual Differences 26 (3): 107-120.

BALCOMBE, K., A. CHALAK and I. FRASER (2009): Model selection for the mixed logit with Bayesian estimation. In: Journal of Environmental Economics and Management 57 (2): 226-237.

BALCOMBE, K., I. FRASER and S. DI FALCO (2010): Traffic lights and food choice: A choice experiment examining the relationship between nutritional food labels and price. In: Food Policy (35): 211-220.

Balogh, P., D. Békési, M. Gorton, J. Popp and P. Lengyel (2016): Consumer willingness to pay for traditional food products. In: Food Policy 61: 176-184.

Bech, M., T. Kjaer and J. Lauridsen (2011): Does the number of choice sets matter? Results from a web survey applying a discrete choice experiment. In: Health Economics 20 (3): 273-286.

BEHARRY-BORG, N., J.C. SMART, M. TERMANSEN and K. HUBACEK (2013): Evaluating farmers' likely participation in a payment programme for water quality protection in the UK uplands. In: Regional Environmental Change 13 (3): 633-647.

BLIEMER, M.C.J., J.M. ROSE and D.A. HENSHER (2009): Constructing efficient stated choice experiments allowing for differences in error variances across subsets of alternatives. In: Transportation Research B 43: 19-35.

BOCK, B.B. and M.M. VAN HUIK (2007): Animal welfare: the attitudes and behaviour of European pig farmers. In: British Food Journal 109 (11): 931-944.

BORGES, J.A.R., C.H.F. DOMINGUES, F.R. CALDARA, N.P.D. ROSA, I. SENGER and D.G.F. GUIDOLIN (2019): Identifying the Factors Impacting on Farmers' Intention to Adopt Animal Friendly Practices. In: Preventive veterinary medicine 170.

BORNETT, H.L.I., J.H. GUY and P.J. CAIN (2003): Impact of animal welfare on costs and viability of pig production in the UK. In: Journal of Agricultural and Environmental Ethics 16 (2): 163-186.

BROCH, S.W., N. STRANGE, J.B. BREDAHL JACOBSEN and K.A. WILSON (2013): Farmers' willingness to provide ecosystem services and effects of their spatial distribution. In: Ecological Economics 92: 78-86.

CARLSSON, F., P. FRYKBLOM and C.J. LAGERKVIST (2005): Using cheap talk as a test of validity in choice experiments. In: Economics Letters 89 (2): 147-152.

CARVALHO, V C. de, I. de ALENCAR NÄÄS, M.M. NETO and S.R.L.DE SOUZA (2009): Measurement of pig claw pressure distribution. In: Biosystems Engineering 103 (3): 357-363.

CHOICE METRICS (2016): NGENE download. http://www.choice-metrics.com/download.html, call: 08 January 2016.

CHRISTENSEN, T., A. PEDERSEN, H. . NIELSEN, M. . MØRKBAK and B. HASLER (2011): Determinants of farmers' willingness to participate in subsidy schemes for pesticide-free buffer zones. A choice experiment study. In: Ecological Economics 70 (8): 1558-1564.

CLARK, B., G.B. STEWART, L.A. PANZONE, I. KYRIAZAKIS and L.J. FREWER (2017): Citizens, consumers and farm animal welfare: A meta-analysis of willingness-to-pay studies. In: Food Policy 68: 112-127.

CORNISH, A., D. RAUBENHEIMER and P. MCGREEVY (2016): What We Know about the Public's Level of Concern for Farm Animal Welfare in Food Production in Developed Countries. In: Animals 6 (11): 74.

CUMMINGS, R.G. and L.O. TAYLOR (1999): Unbiased value estimates for environmental goods. A cheap talk design for the contingent valuation method. In: The American Economic Review 89 (3): 649-665.

DEBLITZ, C., J. EFKEN, M. BANSE, F. ISERMEYER, C. ROHLMANN, H. TERGAST and M. VERHAAGH (2021). Politikfolgenabschätzung zu den Empfehlungen des Kompetenznetzwerks Nutztierhaltung (173). Thünen Working Paper. Thünen Institut Braunschweig.

DEN OUDEN, M., J.T. NIJSING, A.A. DIJKHUIZEN and R.B.M. HUIRNE (1997): Economic optimization of pork production-marketing chains: I. Model input on animal welfare and costs. In: Livestock Production Science 48 (1): 23-37.

DENVER, S., P. SANDØE and T. CHRISTENSEN (2017): Consumer preferences for pig welfare–Can the market accommodate more than one level of welfare pork? Meat science 129: 140-146.

ESPINOSA-GODED, M., J. BARREIRO-HURLÉ and E. RUTO (2010): What do farmers want from agri-environmental scheme design? A choice experiment approach. In: Journal of Agricultural Economics 61 (2): 259-273.

FRASER, D. (2005): Animal welfare and the intensification of animal production: An alternative interpretation. In: FAO Readings in Ethics 2, Rome, Italy.

FRASER, D., P.A. PHILLIPS and T. TENNESSEN (1991): Effect of Straw on the Behaviour of Growing Pigs. In: Applied Animal Behaviour Science 30 (3): 307-318.

FRITZSCHE, ST., B. HÖRNING, G. TREI, M. RIEGEL and M. SCHICK (2007): Ausläufe in der Schweinehaltung. Planungsempfehlungen, Bewirtschaftung und Kosten. KTBL-Heft 68, KTBL, Darmstadt.

GERMAN FEDERAL STATISTICAL OFFICE (2015a): Agricultural holdings. https://www.destatis.de/EN/FactsFigures/EconomicSectors/AgricultureForestryFisheries/AgricultAgricultural/Tables/AgriculturalHoldingsandUtilisedAgriculturalAreabySizeoftheUtiliseAgriculturalHoldi.html, call: 03 September 2015.

GERMAN FEDERAL STATISTICAL OFFICE (2015b): Animal production. https://www.destatis.de/EN/FactsFigures/EconomicSectors/AgricultureForestryFisheries/AnimalsAnimalProduction/Tables/3HoldingsWithPigsAndStockOfPigs.html, call: 03 September 2015.

GERMAN FEDERAL STATISTICAL OFFICE (2013): Land- und Forstwirtschaft, Fischerei. Arbeitskräfte Agrarstrukturerhebung. Berlin.

GOCSIK, É., A.O. LANSINK, G. VOERMANS and H.W. SAATKAMP (2015): Economic feasibility of animal welfare improvements in Dutch intensive livestock production: A comparison between broiler, laying hen, and fattening pig farm. In: Lifestock Science 182: 38-53.

GOURMELEN, C., Y. SALAUN and P. ROUSSEAU (2000): Economic incidence of possible future regulations regarding the welfare of intensively kept pigs on pig meat cost in france. Paper prepared for the 51st Annual Meeting of the European Association for Animal Production, The Hague.

GREINER, R., M. BLIEMER and J. BALLWEG (2014): Design considerations of a choice experiment to estimate likely participation by north Australian pastoralists in contractual biodiversity conservation. In: Journal of Choice Modelling 10: 34-45.

GRUNERT, K.G., W.I. SONNTAG, V. GLANZ-CHANOS and S. FORUM (2018): Consumer Interest in Environmental Impact, Safety, Health and Animal Welfare Aspects of Modern Pig Production: Results of a Cross-National Choice Experiment. In: Meat Science 137.

GUY, J.H., P. ROWLINSON, J.P. CHADWICK and M. ELLIS (2002): Behaviour of two genotypes of growing-finishing pig in three different housing systems. In: Applied Animal Behaviour Science 75 (3): 193-206.

HANLEY, N., S. MOURATO and R.E. WRIGHT (2001): Choice modelling approaches. A superior alternative for environmental valuation? In: Journal of Economic Surveys 15 (3): 435-462.

HEID, A. and U. HAMM (2013): Animal welfare versus food quality: factors influencing organic consumers' preferences for alternatives to piglet castration without anaesthesia. In: Meat Science 95 (2): 203-211.

HEISE, H. and L. THEUVSEN (2017): What do consumers think about farm animal welfare in modern agriculture? Attitudes and shopping behaviour. In: International Food and Agribusiness Management Review 20 (3): 379-399.

HEISE, H. and S. SCHWARZE (2019): Lohnt sich die Teilnahme an der Initiative Tierwohl? Ergebnisse einer Befragung unter Schweinehaltern.

HENSHER, D.A. and W.H. GREENE (2011): Valuation of travel time savings in WTP and preference space in the presence of taste and scale heterogeneity. In: Journal of Transport Economics and Policy 45 (3): 505-525.

HENSHER, D.A., J.M. ROSE and W.H. GREENE (2015): Applied choice analysis. A primer. Cambridge University Press, Cambridge.

HESS, S., L.A. BOLOS, R. HOFFMANN and Y. SURRY (2014): Is animal welfare better on small farms? Evidence from veterinary inspections on Swedish farms. In: 2014 International Congress, August 26-29, 2014, Ljubljana, Slovenia: 1-13.

HUBBARD, C., M. BOURLAKIS and G. GARROD (2007): Pig in the middle: farmers and the delivery of farm animal welfare standards. In: British Food Journal 109 (11): 919-930.

INITIATIVE TIERWOHL (2020): Initative Tierwohl: Über uns. https://initiative-tierwohl.de/initiative/ueber-uns/, accessed February 1, 2021.

KACZAN, D., B.M. SWALLOW and W.L.V. ADAMOWICZ (2013): Designing a payments for ecosystem services (PES) program to reduce deforestation in Tanzania. An assessment of payment approaches. In: Ecological economics: the transdisciplinary journal of the International Society for Ecological Economics 95 (2013): 20-30.

KARPENSTEIN, U., F. FELLENBERG, A. SCHINK, C. JOHANN, K. DINGEMANN, M. KOTTMANN, J. AUGUSTIN and B. GAUSING (2021): Machbarkeitsstudie zur rechtlichen und förderpolitischen Begleitung einer langfristigen Transformation der deutschen Nutztierhaltung. Berlin/Bonn/Kraainem/Herne.

KAUPPINEN, T., A. VAINIO, A. VALROS, H. RITA and K.M. VESELA (2010): Improving animal welfare: qualitative and quantitative methodology in the study of farmers' attitudes. In: Animal Welfare 19 (4): 523-536.

KAUPPINEN, T. (2013): Farm Animal Welfare and Production in Relation to Farmer Attitudes. Ph.D.Thesis, University of Helsinki, Helsinki, Finland, 29 November 2013.

KJÆRNES, U., M. MIELE and J. ROEX (2007): Attitudes of Consumers, Retailers and Producers to Farm Animal Welfare. 2nd edition of Welfare Quality Reports, UWP, Wales, UK: 1-183.

LAGERKVIST, C.J. and S. HESS (2011): A meta-analysis of consumer willingness to pay for farm animal welfare. In: European Review of Agricultural Economics 38 (1): 55-78.

LAGERKVIST, C.J., F. CARLSSON and D. VISKE (2006): Swedish consumer preferences for animal welfare and biotech: A choice experiment. In: AgBio Forum 9 (2006): 51-58.

LANCSAR, E. and J. LOUVIERE (2008): Conducting discrete choice experiments to inform healthcare decision making. In: Pharmacoeconomics 26 (8): 661-677.

Latacz-Lohmann, U. and J.A. Schreiner (2019): Assessing consumer and producer preferences for animal welfare using a common elicitation format. In: Journal of Agricultural Economics 70 (2): 293-315.

LILJENSTOLPE, C. (2008): Evaluating animal welfare with choice experiments. An application to Swedish pig production. In: Agribusiness 24 (1): 67-84.

LUCE, R.D. (1959): Individual choice behavior. A theoretical analysis. Wiley, New York.

MARQUER, P., T. RABADE and R. FORTI (2014): Pig farming sector - statistical portrait 2014. Pig farming in the European Union: considerable variations from one Member State to another. http://ec.europa.eu/eurostat/statistics-explained/index.php/Pig_farming_sector_-_statistical_portrait_2014, call: 11.8.2015.

MCFADDEN, D. (1974): Conditional logit analysis of qualitative choice behavior. In: Frontiers in Econometrics: 105-142.

MCINERNEY, J. (2004): Animal welfare, economics and policy. Paper prepared for the Farm & Animal Health Economics Division of Defra.

MCKENDREE, M.G.S., N.O. WIDMAR, D.L. ORTEGA and K.A. FOSTER (2013): Consumer Preferences for Verified Pork-Rearing Practices in the Production of Ham Products. In: Journal of Agricultural and Resource Economics 38 (3): 397-417.

MEGINNIS, K., M. BURTON, R. CHAN and D. RIGBY (2021): Strategic bias in discrete choice experiments. In: Journal of Environmental Economics and Management 109: 102-163.

MEUNIER-SALAUN, M.C., M.N. VANTRIMPONTE and A. RAAB and R. DANTZER (1987): Effect of floor area restriction upon performance, behavior and physiology of growing-finishing pigs. In: Journal of Animal Science 64 (5): 1371-1377.

MORGAN, C.A., L.A. DEANS, A.B. LAWRENCE and B.L. NIELSEN (1998): The effects of straw bedding on the feeding and social behaviour of growing pigs fed by means of single-space feeders. In: Applied Animal Behaviour Science 58 (1-2): 23-33.

MÜLLER, J. (2014): Betriebswirtschaftliche Richtwerte Schweinemast. Thüringer Landesanstalt für Landwirtschaft, Jena.

NOCELLA, G., L. HUBBARD and R. SCARPA (2010): Farm animal welfare, consumer willingness to pay, and trust. Results of a cross-national survey. In: Applied Economic Perspectives and Policy 32 (2): 275-297.

ORTEGA, D.L. and C.A. WOLF (2018): Demand for farm animal welfare and producer implications: Results from a field experiment in Michigan. In: Food Policy 74: 74-81.

PURWINS, N. and B. SCHULZE-EHLERS (2018): Improving market success of animal welfare programs through key stakeholder involvement: heading towards responsible innovation? In: International Food and Agribusiness Management Review 21 (4): 543-558

ROCHA, L.M., A. VELARDE, A. DALMAU, L. SAUCIER and L. FAUCITANO (2016): Can the monitoring of animal welfare parameters predict pork meat quality variation through the supply chain (from farm to slaughter)? In: Journal of Animal Science 94 (1): 359-376.

SANDOR, Z. and M. WEDEL (2001): Designing conjoint choice experiments using managers' prior beliefs. In: Journal of Marketing Research 38 (4): 430-444.

SCARPA, R., M. THIENE and K. TRAIN (2008): Utility in willingness to pay space. A tool to address confounding random scale effects in destination choice to the Alps. In: American Journal of Agricultural Economics 90 (4): 994-1010.

SCHMIDT, J. and T.H. BIJMOLT (2020): Accurately measuring willingness to pay for consumer goods: a meta-analysis of the hypothetical bias. In: Journal of the Academy of Marketing Science 48 (3): 499-518.

SCHUKAT, S., A. KUHLMANN and H. HEISE (2019): Fattening pig farmers' intention to participate in animal welfare programs. In: Animals 9 (12): 1042.

SCHUKAT, S., T. OTTMANN and H. HEISE (2020): Betriebswirtschaftliche Bewertung von Maßnahmen zur Steigerung des Tierwohls am Beispiel der Initiative Tierwohl aus der Perspektive konventioneller Schweinemäster. Berichte über Landwirtschaft-Zeitschrift für Agrarpolitik und Landwirtschaft.

SCHULZ, N., G. BREUSTEDT and U. LATACZ-LOHMANN (2014): Assessing farmers' willingness to accept "greening". Insights from a discrete choice experiment in Germany. In: Journal of Agricultural Economics 65 (1): 26-48.

SCHULZE, B. (2014): Konflikte um die Nutztierhaltung-Tierwohlstandards als Lösung? Versuch einer Antwort. Schriftenreihe der Agrar- und Ernährungswissenschaftlichen Fakultät der Universität Kiel 121: 115-122.

SMITH, B., D. OLARU, F. JABEEN and S. GREAVES (2017): Electric vehicles adoption: Environmental enthusiast bias in discrete choice models. In: Transportation Research Part D: Transport and Environment 51: 290-303.

SCOTT, K., D.J. CHENNELLS, F.M. CAMPBELL, B. HUNT, D. ARMSTRONG, L. Taylor and S.A. EDWARDS (2006): The welfare of finishing pigs in two contrasting housing systems: Fully-slatted versus straw-bedded accommodation. Livestock Science 103 (1-2): 104-115.

TONSOR, G.T. (2011): Consumer inferences of food safety and quality. In: European review of agricultural economics 38 (2): 213-235.

TRAIN, K. and M. WEEKS (2005): Discrete Choice Models in Preference Space and Willingness-to-Pay Space. Applications of simulation methods in environmental and resource economics. Springer, Dordrecht: 1-16.

TRAIN, K. (2009): Discrete choice methods with simulation. Cambridge University Press, Cambridge, New York.

TUYTTENS, F.A.M., S. VAN GANSBEKE and B. AMPE (2011): Survey among Belgian pig producers about the introduction of group housing systems for gestating sows. In: Journal of Animal Science 89 (3): 845-855

VANHONACKER, F., W. VERBEKE, E. VAN POUCKE and F.A. TUYTTENS (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? Livestock science 116 (1-3): 126-136.

WEISS, E., G. PATRONEK, M. SLATER, L. GARRISON and K. MEDICUS (2013): Community Partnering as a Tool for Improving Live Release Rate in Animal Shelters in the United States. In: Journal of Applied Animal Welfare Science 16 (3): 221-238.

WELLNER, K., L. THEUVSEN and H. HEISE (2019): Die Teilnahmebereitschaft deutscher Landwirte an der Initiative Tierwohl - Wodurch wird sie beeinflusst? Paper prepared for the 59th annual conference of the German Association of Agricultural Economists, Braunschweig.

WENG, R.C., S.A. EDWARDS and P.R. ENGLISH (1998): Behaviour, social interactions and lesion scores of group-housed sows in relation to floor space allowance. In: Applied Animal Behaviour Science 59 (4): 307-316.

ZANDER, K., F. ISERMEYER, D. BÜRGELT, I. CHRISTOPH-SCHULZ, P. SALAMON and D. WEIBLE (eds.) (2013): Erwartungen der Gesellschaft an die Landwirtschaft. Gutachten im Auftrag der Stiftung Westfälische Landschaft, Münster.

ZWICKER, B., L. GYGAX, B. WECHSLER and R. WEBER (2013): Short-and long-term effects of eight enrichment materials on the behaviour of finishing pigs fed ad libitum or restrictively. In: Applied Animal Behaviour Science 144 (1): 31-38.

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Appendix

A1 Cheap Talk Script

"The experience from previous similar surveys is that people often respond in one way but act differently. It is particularly common that one states a higher compensatory payment than what one actually needs in practice for covering the costs for the implementation of an animal welfare practices So please make your choice as if you really have to implement the suggested animal welfare packages."
Adapted from CARLSSON et al. (2005).

A2 Syntax Design Choice Experiment

Design

;alts = alt1,alt2,alt3
;rows= 12
;eff=(rp,d,median)
;rep=50
;rdraws= halton(50)
;model:

*U(alt1) = b1[1.04] + pa[-0.07] * A[10,20,30,40] + rf.dummy[-0.28] * B[0,1] + al.dummy[n,(n,-4.66,1.23),(u,3.1,5.86)] * C[0,1] + lf.dummy[-2.69|n,(n,-4.97,1.71),(u,3.06,6.62)|n,(n,-3.48,1.1),(u,1.98,4.16)] * D[1,2,3,4] + ob.dummy[n,(n,-0.48,0.54),(u,0.87,1.79)] * E[0,1] + bz[n,(n,0.2,0.05),(u,0.06,0.11)] * F[5,10,15,20] /*

*U(alt2) = b1[1.04] + pa * A + rf.dummy * B + al.dummy * C + lf.dummy * D + ob.dummy * E + bz * F $*

A3 Utility Functions for Model Estimation

The first part of the following formula is Model 1 without interactions and the part in brackets is added to Model 1 for estimating Model 2 that regards interactions:

$$
\begin{aligned}
U_{ntj} = {} & \beta_{ASC} * ASC + \beta_{more\ space} \cdot \\
& more\ space + \beta_{manipulable\ material} \cdot \\
& manipulable\ material + \beta_{roughage} \cdot \\
& roughage + \beta_{partly\ slatted\ floor} \cdot \\
& partly\ slatted\ floor + \beta_{bedding} \cdot \\
& bedding + \beta_{soft\ mat} \cdot soft\ mat + \beta_{outdoor\ yard} \cdot \\
& outdoor\ yard + \beta_{bonus\ payment} * bonus\ payment \\
& [\beta_{outdoor\ yard*pigs} \cdot outdoor\ yard * \\
& pigs + \beta_{bedding*pigs} \cdot bedding * \\
& pigs + \beta_{more\ space*welfare\ increase} \cdot more\ space * \\
& welfare\ increase + \beta_{outdoor\ yard*welfare\ increase} \cdot \\
& outdoor\ yard * \\
& welfare\ increase + \beta_{bedding*trust\ consumers`WTP} \cdot \\
& bedding * \\
& trust\ consumers`WTP + \beta_{soft\ mat*trust\ consumers`WTP} \cdot \\
& soft\ mat * trust\ consumers`WTP \\
& + \beta_{partly\ slatted\ floor*trust\ consumers`WTP} \cdot \\
& partly\ slatted\ floor * trust\ consumers`WTP]
\end{aligned}
$$