What counts more – fairness to dairy cows or fairness to farmers?

The preferences of conventional milk buyers for ethical attributes of milk

Authors: Nonka Markova-Nenova and Frank Wätzold

Affiliation: Brandenburg University of Technology Cottbus-Senftenberg; Chair of Economics, especially Environmental Economics

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Abstract:

Stable organic milk producer prices over the course of the 2015/2016 conventional milk price crisis in the EU suggest that product differentiation according to the preferences of buyers for ethical milk attributes could be a good marketing strategy for conventional milk. Through an online choice experiment conducted in Germany we analyse the preferences of conventional milk buyers for ethical attributes of milk, among others for biodiversity protection and regional production. We especially concentrate on the trade-offs between animal welfare (indicated by the housing system for dairy cows and pasture access) and fairness to farmers (to all farms or to small, below-average-income farms). Our results show highest preferences for the most animal-friendly housing system – free-stall with summer pasture. Overall, respondents have positive willingness to pay for support of small, below-average-income farms in combination with tethering, which suggests that animal welfare concerns are to some extent counterbalanced by fairness to poor farmers.

Keywords: milk preferences, ethical attributes, fairness, choice modelling, latent class model

1. Introduction

During the recent EU milk price crisis in 2015-2016 a producer price drop from around 0.38 €/kg in 2014 to less than 0.27 €/kg in 2016 for conventional milk could be observed in Germany (Bioland, 2017). These low milk prices led to the closure of many small farms and contributed to the trend of conversion to more intensive, large scale milk production (Ilchmann, 2017; Sauer, 2016). In Germany the number of milk farms is gradually decreasing, whereas the number of cows per farm is increasing (BMEL, 2017).

Similar milk price developments took place in other European countries (e.g. BLE, 2017 for milk prices in Germany, France, and Austria between 2012 and 2017). As a response, the EU intervened in the market to restore the milk prices, so that they began increasing in the middle of 2016 and until end of 2016 have again reached the levels prior to the milk price crisis (EU Milk Market Observatory, 2017). From an economic perspective, market interventions are in general inefficient, due to the deadweight losses they create. The market interventions in the milk price crisis, for which about €1 billion EU funding were provided (European Commission, 2016), are not an exception. Public intervention, as a price control mechanism, is in general inefficient and has led to the piling up of stored skimmed milk powder between 2015 and 2017 (AHDB Dairy, 2017). Moreover, the voluntary production reduction scheme has been criticized to have ‘compensated farmers for production decisions they had already made’ (Dairy Australia, 2017: 27).

Dairy farming has also been under pressure for reasons of animal welfare. It has been criticized that cows are kept in tie-stalls (where they are tethered and cannot move freely, in contrast to free-stalls) and that they lack access to pasture (Algers et al., 2009; Kikou, 2015). Moreover, an important part European biodiversity depends on the existence of grassland and its management and, consequently, on how the production system of dairy farming is organised (Klimek, Hofmann and Isselstein, 2007). A diverse and extensive grassland management is highly beneficial for endangered biodiversity (Klimek, Hofmann and Isselstein, 2007; Wätzold et al., 2016). However, such a production system, with low economic yield, is not any more economically viable (Hodgson et al., 2005). In contrast, the increasing replacement of grazed-herbage by maize silage and concentrate feed increases the pressure even on intensively managed grassland to be transformed to arable land resulting in adverse effects on biodiversity (IEEP, 2007).

Interestingly, during the crisis of conventional milk prices, producer prices for organic milk remained rather stable (around 0.48 €/kg in Germany, see Bioland, 2017), despite conventional milk price fluctuations. This is unusual as earlier the price of organic milk usually followed the fluctuations of conventional milk prices. However, a similar development of the gap between organic and conventional milk prices could be observed in France during the milk price crisis (CLAL, 2017). This, together with an increasing share of organically produced agricultural goods, including milk, over the past 10 years (Meredith and Willer, 2016), suggests that consumers are increasingly willing to pay more for what they perceive as higher valued agricultural products. However, the market share of organic milk is still low. It accounted for only about 2.6% of the of total EU milk production in 2014, whereby there are significant country differences - in Germany the share was 8.1 % and in Austria - 15.7% (Meredith and Willer, 2016). The reasons for this are diverse – from price sensitivity of customers, scepticism of certification labels and satisfaction with conventional products to lower availability of organic products and ineffective marketing (cf. Hughner et al., 2007).

Besides organic farming, another marketing strategy for more stable milk prices could be value-creation and product differentiation through introducing and marketing different ethical attributes of production. Ethical attributes are associated with social and environmental issues (Luchs, 2010). In milk production ethical issues which are marketed through labelling include e.g. regional/local production, fair prices to farmers (assuring a certain amount of the milk price goes back to the producer), and animal welfare through access to pasture.

Several studies on preferences for ethical attributes of milk production from an economic perspective have been conducted in Europe. Some of them have focused on preferences for organic milk (Hasselbach and Roosen, 2015; Illichmann and Abdulai, 2013; Wägeli, Janssen and Hamm, 2016; Zander and Hamm, 2010), or have analysed willingness to pay (WTP) but have not involved a monetary valuation of specific milk attributes (e.g. Ellis, 2009 in the UK, Hellberg-Bahr, Steffen and Spiller, 2012, and Weinrich, Zühlsdorf and Spiller, 2014 in Germany, which all analysed preferences and WTP for pasture access on a more general level). Zander and Hamm (2010) have used an Information Display Matrix to study the preferences of regular and occasional consumers of organic food in Germany and four other European countries for additional ethical attributes of organic milk. Thereby animal welfare, regional production, product price, and protection of biodiversity were ranked highest by the respondents in Germany, however no WTP values were elicited and the focus was on organic milk preferences.

We try to fill those research gaps by including a comprehensive list of ethical attributes of milk in a monetary valuation study using a choice experiment. We are especially interested in the preferences of conventional milk buyers, since they still form the majority of consumers. Our results can inform the development of policies and labels which reflect the preferences of customers and meet their needs.

In contrast to previous studies on milk preferences, the ethical attributes in our experiment are not linked to explicitly using labels, certifications or brands, as it has been in most previous valuation studies. We conduct a hypothetical choice experiment, using some ethical characteristics which are not present on the market yet, namely, statement of the type of housing system for the dairy cows as an indicator for animal welfare, whether the milk production supports biodiversity, and whether small farms with below-average income or all farms get support, or no support is provided. None of the above mentioned characteristics have yet been included as attributes in stated-preference valuation studies for milk. So far, valuation studies have focused on fair prices to all farmers. We introduce another dimension of farmers' equity to the discussion, namely, fairness to small and below-average-income farms. Regional origin is the ethical attribute included in the experiment which is already part of existing milk marketing strategies.

In Germany several studies, including choice experiments, have analysed the preferences of milk buyers for different ethical attributes of milk. Stolz et al. (2011) show through purchase simulations that in Switzerland and central Germany many occasional organic consumers who usually buy conventional milk choose to switch to conventional-plus milk (pasture milk), whereas regular organic consumers rather stay with organic milk. In a discrete choice experiment with German organic consumers, Wägeli, Janssen and Hamm (2016) find a strong preference for organic milk produced with local feed over German feed and for local milk over milk from Germany or from a specific part of a federal state. This also supports the results of Illichmann and Abdulai (2013), where respondents show highest WTP for milk from their region, followed by milk from their state, followed by German milk. Hasselbach and Roosen (2015) also confirm a WTP for local and organic milk, and demonstrate that a combination of the two labels obtains much higher WTP values.

The mentioned previous studies have focused on values, attitudes, socio-demographic variables and norms to explain variation in WTP for ethical milk attributes (e.g. Emberger-Klein, Menrad and Heider, 2016). Next to socio-demographics, we use actual buying behaviour to explain heterogeneity in consumers' preferences. The explanatory variables used are gender, buying organic milk frequently, currently paying lowest milk price, currently paying high milk price, having donated for animal protection and having a farmer as friend or family member. In Emberger-Klein, Menrad and Heider (2016) price consciousness, measured by directly asking respondents how important price is in their buying decisions (on a 5-point scale), is the most important determinant of WTP for fairly produced locally grown milk. In our study price consciousness also plays a role and is operationalized by the use of the respondents' currently paid price for milk. Very price-conscious consumers are assumed to currently buy the lowest milk price, whereas consumers who are not very price-conscious are expected to currently buy milk with a relatively high price.

We investigate some detailed *research questions*, which have not, or only to a small extent, been addressed in the literature so far:

(1) *Fairness for dairy cows vs. equity for small farms: How do consumers value support for small farms who use tethering of dairy cows (with and without pasture)?*

According to the latest detailed agricultural report of the Federal Statistical Office Germany (2010) in Germany small dairy farms predominantly use tie-stalls, often in combination with pasture. Large farms rarely use tie-stalls, but also rarely provide for pasture access (see Table A. 1 in the appendix). For small farms tethering is even allowed in organic milk production, provided that summer pasture is used and if in winter the cows have access to open air at least twice a week (Article 39 of Commission Regulation (EC) No 889/2008). A general complete ban of cattle tethering has been a topic of political discussion in Germany in recent years, but has not met enough political support, due to the fact that especially small farms would be affected by it. Thus it becomes an interesting question, whether milk buyers gain utility from supporting small farms, with the milk price they pay, despite cow tethering. Analysing this trade-off between animal welfare and fairness to small farmers is one of our study's objectives.

(2) *Preferences for fairness to milk producers – should all milk producers get more of the price, or only the small and poorer producers?*

As mentioned above, previous studies have focused on the preferences of consumers for ensuring fair prices to all farmers, we add fair prices to small, below-average income farms to the discussion.

(3) *Influence of product origin on preferences for fairness to milk producers.*

We are also interested in the questions whether buyers prefer to support only small, below-average-income farms or all farms in their region and whether they are willing to pay more to support small and poorer farms in their region than in Germany in general.

(4) *Is low milk price more important than animal welfare?*

We investigate how important low price is to conventional milk buyers by showing what percentage of conventional milk buyers still choose the milk with lowest price, even though it involves permanent tethering of cows.

(5) *Preferences of conventional milk buyers for grassland biodiversity protection through milk production practices.*

In a study of Zander and Hamm (2010) on organic milk preferences in Germany biodiversity protection ranks after regionality, animal welfare and fair prices to farmers. In contrast to this study we provide monetary valuation for biodiversity protection in milk production. To facilitate the valuation we inform respondents by specifying how dairy farmers can contribute to biodiversity protection of certain species (endangered butterflies and meadow birds) through some biodiversity protection measures. The results of this analysis can also indicate milk buyers' support for agri-environmental measures in grassland conservation.

2. Choice modelling

To investigate the trade-offs in milk preferences we use the stated-preference method choice experiments, which is based on Lancaster's (1966) characteristics theory of value and on random utility theory (McFadden and Train, 2000). According to the former, consumers' preferences relate to different characteristics of a good and not directly to the good as a whole. According to the random utility theory, the utility U_{nsi} an individual n gets from an alternative i in a choice situation s involves an observable component V_{nsi} and a stochastic or error element ε_{nsi}, which is not observable to the researcher. An alternative specific constant β_i can also be part of the utility specification, indicating preferences for a specific alternative.

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

Different choice models can be employed depending on the assumptions made on the distribution of the stochastic component. The observable part of utility V_{nsi} depends on the characteristics x_{nsi} of the alternative and (or of the respondent) and the corresponding marginal utilities or weights β_n that respondents assign to them.

$$V_{nsi} = \beta'_n x_{nsi} \quad (2)$$

The general form of choice models is represented by equations 3 and 4, where the probability of choosing an alternative i equals the probability that this alternative's utility is higher than the utility of any of the other alternatives J.

$$P_{nsi} = Prob(U_{nsi} \geq U_{nsj}, \forall i \neq j) = Prob(V_{nsi} + \varepsilon_{nsi} \geq V_{nsj} + \varepsilon_{nsj}, \forall i \neq j),\ j = 1, \dots, J \qquad (3)$$

$$P_{nsi} = \frac{\exp(V_{nsi})}{\sum_{j=1}^{J} \exp(V_{nsj})} \qquad (4)$$

In a mixed logit (ML) model the marginal utility parameter estimates are assumed to vary over all respondents with a predefined distribution (cf. Train, 2003). In the form of latent class model (LCM) employed here the utility parameter estimates are assumed to vary between classes of respondents and are fixed within the classes (Boxall and Adamowicz, 2002). The panel specification for the LCM used is shown in equations 5, 6 and 7 (based on Hensher, Rose and Greene, 2015), where c is the index for the estimated latent classes and y is the index of the observed choices. $P_{nsi|c}$ is the probability of individual n choosing alternative i in choice situation s conditional on membership to class c.

$$P_{nsi|c} = \frac{\exp(V_{nsi|c})}{\sum_{j=1}^{J} \exp(V_{nsj|c})} \qquad (5)$$

The probability of membership to class $c\,(P_{nc})$ is estimated based on the observed utility component δ_c from the class assignment model and on predefined respondents' characteristics h_n which determine class membership.

$$P_{nc} = \frac{\exp(V_{nc})}{\sum_{c=1}^{C} \exp(V_{nc})}, \text{ where } V_{nc} = \delta_c h_n \qquad (6)$$

Using equations 5 and 6, $P_{ns|c}$, the choice probabilities conditioned on the observed choices are calculated based both on the class assignment probabilities P_{nc} and the choice situation probabilities $P_{nsi|c}$.

$$P_{ns|c} = \frac{\prod_s y_{nsj} P_{nsi|c} P_{nc}}{\sum_{c=1}^{C} \prod_s y_{nsj} P_{nsj|c} P_{nc}} \quad , \forall c \in C \qquad (7)$$

For calculating overall mean willingness-to-pay (WTP) values over the whole sample, we employ an ML model with a panel specification. For ensuring meaningful WTP estimates with correct signs in the ML model the utility parameter for the price attribute is assumed to be fixed.

For the analysis of preference heterogeneity an LCM with panel data specification is used. Panel data model specifications allow for correlation between the different choice observations a respondent makes and do not assume independence of consecutive choices as cross-sectional models (Hensher, Rose and Greene, 2015). Since the respondents in our choice experiment make eight consecutive choices, we treat the data as panel.

Willingness-to-pay values are calculated as the negative ratio of the marginal utility estimate for an attribute ($ß_{attribute}$) and the marginal utility estimate for price ($ß_{price}$). The confidence intervals of the WTP are computed based on the delta method (Bliemer, 2013).

$$WTP = -\frac{\beta_{attribute}}{\beta_{price}} \quad (8)$$

Since we are particularly interested in the preferences of milk buyers who usually buy the cheapest milk (with price between 0.60€ and 0.69€), using an LCM is more appropriate than using an ML model with heterogeneity. The use of an LCM with class membership function enables us to analyse the preferences of different milk consumer groups and allows for separate estimation of WTP values for each estimated latent class of consumers.

In an LCM the number of classes is specified by the analyst and is usually determined after estimation of models with all possible and plausible number of classes based on the resulting values of information criteria, such as Bayesian Information Criteria (BIC) or Akaike Information Criteria (AIC) (Swait, 2007). In our analysis the Bayesian Information Criterion (BIC) and the Consistent Akaike Information Criterion (CAIC) were employed.

3. Survey

We conducted an online choice experiment survey among conventional milk buyers (individuals who buy occasionally or frequently conventional milk for themselves or their families) in Germany with the help of the survey company Respondi. Respondents who only rarely or never buy conventional milk (as opposed to organic milk) were excluded from the survey, because the study focused on the preferences of conventional milk buyers. Individuals, who frequently or occasionally buy conventional milk and in addition to this frequently or occasionally buy organic milk were allowed to participate. We surveyed 1040 respondents who were additionally screened on representativeness for gender, education, age and size of their place of residence for the German population. The quotas for the sampling were based on data for German milk buyers between 18-95 years in the past 12 months from the German marketing study best4planning 2016. The survey was conducted in February 2017. An overview of sample statistics based on the quota sampling procedure is presented in Table 1. The proportion of females in the sample is greater than for males, due to the fact that more often women are responsible for shopping.

Table 1 Sample statistics

Quota sampling[a] based on:	**Sample in %**	**(count)**
Gender		
Male	42.5	(442)
Female	57.5	(598)
Age (years)		
18-29	15.1	(157)
30-39	14.7	(153)
40-49	18.1	(188)
50-59	18.8	(195)
>=60	33.4	(347)
Highest level of education completed		
No secondary general school-leaving certificate	0.4	(4)
Secondary general school-leaving certificate without apprenticeship (dual system) qualification	5.7	(59)
Secondary general school-leaving certificate with apprenticeship (dual system) qualification	33.0	(343)
Intermediate school-leaving certificate	31.4	(327)
University/ of Applied Sciences entrance qualification	14.5	(151)
Higher education (University/ of Applied Sciences, Polytechnic)	15.0	(156)
Settlement size (population numbers)		
1-4.999	14.3	(149)
5.000-19.999	26.2	(272)
20.000-99.999	27.7	(288)
>=100.000	31.8	(331)
Sample size (count)	1040	

In the choice experiment respondents faced choices among four hypothetical milk alternatives – two alternatives with changing attributes (‘milk A’ and ‘milk B’), one fixed lowest-price milk alternative with all ethical attributes at their lowest levels (‘milk C’), and one ‘no-buy’ alternative. We decided to include a ‘no-buy’ alternative instead of a real opt-out ‘none-of-these’ option, because we were particularly interested, if, how often, and why customers would choose the lowest-price milk, even though it involved the lowest levels for all ethical attributes (animal welfare, biodiversity protection, support for farmers, and origin). The definition of the opt-out as a ‘no-buy’ alternative reduces the attractiveness of the opt-out alternative and therefore is likely to amplify the trade-off between price and the ethical attributes of milk. An example of a choice card used in the experiment is provided below.

Please choose one of the three products below. In all eight decision situations you also have the option not to buy milk. Please be honest in your choices and always take into account your financial situation.

	Milk A	**Milk B**	**Milk C**
Animal welfare/ Housing system of dairy cows	free-stall	free-stall + summer pasture	tie-stall
Biodiversity protection	good for biodiversity protection	no special biodiversity protection	no special biodiversity protection
Support for milk farms	small milk farms with below-average income	no support	no support
Origin of the milk	from your region	from your region	from Germany
Price per litre	1.32 €	0.78 €	0.60 €

○ **I buy milk A** ○ **I buy milk B** ○ **I buy milk C** ○ ***I buy no milk***

Figure 1 An example of a choice card used in the survey

For an overview of the attributes and levels included in the experiment see Table 2. The complete description of attributes and levels from the survey questionnaire is included in Table A. 2 in the appendix. The attributes and levels were chosen based on the aims of the paper, literature review and a focus group discussion.

Table 2 Attributes and levels included in the choice experiment

Attributes	Levels
Animal welfare/ Housing system of dairy cows[1]	- Tie-stall - Tie-stall with summer pasture - Free-stall - Free-stall with summer pasture
Biodiversity protection	- Good for biodiversity protection – many endangered species get protected - No special biodiversity protection – loss of biodiversity not mitigated
Support for milk farms – fair prices to producers	- Support for all milk farms - Support for small milk farms with below-average income - No support
Origin of the milk	- From your region (within a radius of max. 40 km) - From Germany
Price per litre[2]	0.60 €; 0.78 €; 0.96 €; 1.14 €; 1.32€

For the animal welfare attribute we focus on one particular aspect of animal welfare, namely housing system and the provision of pasture access. We distinguish between four different types of housing systems: tie-stall, tie-stall with summer pasture, free-stall and free-stall with summer pasture.

We are also concerned with the preferences of milk buyers for biodiversity protection through milk production practices. Traditional dairy farming supports biodiversity, whereas its abandonment as well as the intensification of milk production leads to a decline in grassland species diversity (CEAS Consultants, 2000). Thus, depending on the type of production, dairy farming can have a negative or a positive effect on grassland biodiversity. The biodiversity protection attribute for the choice experiment is set at two levels – good for biodiversity protection with the protection of many endangered species and no special biodiversity protection whereby, due to intensification, loss of biodiversity is not mitigated. We explicitly

[1] There are other existing housing systems, e.g. having a free-stall and outdoor exercise area. However, we decided to include only the basic kinds of housing systems to keep the complexity of the trade-offs at an acceptable level.
[2] The different price levels were based on real consumer prices in Germany in February 2017.

stated that especially meadow birds and butterflies can profit from extensive grassland management by dairy farmers. As Lienhoop and Brouwer (2015) conclude, in stated-preference studies information on the type of species protected is instrumental for valuing biodiversity by respondents.

Fairness to farmers is defined as support for farmers (fair prices to farmers) and includes three options: no support, support to all farms, and support to small and below-average-income farms, which is related to Rawls' (1971) maximin principle and the needs principle (Miller,1976; Dobson, 1998). According to the former inequalities (in our case in financial support to farmers through milk prices) should be 'to the benefit of the least advantaged' (Rawls, 1971), and the latter postulates that those in need should get higher support.

For the origin of milk we set two levels – regional and national origin - to keep the complexity of trade-offs in acceptable limits. In Germany consumer milk is rarely sold as imported milk and in the last years imports account for only about 7% of the total milk production (MIV, 2016).

The questionnaire for the survey included questions on milk purchases of respondents, importance of/ attitude towards different aspects in buying decisions in general, and information on the choice experiment and the different milk attributes. Moreover, it contained the choice cards, debriefing questions on attribute non-attendance and on the choice of the fixed and 'no-buy' alternatives and an explicit question on individual WTP for milk with additional ethical attributes as well as socio-demographic questions.

Ngene software was used to create a Bayesian D-efficient design (cf. Bliemer, Rose and Hess, 2008) with a fixed alternative and a 'no-buy' alternative for the estimation of main effects and the four interaction effects of interest, which help in answering the research questions presented above - namely tethering milk cows (with or without pasture) in combination with support for small farms with below-average income, and regional origin in combination with support for either all farmers or for small farms with below-average income. The design included a requirement for the combination of levels of the fixed C-alternative and a constraint for excluding alternatives with all attributes equal to the fixed C-alternative in the A and B alternatives. Alternative specific constants were included for the fixed and ‘no-buy’ alternative. The attribute levels were effects coded, except for price, which was coded as a continuous variable.

A pretest consisting of two consecutive parts, with separate D-efficient Bayesian designs and 50 respondents each, was conducted online by the survey company. In the first pretest trial no regional production attribute was included, but a three-level biodiversity protection attribute (high, medium and no biodiversity protection level). In the second pretest trial the choices included regionality of milk production and a two-level biodiversity protection attribute. The estimated two parameters for the three effects-coded levels of biodiversity protection in the first pretest trial - without regionality - were insignificant, whereas the parameter for the one effects-coded biodiversity protection variable for the two levels in the second pretest trial was highly significant. Since information load is important in eliciting preferences (see e.g. Hensher, 2006) we decided to use two levels for biodiversity protection in the main survey.

In the main survey normally distributed Bayesian priors based on the results of the pretest were used to generate a D-efficient Bayesian design with 24 choice sets in three blocks with 8 choice sets each, including the four interactions of interest. Respondents were randomly assigned to the three blocks and the order of choice cards was randomized between respondents. The priors of the price and the ‘no-buy’ constant were fixed to facilitate the design procedure.

4. Results

4.1. Overall results

Only five respondents chose the ‘no-buy’ alternative on each choice card, the answers to the debriefing questions showed no protest responses. 11.8%, or 123 respondents chose the fixed lowest-price alternative on all cards: 107 of them (corresponding to 10% of all respondents) because for them price is the most important factor in the buying decision; 10 of them, because the decision was difficult due to too much information; six of them chose other reasons, which however also do not show protest responses. 106 (or 86%) of the 123 lowest-price-alternative choosers pay currently the lowest milk price - 0.60 € to 0.69. Overall, the lowest fixed-price alternative accounted for 20% of all the choices made.

In the ML model the utility parameters for price and interaction effects were fixed, to facilitate model estimation and WTP calculation. All other parameters were set as normally distributed random parameters. The coefficients derived from this model were used in the estimation of overall mean WTP values over all respondents (Table 3 below).

An overview of the estimated utility parameters in the choice models and goodness-of-fit indicators provide Table A. 4 and Table A. 5 in the appendix. The LCM model with heterogeneity in preferences leads to a substantial improvement in goodness of fit. Especially the choice of the fixed option can be much better modelled with it.

In the process of LCM model specification we tested different current buying behaviour variables and socio-demographic characteristics as predictors of preference heterogeneity in the class membership function and selected only the significant ones. Income, education, age and having children were insignificant socio-demographic covariates. We also checked whether heterogeneity of preferences was present depending on whether respondents live in rural or urban areas (differentiated according to data on district type from BBSR 2015, German Federal Institute for Research on Building, Urban Affairs and Spatial Development). However, since the influence was insignificant, we could not confirm this. Actual buying behaviour variables which were tested and had no significant influence on heterogeneity of preferences were: frequently buying pasture milk, frequently buying regional milk and having donated for environmental protection in the last two years.

The estimated LCM model with significant covariates and best fit, which is presented below, includes a class membership function based on gender, frequent organic milk purchasing, lowest currently paid price, high currently paid price, having a farmer as friend or family member and having donated for animal protection in the last two years (see covariates in Table A. 3 in the appendix).

By including the variable ‘buyers with lowest currently paid price’ in the class membership function of the LCM we can show which attributes appeal most to many of the members of this class and are also able to derive corresponding WTP values. In the sample, the group of respondents who usually buy the cheapest milk is represented by milk buyers from all income classes, not only from the lowest income classes. Thus, also all LCM classes include some respondents from the group of the lowest-price milk buyers.

The LCM with the above mentioned class membership function parameters can be estimated with up to 6 classes using the data from the survey. For further analysis we use the results of the five-class LCM, since it leads to best fit - lowest values for the information criteria BIC and CAIC.

4.2. WTP estimation

The marginal WTP (MWTP) over all respondents, resulting from the ML model, is highest for the highest level of animal welfare (free-stall plus summer pasture) and equals 27 Cent/litre (Table 3). Biodiversity protection, the second most preferred housing system (tie-stall plus summer pasture) and support for small, below-average-income farms are all similarly valued at 8 Cent, 7 Cent and 6 Cent per litre, respectively. Regional production, in contrast to the results of other studies, is valued less than the afore-mentioned ethical attributes, at 4 Cent/litre. The WTP as well as the marginal utility estimate for free-stall from the ML model are negative and insignificant.

The combinations of tethering (with and without pasture) and support for small, below-average-income farms are positively valued by respondents. The WTP for support of small, below-average-income farms with tethering is 7 Cent/litre, equal to the WTP for small, below-average-income farms support in general. The WTP for support of small, below-average-income farms with tethering and summer pasture is even 12 Cent/litre, which is the second highest estimated WTP value from the ML model. Support of small, below-average-income farms is, as expected, higher valued than support for all farms. Surprisingly, the mean overall WTP for supporting all farms is negative (significant on 10% level). The WTP for the two interaction effects between regional origin and support for all farms and small below-average income farms also gives some surprising insights. For regional milk respondents show positive WTP for supporting all farms and negative WTP (significant on 10% level) for supporting only small, below-average income farms. A possible explanation of this result might be different viewpoints of consumers concerning fairness to farmers on the national and regional level. In general, on national level, respondents show greater support for small, below-average income farms. However, apart from contributing to environmental protection, by buying regional products, consumers typically want to support the local economy (Hasselbach and Roosen, 2015; Menapace and Raffaelli, 2016) and thus may focus more on supporting all farms. This might also imply that large farms face better public acceptance in the own region of residence or in other words, that milk buyers have a more positive attitude to large farms in their own region than to large farms in general.

Table 3 Marginal WTP from ML model (insignificant values in grey colour)

Attributes/ Interactions	MWTP	95% Confidence interval	
Free-stall+pasture	0.27***	0.237	0.300
Free-stall	-0.02	-0.042	0.007
Tie-stall+pasture	0.07***	0.036	0.092
Biodiversity protection	0.08***	0.064	0.096
Support for small farms	0.06***	0.029	0.097
Support for all farms	-0.03*	-0.055	0.001
Regional milk	0.04***	0.016	0.061
Interactions			
Tie-stall*Support for small farms	0.07**	0.013	0.135
Tie-stall+pasture*Support for small farms	0.12***	0.058	0.178
Regional milk*Support for small farms	-0.05*	-0.099	0.006
Regional milk*Support for all farms	0.08**	0.018	0.138

*Note: *** significant at 1%, ** significant at 5%, * significant at 10%*

4.3. Heterogeneity in preferences – LCM class differences

Since the model fit of the estimated LCM is much better and it captures heterogeneity in preferences among different consumer groups, the WTP values resulting from it are more indicative (Table 4).

Table 4 Marginal WTP from LCM panel model (insignificant values in grey colour)

	Class 1 - 'the higher income, organic, fairness and regional buyers'			Class 2 - 'the lower income, lowest-price milk buyers'			Class 3 - 'highest animal welfare, biodiversity and regional buyers'			Class 4 - 'price sensitive low-price milk buyers with preferences for highest animal and farmer fairness'			Class 5 - 'the (animal and farmer) fairness buyers'		
Attributes/ interactions	**MWTP**	**95% Confidence interval**		**MWTP**	**95% Confidence interval**		**MWTP**	**95% Confidence interval**		**MWTP**	**95% Confidence interval**		**MWTP**	**95% Confidence interval**	
Free-stall+pasture	2.48***	0.64	4.32	-0.49	-348.94	347.95	0.47***	0.39	0.54	0.07***	0.03	0.11	0.11***	0.09	0.14
Free-stall	-0.46**	-0.88	-0.04	0.43	-158.57	159.44	0.05	-0.02	0.12	-0.01	-0.04	0.02	-0.02	-0.04	0.01
Tie-stall+pasture	0.60**	0.09	1.11	0.37	-154.09	154.83	0.04	-0.03	0.12	0.00	-0.02	0.03	0.04***	0.02	0.06
Biodiversity protection	0.89***	0.29	1.49	0.06	-5.43	5.54	0.16***	0.13	0.19	0.01	0.00	0.03	0.06***	0.05	0.07
Support small farms	0.81**	0.08	1.54	0.18	-41.25	41.61	0.05	-0.02	0.12	-0.03	-0.08	0.02	0.05***	0.02	0.09
Support for all farms	0.00	-0.30	0.31	0.01	-42.85	42.87	0.00	-0.07	0.07	0.03*	0.00	0.07	-0.03*	-0.06	0.00
Regional milk	0.61**	0.10	1.12	0.21	-66.81	67.23	0.08**	0.01	0.14	0.01	-0.01	0.03	0.02	0.00	0.04
Tie-stall* Support small farms	0.57*	-0.09	1.23	-0.01	-1.30	1.28	0.18**	0.04	0.33	0.10**	0.02	0.19	-0.02	-0.08	0.05
Tie-stall+pasture* Support small farms	0.25	-0.36	0.87	-0.24	*******	*******	0.00	-0.28	0.28	0.09*	0.00	0.18	0.08**	0.01	0.15
Regional milk* Support small farms	0.07	-0.51	0.65	-0.57	-158.75	157.61	-0.10	-0.26	0.06	0.03	-0.04	0.09	-0.03	-0.08	0.02
Regional milk* Support all farms	-0.32	-1.02	0.39	-0.27	-139.69	139.14	0.09	-0.10	0.28	-0.01	-0.08	0.06	0.04	-0.02	0.11

*Note: *** significant at 1%, ** significant at 5%, * significant at 10%*

The differences in socio-demographic characteristics, attitudes and buying behaviour among the five LCM classes of respondents are described below. The comparison is based on the estimates for the class membership function from the LCM and tests of statistical significance (Pearson Chi-square, Mann-Whitney and Kruskal-Wallis tests) of differences between the classes.

Two of the five estimated latent classes of respondents have higher proportion of lowest-price milk buyers (classes 2 and 4) and three classes have higher proportion of high-price milk buyers (classes 1, 3 and 5). Class 2 is with a very high price sensitivity, lower mean income, lower mean education level and no WTP for ethical attributes (most of the members are only lowest-price alternative choosers). Class 4 is also highly price-sensitive, with lower mean income and higher percentage of younger individuals, below 40 years, but shows WTP for highest animal welfare and support for farmers. Mean education of class 4 is not statistically significant from that in classes 1, 3 and 5. Class 1 shows overall highest WTP values and would support small below-average-income farms, but not all farms. It includes many higher income, mainly female, organic and regional milk buyers, who currently pay higher milk prices. Class 3, with the second highest WTP values, also has higher female representation and higher proportion of members, who currently pay higher milk prices. Respondents in class 3 show preferences for highest animal welfare, biodiversity and regional production, and less strong preferences for support to farmers than the other classes, except class 2 (which does not have any WTP for farmer support). Class 5 respondents have significant WTP for animal welfare and farmer support, but no significant WTP for regional production.

Paired-classes income comparisons show that the income of class 1 is not higher than that of class 3 but higher than other classes, there is no statistical difference in income between class 1 and class 3 and class 3 and class 5. Mean income is, however, lower in class 2 and class 4. The higher income classes (above 3,000 €/month household net income) are most represented in class 1 and class 5 and less in class 3, but all the other (lower) income classes are also represented by one forth to one third in these two biggest LCM classes (Figure A. 1

in the appendix). Class 2 has the highest proportion of low-income individuals as members (with below 1,000 €/ month household net income), and the lowest proportion of high-income individuals. Thus, income seems to play a role in milk preferences, but not in each case.

All respondents who chose the fixed lowest-price alternative (quasi-status quo) on all cards are members of class 2 and make up 87% of it. 86.5% of this class also currently pay the lowest milk price (Figure A. 2 in the appendix). In class 4 these respondents account for 73.3% of the members. Thus, class 2 and 4 are the classes with highest percentage membership of lowest-price milk buyers, one third of them are members of class 2. Lowest-price milk buyers are, however, represented in all LCM classes and make up about one third of the members of classes 3 and 5. The majority of buyers with high currently paid price (above 1 € per litre) are members of class 1, followed by class 3 and class 5. In class 1 these are 50% of the members, in class 3 – 28.5%, in class 5 - 9%, whereas in class 2 and 4 only 3% and respectively 2% currently pay above 1€ for milk.

Lowest-price milk buyers are also represented in all income classes – they account for almost 50% of the members of the lowest income class and for almost 20% of the highest income class (Figure A. 3 in the appendix).

Class 1 and 3, with the highest WTP values, have more female representation, as also shown in the results for the class membership function of the estimated LCM. Only about one third of the members in these classes are male (Table A. 6 in the appendix). By contrast, class 2 and class 4 have a bit more than 50% male members. Mean age class is statistically not different between the LCM classes, except that it is lower in class 4. This class has the highest proportion of younger individuals, below 40 years.

70% of the frequent organic milk buyers are in class 1, none of them are members of class 2 and only 2 of them are in class 4. Class 1 contains also half of the frequent pasture milk buyers (Table A. 6 in the appendix). Mean milk consumption per week is significantly lower in class 3 and mean meat consumption is fairly the same in classes 2, 4 and 5, but is lower in classes 1 and 3, with higher female representation.

Respondents having donated for animal protection in the last two years and those with a farmer as friend or family member are not expected to belong to class 2 (the corresponding parameter estimates in the LCM class membership function are negative). Individuals who have donated for animal protection and those having donated for environmental protection in the last two years are most represented in class 1. Individuals having farmers as friend or family member are most represented in class 1 and 5 (Table A. 6 in the appendix). There are accordingly significant differences in general attitude to agriculture between classes. Respondents in class 1 have on average most positive attitude followed by class 5 and class 3, class 2 has least positive attitude.

5. Discussion and conclusions

By far, the highest ranked ethical milk attribute in our experiment is the highest level of animal welfare included in the experiment - having free-stall plus summer pasture. Almost all buyers are willing to pay for it, including buyers with lower income and less ethical preferences in general. Thus, developing a nationwide official pasture milk label seems appropriate. The significant WTP for support of small, below-average-income farms in combination with tie-stall and pasture indicates that a pasture label could be attractive to customers even without a complete restriction on tethering, as it is the case with the newly developed pasture milk label for the federal state of Lower Saxony. In its guidelines tethering is allowed, but under the condition of more pasture days per year than for free-stall cows and if outdoor access is provided every two days for at least one hour.

The recently developed guidelines for a German animal welfare label for dairy cows involves a prohibition of tethering (German Animal Welfare Association, 2017). The first certification level prescribes free-stalls and the premium certification level requires additionally access to an exercise yard and to pasture in the grazing period. However, since the certification is voluntary, the label might not induce substantial changes in the existing housing systems for dairy cows.

The existing WTP for a combination of tethering (with and without pasture) and support for small and below-average-income farms means that to many consumers fairness to farmers is more important than animal welfare, when it comes to small farms with lower-than-average income. This is an argument in favour of those who reject a complete ban on tie-stalls in Germany. Preferences of Germans for fairness to weak income groups has also been supported in the context of donations for forest conservation in developing countries by the results of Markova-Nenova and Wätzold (2017).

In the UK, preferences for dairy cows welfare have been investigated by Ellis et al. (2009). They found strong disapproval for keeping dairy cows permanently indoors (95% of the respondents stated this was unacceptable). Tethering of cows was also not acceptable for most respondents (95%). 73% of respondents considered keeping cows outdoors in summer and indoors in winter as acceptable. The majority of respondents (92%) stated willingness to pay higher milk prices for guaranteed animal welfare, 37% of respondents indicated they would pay 30% higher prices.

In some previous studies socio-demographic characteristics have been less important determinants of preferences for ethical attributes of food than social identification, attitudes and values (e.g. Bartels, 2010 – for adoption of new organic products in general; Klein, 2011 and Stolz et al., 2011 – for milk). Similarly to our study, however, Illichmann and Abdulai (2013) found significant differences in preferences and WTP between males and females (for organic milk, beef and apples).

As our results suggest, income also to some extent plays a role as a determinant of WTP for ethical milk attributes, lower income inferring lower WTP. However, we also find that conventional lowest-price milk buyers are represented in all income classes and that many of them show WTP for additional ethical attributes and a willingness to spend more (than what they currently pay) to buy milk with such ethical attributes. This change in price sensitivity could be to some extent triggered by the provision of information on ethical attributes of milk through the choice experiment. Positive feedback provided by respondents at the end of the online survey supports this conclusion. The importance of information for raising awareness and building consumers' preferences for ethical milk attributes is also confirmed by Wägeli, Janssen and Hamm (2016).

The greater amount of information provided in our survey might be also the reason why regional/ local origin of milk is less valued in our choice experiment than in previous experiments. In the survey conducted by Illichmann and Abdulai (2013), respondents were willing to pay much higher premium for organic milk from their region - 0.58 € more. The WTP for organic milk from the state was 0.12 € for females and 0.35 € for males. Since the study focused on organic milk, higher premiums for regional origin are plausible. Another reason for the lower importance of local origin for respondents in our study could be the so-called embedding effect. In our choice experiment the respondents faced trade-offs between a higher number of appealing ethical attributes. As a recent study by Waldrop, McCluskey and Mittelhammer (2017) suggests, adding multiple sustainability claims or certifications to a product may result in 'diminishing returns' (lower price premiums) for the additional claims.

The more detailed and differentiated definition of fairness to farmers in our case (through the inclusion of a maximin option) also leads to some interesting results. Namely, overall, respondents prefer to support small, below-average-income farms and are against supporting all farms with the price they pay for milk. This is in contrast to previous studies (e.g. Klein 2011) where fair production has been defined as all farmers getting back a fixed amount of the price per litre. In our case, we have specified an additional, higher level of fairness – to poorer farmers – and it is indeed on its own valued higher by consumers. On the other hand, interestingly, if we include the dimension of regionality in the analysis of fairness preferences – by looking at the interaction effects – on a regional scale support to all farms is preferred.

The results of the study can be used in developing labels for milk to reach a broader group of consumers or to target a specific group of consumers and can be informative for the design of agri-environmental schemes for grassland conservation. The significant preferences for biodiversity protection in milk production among higher income buyers, which are strong tax payers, indicate support for effective agri-environmental measures.

A possible limitation of our study is the inclusion of a 'no-buy' alternative instead of a real opt-out 'none-of-these' option and thus restricting the possible choices for respondents. One argument why we define the no-choice alternative as 'no-buy' and not simply as an opt-out option is that lowest price is the main factor for buying conventional milk. Conventional milk buyers decide primarily based on price. We hypothesize that when they get informed about other ethical characteristics of milk, they have a WTP for them, which is also supported by the findings of Stolz et al. (2011). In addition, in our hypothetical experiment, one of the aims was to check to what extent milk buyers are price sensitive and the trade-off between price and the ethical attributes of milk was particularly important. Since we included a fixed lowest-price milk alternative as a quasi-status-quo option, the inclusion of a 'none-of-these' alternative would have been inappropriate, taking into account the fact that this could have increased the probability of choosing the opt-out. By defining a fixed alternative and a 'no-buy' alternative we can check what portion of the milk buyers are only interested in price or can only afford the lowest price and would not dispense with milk. Another possibility for the opt-out format could have been to set it as a choice of the respondents' own brand. However, for the ethical attributes involved in the survey using revealed preferences data is not possible, since these attributes are not always explicitly specified as characteristics of existing milk products or do not exist yet. Thus a 'no-buy' alternative was a better solution.

The attitude-behavior gap discussed in the literature on consumer preferences (Meyerhoff, 2006; Vermeir and Verbeke, 2006) can bias the estimation of consumers' willingness to pay. This and the hypothetical nature of the choice experiment might be reasons for the high WTP values of the first class of respondents in the estimated LCM. However, since these respondents are also members of the LCM class with overall highest income and high proportion of frequent organic buyers, a much higher WTP than that of other LCM classes is reasonable. This is also in line with the high WTP values elicited by Hasselbach and Roosen (2015) for combinations of organic and regional milk.

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Appendix:

Table A. 1 Percent of dairy cows kept in tie- and free-stalls and provided with pasture access in Germany, in total and according to farm size (data from 2009 provided by the Federal Statistical Office Germany 2010).

According to farm size:	Tie-stall	Free-stall	Access to pasture	% of all dairy cows in farm size category
smallest farms (1-19 cows)	89.9%	8.4%	44.5%	6.0%
small farms (20-49 cows)	69.4%	30.1%	41.2%	24.9%
medium-sized farms (50-199 cows)	8.5%	91.2	50.6%	48.8%
large farms (≥ 200 cows)	2.9%	95.6	16.6%	20.4%
All farms	27.3%	72.0%	41.8%	100%

Note: In tie-stall systems cows are tethered and cannot move freely and in free-stalls they can move around the stall.

Table A. 2 Information on attributes and levels used in the text of the survey

Information pertaining to the characteristics and production processes involved in the different milk alternatives, which you will see in the next survey section.
• Animal welfare/ Housing system of dairy cows This characteristic of the milk alternatives shows how appropriate the housing system is for the species. In Germany about one fourth of the milk cows are kept in tie-stalls, 42% of all dairy cows have access to pasture. - Tie-stall, i.e. the dairy cows cannot walk around, but just stay up or lie - Tie-stall with summer pasture, i.e. the dairy cows cannot walk around in the stall, but they are kept on pasture during summer - Free-stall, i.e. the dairy cows can walk around in the stall, but not outside - Free-stall with summer pasture, i.e. the dairy cows can move around all year round in the stall and in summer also on the pasture field
• Biodiversity protection – Effect of the milk production on the protection of endangered species, especially birds, which breed on pastures and meadows, but also on butterflies and other insects. Irrespective of the housing system used (e.g. if pasture access is provided or not) milk farmers can aid biodiversity protection by e.g. longer intervals between cuts and by mowing outside the breeding times of meadow birds, and by reduced use of fertilizer and concentrated feed. Thus, milk production can have the following effect on endangered species: - Good for biodiversity protection – many endangered species get protected e.g. through reduced use of mineral fertilizer and a differentiated meadow and pasture management that is oriented at protecting many different endangered species – such as ensuring no cut during the reproductive period of meadow birds. - No special biodiversity protection – loss of biodiversity is not mitigated

e.g. in the case of intensive grassland management without fertilizer use restrictions and with high input of concentrated feed, such as grain, maize and soy

- Support for milk farms – fair prices to producers

To ensure that milk farmers get sufficient income, a specific part of the end price of milk (e.g. 10 Cent per litre) can go to a special fund for the support of either all milk farms or of only small milk farms with below-average income.

  - Support for all milk farms
  - Support for small milk farms with below-average income
  - No support

- Origin of the milk – through regional/local production transport distances are shortened and regional enterprises are supported
  - From your region (within a radius of max. 40 km)
  - From Germany

- Price per litre – 0.60 €; 0.78 €; 0.96 €; 1.14 €; 1.32€

Table A. 3 Overview of variables used in the presented choice models

Variable	Meaning	Coding
Attributes		
Free-stall+pasture	Free-stall+summer pasture	1, if yes, -1, if tie-stall, 0, otherwise
Free-stall	Free-stall	1, if yes, -1, if tie-stall, 0, otherwise
Tie-stall+pasture	Tie-stall+summer pasture	1, if yes, -1, if tie-stall, 0, otherwise
Biodiversity protection	Biodiversity protection	1, if yes -1, if no
Support small farms	Support for small farms with below-average income	1, if yes, 0, if support for all farms, -1, if no support
Support all farms	Support for all farms	1, if yes, 0, if support for small farms, -1, if no support
Regional milk	Regional milk	1, if yes 0, if no
Price	Price in € per litre	0.60, 0.78, 0.96, 0.14, 0.32
Covariates		
Gender	Female Male	1, if female 0, if male
BuyerOrg	Frequent organic milk buyers	1, if yes 0, if no
SQPlow	Buyers with lowest currently paid price (0.60 € – 0.69 €)	1, if yes 0, if no
SQPhigh	Buyers with high currently paid price (≥1.00 €)	1, if yes 0, if no
Friendfarm	Buyers having a farmer as friend or family member	1, if yes 0, if no
DonAnimal	Buyers having donated for animal protection in the last two years	1, if yes 0, if no

Table A. 4 Results of panel mixed logit (ML) model

Attribute	Marginal utility	Standard error	95% Confidence interval	
Random parameters in utility functions				
Free-stall+pasture	1.19***	0.07	1.05	1.33
Free-stall	-0.08	0.06	-0.19	0.03
Tie-stall+pasture	0.28***	0.07	0.16	0.41
Biodiversity protection	0.36***	0.04	0.28	0.43
Support small farms	0.28***	0.08	0.13	0.43
Support all farms	-0.12*	0.06	-0.24	0.00
Regional milk	0.17***	0.05	0.07	0.27
Nonrandom parameters in utility functions				
Price	-4.43***	0.16	-4.75	-4.12
Tie-stall*Support small farms	0.33**	0.14	0.06	0.60
Tie-stall-pasture*Support small farms	0.52***	0.14	0.25	0.79
Regional milk*Support small farms	-0.21*	0.12	-0.44	0.03
Regional milk*Support all farms	0.35***	0.13	0.09	0.61
SQ-ASC	-0.99***	0.10	-1.18	-0.80
NO-ASC	-5.95***	0.18	-6.30	-5.59
Std.Dev. of random parameters				
NsFree-stall+pasture	1.48***	0.08	1.32	1.63
NsFree-stall	0.58***	0.12	0.35	0.80
NsTie-stall+pasture	0.94***	0.08	0.78	1.09
NsBiodiversity protection	0.87***	0.04	0.79	0.95
NsSupport small farms	1.04***	0.06	0.93	1.15
NsSupport all farms	0.43***	0.07	0.31	0.56
NsRegional milk	0.53***	0.04	0.44	0.61
Goodness of fit indicators				
Number of respondents	1,040			
Number of observations	8,320			
Log-likelihood	-7,552.27			
McFadden Pseudo-R^2	34.52%			
BIC	15,294.10			
CAIC	15,315.10			
AIC(normalized)	1.82			

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*Note: *** significant at 1%, ** significant at 5%, * significant at 10%.*
Fixed parameter is constrained to equal the value.

Table A. 5 a. Results from latent class model (LCM) model with class membership function (insignificant values in grey colour)

Class	Class 1 - 'the higher income, organic, fairness and regional buyers'			Class 2 - 'the lower income, lowest-price buyers'			Class 3 – 'highest animal welfare, biodiversity and regional buyers'			Class 4 - 'price sensitive low-price milk buyers with preferences for highest animal and farmer fairness'			Class 5 - 'the (animal and farmer) fairness buyers'		
Attribute	**Marginal utility**	**95% Confidence interval**		**Marginal utility**	**95% Confidence interval**		**Marginal utility**	**95% Confidence interval**		**Marginal utility**	**95% Confidence interval**		**Marginal utility**	**95% Confidence interval**	
Utility parameters															
Free-stall+pasture	1.35***	1.19	1.50	-6.87	-4726.12	4712.38	1.78***	1.54	2.02	0.80***	0.27	1.33	0.75***	0.55	0.94
Free-stall	-0.25***	-0.39	-0.11	6.03	-1925.32	1937.37	0.18	-0.07	0.43	-0.11	-0.47	0.26	-0.10	-0.27	0.07
Tie-stall+pasture	0.33***	0.16	0.49	5.17	-1926.06	1936.40	0.15	-0.13	0.44	0.06	-0.23	0.34	0.25***	0.10	0.40
Biodiversity protection	0.48***	0.38	0.58	0.77	-197.10	198.64	0.61***	0.48	0.75	0.13	-0.07	0.34	0.39***	0.30	0.47
Support small farms	0.44***	0.28	0.60	2.49	-190.92	195.91	0.20	-0.07	0.46	-0.37	-0.96	0.22	0.36***	0.14	0.59
Support all farms	0.00	-0.17	0.17	0.12	-578.35	578.58	0.00	-0.28	0.27	0.37*	-0.07	0.81	-0.18*	-0.37	0.00
Regional milk	0.33***	0.19	0.47	2.92	-475.41	481.25	0.29**	0.05	0.52	0.10	-0.16	0.36	0.11	-0.03	0.25
Price	-0.54**	-0.97	-0.12	-13.92	-2213.81	2185.97	-3.81***	-4.58	-3.03	-11.59***	-13.52	-9.65	-6.66***	-7.25	-6.08
Tie-stall*Support small farms	0.31*	-0.03	0.65	-0.11	-4.02	3.80	0.70**	0.16	1.24	1.20**	0.15	2.25	-0.12	-0.55	0.32
Tie-stall+pasture*Support small farms	0.14	-0.23	0.50	-3.34	------	------	0.00	-1.06	1.06	1.05*	-0.09	2.18	0.55**	0.09	1.00
Regional milk*Support small farms	0.04	-0.28	0.36	-7.92	-1010.00	994.15	-0.39	-0.98	0.20	0.30	-0.43	1.04	-0.19	-0.54	0.16
Regional milk*Support all farms	-0.17	-0.56	0.22	-3.81	-1348.02	1340.39	0.35	-0.36	1.06	-0.15	-0.95	0.65	0.30	-0.13	0.72
SQ-ASC	-2.78***	-3.83	-1.73	15.81	-4103.73	4135.35	-3.55***	-6.09	-1.00	-1.39***	-1.92	-0.87	-2.90***	-3.19	-2.61
NO-ASC	-3.65***	-4.18	-3.11	-7.88	-2621.93	2606.17	-3.01***	-3.70	-2.34	-13.99***	-15.65	-12.34	-9.72***	-10.44	-9.01
Class membership function parameters															
Constant	-0.91***	-1.31	-0.51	-2.13***	-2.80	-1.47	-1.65***	-2.11	-1.18	-1.52***	-2.09	-0.96	0.00	(Fixed Parameter)	
Gender	0.85***	0.43	1.27	-0.26	-0.75	0.24	0.72***	0.22	1.22	-0.29	-0.84	0.25	0.00	(Fixed Parameter)	
BuyerOrg	1.03**	0.24	1.82	-7.76	------	30744.23	0.69	-0.31	1.69	0.15	-8.18	8.48	0.00	(Fixed Parameter)	
SQPlow	-0.33	-0.83	0.17	2.77***	2.13	3.42	0.12	-0.45	0.69	1.68***	1.08	2.28	0.00	(Fixed Parameter)	
SQPhigh	2.02***	1.44	2.60	0.56	-0.68	1.81	1.22***	0.53	1.91	-0.93	-9.32	7.46	0.00	(Fixed Parameter)	
Friendfarm	-0.38	-0.91	0.14	-0.73**	-1.39	-0.07	0.31	-0.24	0.86	-0.62	-1.38	0.13	0.00	(Fixed Parameter)	
DonAnimal	0.84**	0.18	1.49	-2.33**	-4.44	-0.23	0.80**	0.06	1.53	-0.33	-1.60	0.94	0.00	(Fixed Parameter)	

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*Note: *** significant at 1%, ** significant at 5%, * significant at 10%. Fixed parameter is constrained to equal the value*

b. Results for goodness of fit from LCM model with class membership function

Indicator	Value
Number of respondents	1,040
Number of observations	8,320
Log-likelihood	-6,019.47
McFadden Pseudo-R^2	47.81%
BIC	12,923.53
CAIC	13,021.53
AIC(normalized)	1.47

Table A. 6 LCM class membership of females, frequent organic and pasture milk buyers, donors for animal end environmental protection and individuals with farmer as friend or family member

LCM class		Category					
		Females	Frequent organic buyers	Frequent pasture milk buyers	Donors for animal protection	Donors for environmental protection	Having farmer as friend or family member
1	Count	247	70	79	62	48	62
	% within class	69.4%	19.7%	22.2%	17.4%	13.5%	17.4%
	% within category	41.3%	70.0%	49.7%	54.4%	55.2%	31.2%
2	Count	65	0	12	1	2	18
	% within class	46.1%	0.0%	8.5%	0.7%	1.4%	12.8%
	% within category	10.9%	0.0%	7.5%	0.9%	2.3%	9.0%
3	Count	92	15	22	23	15	41
	% within class	67.2%	10.9%	16.1%	16.8%	10.9%	29.9%
	% within category	15.4%	15.0%	13.8%	20.2%	17.2%	20.6%
4	Count	48	2	10	5	5	14
	% within class	45.7%	1.9%	9.5%	4.8%	4.8%	13.3%
	% within category	8.0%	2.0%	6.3%	4.4%	5.7%	7.0%
5	Count	146	13	36	23	17	64
	% within class	48.5%	4.3%	12.0%	7.6%	5.6%	21.3%
	% within category	24.4%	13.0%	22.6%	20.2%	19.5%	32.2%
Total	Count	598	100	159	114	87	199
Count in category as % of respondents		57.5%	9.6%	15.3%	11.0%	8.4%	19.1%

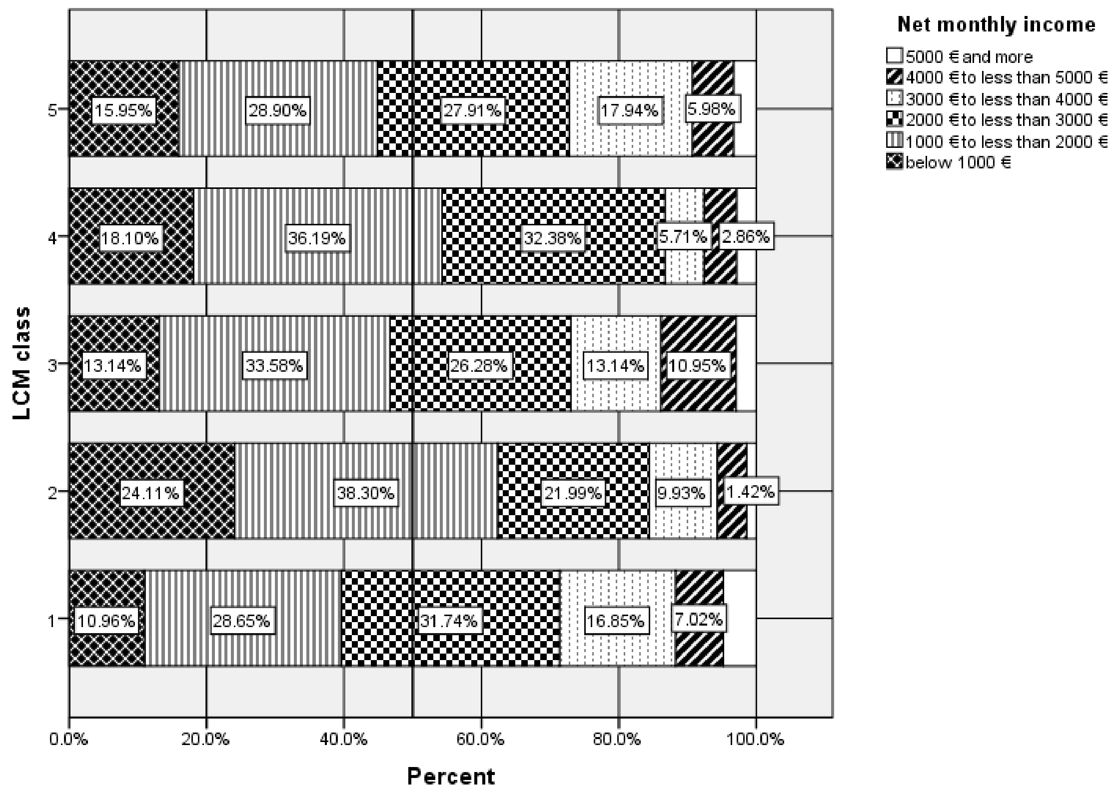

Figure A. 1 Net monthly household income vs. LCM class

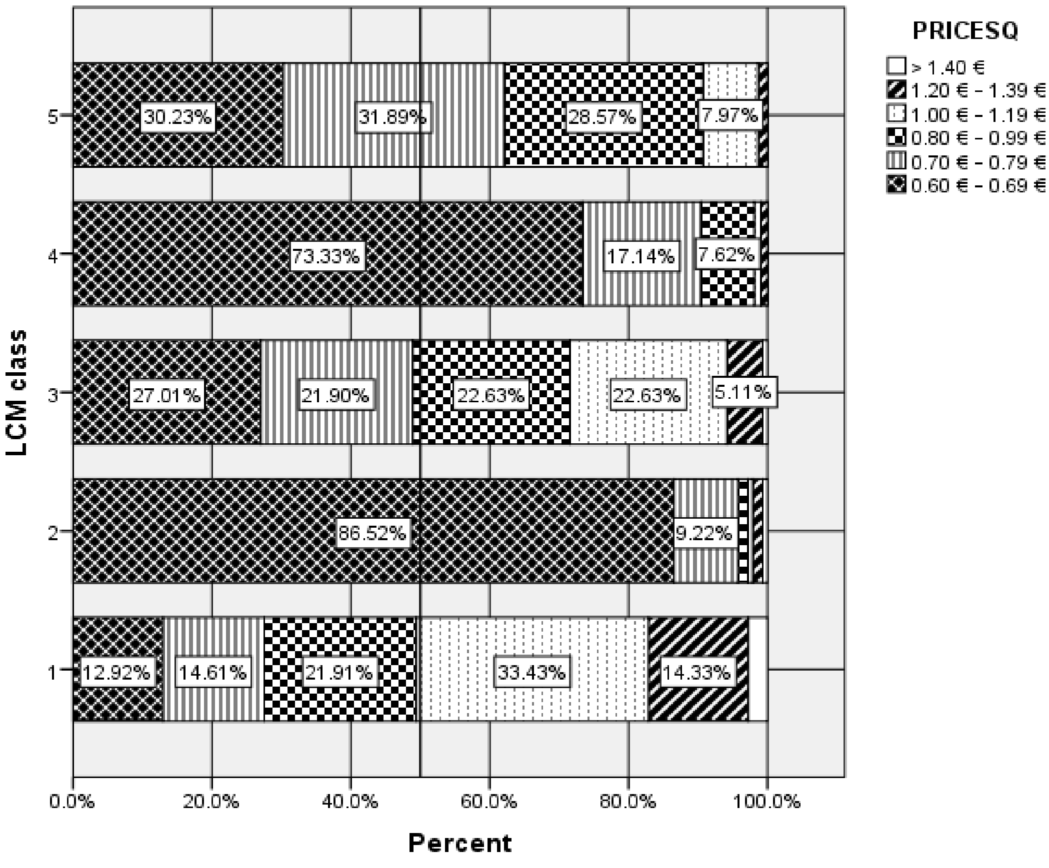

Figure A. 2 Currently paid milk price vs. LCM class

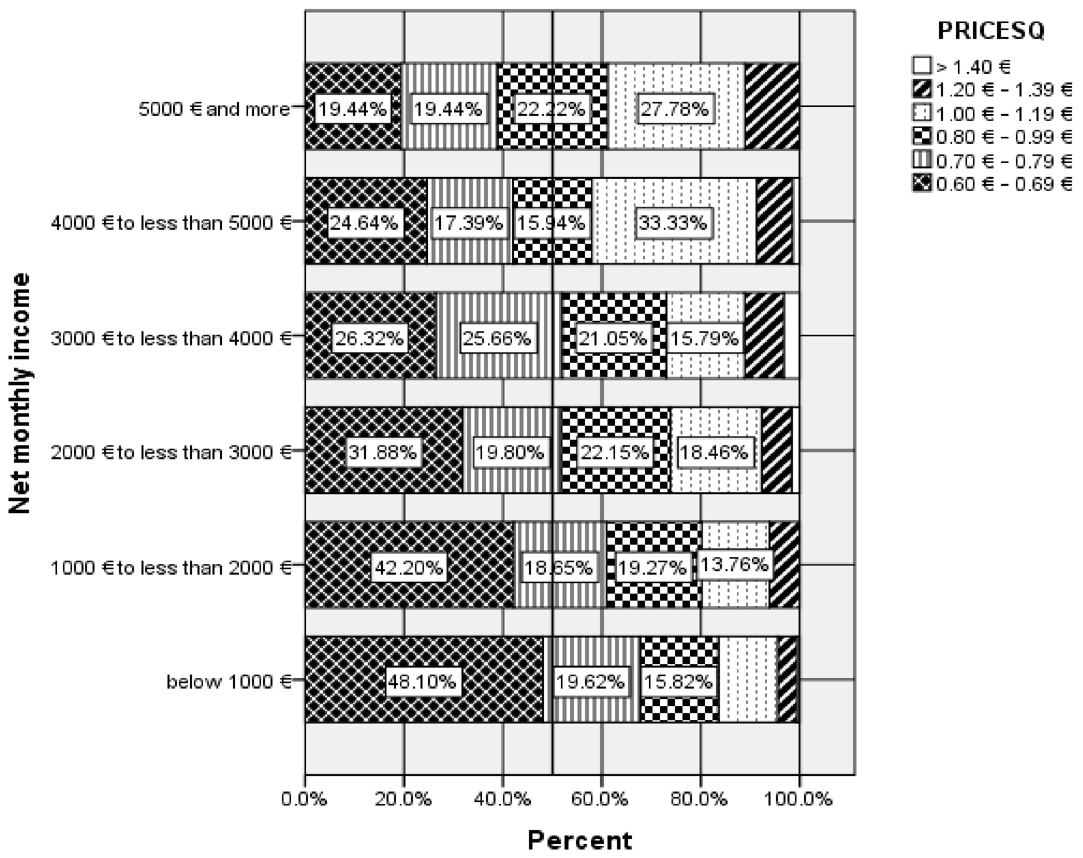

Figure A. 3 Currently paid milk price vs. net monthly household income