Fairness to dairy cows or fairness to farmers: What counts more in the preferences of conventional milk buyers for ethical attributes of milk?

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1 December 2017

This article has been published in Land Use Policy 2018, 79, p. 223-239,
https://doi.org/10.1016/j.landusepol.2018.07.045

Fair to the cow or fair to the farmer? The preferences of conventional milk buyers for ethical attributes of milk

Abstract:

Conventional dairy farming has been under pressure for lacking animal welfare, biodiversity loss through abandonment and intensification of grassland, and low milk prices during the 2015/16 milk price crisis. The relatively stable organic milk prices during the milk price crisis indicate that consumers have preferences for product characteristics besides the price. We investigate through a choice experiment the willingness-to-pay (WTP) of German conventional milk buyers for ethical attributes of milk production that address the above-mentioned concerns. Respondents have the highest WTP for animal welfare – free-stall plus summer pasture – followed by biodiversity conservation, support for small, below-average income farms, and regional milk production. Respondents also have a positive WTP to support all farms but only in combination with regional production. We further find a positive WTP to support small farms in combination with tethering. This implies animal-welfare concerns are somewhat counterbalanced by fairness aspects. Our insights may support developing labels and agri-environmental policies concerning ethical aspects of conventional milk production.

Keywords:

dairy production; ethical attributes; fairness; grassland biodiversity; choice modelling; latent class model

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

1. Introduction

Dairy farming in the EU has been recently under pressure for several reasons. From an animal welfare point of view, the keeping of cows in tie-stalls (where they are tethered and cannot move freely) and their frequent lack of access to pasture has been criticized (Algers et al., 2009; Kikou, 2015).

Moreover, an important part of European biodiversity depends on the existence of grassland and its management and hence on how the production system of dairy farming is organised (Klimek et al., 2007). Diverse and extensive grassland management supports a high level of biodiversity (Wätzold et al., 2016; Young et al., 2007) whereas intensively managed pasture leads to less biodiversity (Plieninger et al., 2012). However, extensive grassland management with low economic yield is not economically viable today (Hodgson et al., 2005). Even intensively managed grassland is under growing pressure to convert to arable land as grazed-herbage is increasingly replaced by maize silage and concentrated feed, resulting in even more adverse effects on biodiversity (IEEP, 2007).

Conventional dairy farmers have also been under pressure in terms of profitability. During the recent EU milk price crisis, producer prices dropped from around 0.38 €/kg in 2014 to less than 0.27 €/kg in 2016 for conventional milk 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). Similar milk price developments took place in other European countries (see BLE, 2017 for Germany, France, and Austria). Only at the end of 2016, after public intervention by the EU (buying up and storage of skimmed milk powder) and the provision of financial support to dairy farms, milk prices returned to levels seen prior to the milk price crisis (EU Milk Market Observatory, 2017).

Interestingly, during the milk price crisis, producer prices for organic milk remained rather stable in Germany at around 0.48 €/kg, (Bioland, 2017). This is unusual as previously the price of organic milk typically followed conventional milk price fluctuations. However, a similar widening 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 are higher-value agricultural products.

Yet organic milk does not offer much product and price differentiation, which suggests that the product and price segment between conventional and organic milk has not yet been fully utilized. So, besides organic farming, another marketing strategy for more stable milk prices, which may also address the challenges of dairy farming mentioned above, could be value creation and product differentiation through the introduction and marketing of different ethical attributes of production. Ethical attributes are associated with social and environmental issues (Luchs, 2010).

Several economic studies on preferences for ethical milk attributes have been conducted in Europe applying either choice experiments (CE) or other willingness-to-pay (WTP) approaches. Previous CE studies have focused on preferences for organic and local milk (Illichmann and Abdulai 2013), partly in combination with other attributes (Hasselbach and Roosen, 2015 with brand names; Klein, 2011 with fair prices for producers; Wägeli et al., 2016 with exclusion of GMO production). Some studies analysed preferences for ethical milk attributes on a more general level but have not involved a monetary valuation of specific attributes (e.g. Stolz et al., 2011; Zander and Hamm, 2010). Others directly asked respondents about their WTP for certain ethical attributes (Hellberg-Bahr et al., 2012 and Weinrich et al., 2014 for pasture milk; Ellis et al., 2009 for animal welfare; Emberger-Klein et al., 2016 for regional milk).

We contribute to this literature by conducting a CE among German milk buyers to elicit their WTP for ethical attributes of milk production. Our study is novel as we focus on conventional milk buyers and include a comprehensive list of ethical milk attributes which enables us to rank the relevance of the ethical attributes for the conventional milk buyers. These attributes are:

animal welfare, the support of biodiversity through milk production, financial support for small farms with below-average income or for all farms, and production in one's own region. Furthermore, the ethical attributes in our experiment are not linked to the explicit use of labels, certifications or brands, as in previous studies (Hasselbach and Roosen, 2015; Illichmann and Abdulai, 2013; Klein, 2011; Wägeli et al., 2016). This is because there is no existing label for these ethical attributes (except for regional origin) in Germany and they have not been covered in valuation studies. Our study also provides novel insights in other respects. Previous valuation studies focused on fair prices to all farmers (Klein, 2011). We introduce another dimension of farmers' equity by including fairness to small, below-average income farms. To our knowledge, this is also the first study to provide a monetary valuation for biodiversity conservation in the context of milk production.

The aforementioned studies on milk preferences focused on values, attitudes, socio-demographic variables and norms to explain variation in preferences for ethical milk attributes (e.g. Emberger-Klein et al., 2016). In addition to socio-demographic factors, we use stated buying behaviour towards milk to explain heterogeneity in consumers' preferences for ethical milk attributes. The explanatory variables we use are: gender, frequency of organic milk purchase, currently paid milk price, having donated to animal protection and having a farmer as a friend or family member.

Moreover, we investigate respondents' preferences for some combinations of ethical attributes (four interaction effects) which, to our knowledge, have not been addressed in the literature.

(1) Fairness for dairy cows vs. equity for small, poor farms. How do milk buyers value support for small, below-average income farms that use tethering of dairy cows (1a) with pasture and (1b) without pasture?

(2) Influence of product origin on preferences for fairness to milk producers. Do buyers prefer to support (2a) small, below-average-income farms only or (2b) all farms in their region?

Our results can inform the development of labels for milk products which reflect customers' preferences and are also relevant for the development of agri-environment policies in general. From an economic perspective, the design of agri-environment policies and in particular agri-environment payments should be based on the population's preferences for public goods provided by agriculture (Hall et al., 2004). Our study provides information on the preferences of a substantial part of the population – conventional milk buyers – for selected public goods related to milk production.

2. Choice modelling

To investigate the trade-offs in milk preferences we use the stated-preference method choice experiments. Appendix A provides an overview of the basic methodological approach whereas here we focus on specific aspects needed to understand our analysis. We employ a mixed logit model (MLM) with a panel specification for calculating overall mean WTP values over the whole sample. To ensure meaningful WTP estimates with correct signs, the utility parameter for price is assumed to be fixed, whereas the other parameters are normally distributed. In the MLM the probability of observing a sequence of choices under the assumption of a certain parameter distribution $f(\beta)$, e.g. normal distribution, is specified as (cf. Train, 2009 for general considerations and for an example see Kuhfuss et al., 2016):

$$P_n = \int \prod_s \left(\frac{\exp(\beta' x_{nsi})}{\sum_{j=1}^{J} \exp(\beta' x_{nsj})} \right) f(\beta) d(\beta) \qquad (1)$$

WTP values are calculated as the negative ratio of the marginal utility estimates for the attributes ($\beta_{attribute}$) and the marginal utility estimate for price (β_{price}). The confidence intervals of the WTP are computed based on the delta method (Bliemer and Rose, 2013).

$$WTP = -\frac{\beta_{attribute}}{\beta_{price}} \qquad (2)$$

Alternative-specific constants (ASC) are included for the A-alternative, the lowest-price fixed alternative and the 'no-buy' option and are assumed to be fixed. We selected the model with

A-ASC, since including this constant improved the model fit and the constant turned out to be significant. As Hensher et al. (2015, p. 52) note: "Treating constants as generic parameters…should only be done if, empirically, the ASCs for two or more alternatives are found to be statistically equivalent." Furthermore, an ASC can be used to test for systematic bias, where respondents might tend to select the first alternative in a choice set (Hasselbach and Roosen, 2015)."

We use a latent class model (LCM) with class membership function to analyse the preferences of different milk consumer groups. It allows for separate estimation of WTP values for each estimated latent class of consumers. Since we are interested in the preferences of milk buyers who usually buy the cheapest milk, using an LCM is more appropriate than using MLM with heterogeneity. We identify the cheapest milk buyers by including a question on the currently paid price for milk in the survey questionnaire and use the currently paid price as one determinant of preferences. Thereby, respondents' currently paid milk price serves as an indicator of price consciousness, which we expect to have an influence on the WTP for ethical milk attributes.

In the LCM employed here the utility parameter estimates are assumed to vary between classes of respondents and are fixed within the classes (cf. Boxall and Adamowicz, 2002). The number of classes in an LCM 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 the Bayesian information criterion (BIC) or the Akaike information criterion (AIC) (Swait, 2007). In our analysis we used the BIC and the consistent Akaike information criterion (CAIC).

3. Background information and survey

3.1. German milk sector

Dairy milk production is the most important agricultural activity in Germany and the dairy industry is the biggest sector in the country's food industry (MIV, 2017a). In 2016, 32,672,000 t cow's milk were produced in Germany in total, 5,182,000 t of which as drinking milk (MIV, 2017b). The drinking milk consumption was 4,350,800 t overall and 52.6 kg per capita (MIV, 2017b). Thus, Germany is by far the biggest producer of cow's milk in the EU, followed by France, and the second-biggest consumer of drinking milk behind the UK (Eurostat, 2017). Since 1950, due to intensification and increased productivity, cow's milk production has steadily increased, whereas the number of dairy farms and cows kept has decreased. In 1950 1.6 million dairy farms existed in Germany, whereas their number was only 67.319 in 2017 (MIV, 2017a). Especially the number of small farms has drastically decreased and there is a clear trend to large-scale dairy farming.

According to the latest available detailed agricultural report of the Federal Statistical Office Germany (2010), in 2009, only 6% of the dairy cows in Germany were kept in smallest farms, with up to 19 cows; 24.9% were kept in small farms with 20-49 cows; about 48.8% were in medium-sized farms with 50-199 cows and 20.4 % - in large farms with 200 cows or more (see Table B. 1). Overall, more than one fourth of the dairy cows (27.3%) were kept in tie-stall (tethering) systems and 72% in free-stall barns; 42% of the dairy cows in Germany had access to pasture. Thereby, pasture is relatively widely used in small and medium farms, but only rarely used in large farms (see Table B. 1).

Grassland is highly important for biodiversity conservation as it contains more than half of all species occurring in Germany (Federal Environmental Agency, 2015). Especially extensive, high nature value grassland, which contains a large number of endangered species, is highly threatened. It has declined by 7.4% between 2009 and 2013 in Germany (BfN 2014), and continues to decline in recent years (Länderinitiative Kernindikatoren, 2018).

In sum, in Germany small farms predominantly use tie stalls, often in combination with pasture, whereas large farms rarely use tie stalls, but also rarely provide for pasture access (Table B. 1). 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.[1] 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, since they usually cannot afford big investments in equipment. Small farms are also more susceptible to milk price changes and have suffered more during the milk price crisis in 2015 and 2016 (Ilchmann, 2017).

Organic milk prices were less affected by the latest milk price crisis. However, in Germany organic milk accounted for only 2.5% of the milk delivered to dairy factories in 2016 (MIV, 2017b). Similarly, the production share of organic milk in the EU as a whole is still low - at about 2.6% of the total EU cow's milk production in 2014 (Meredith and Willer, 2016). Even in Germany and France - the largest organic milk markets in the EU - the market share of organic milk (based on sales value) remains low - 8.1% and 10.8% respectively. In Austria and Switzerland the share is higher - 15.7 and 18.9% respectively (Meredith and Willer, 2016).

3.2. Survey

To investigate preferences for ethical milk attributes, in February 2017, we conducted an online CE survey of 1,040 conventional milk buyers (individuals who occasionally or frequently buy 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. Individuals, who frequently or occasionally buy conventional milk and in addition to this frequently or occasionally buy organic milk were allowed to participate. Respondents were screened for gender, education, age and size of their place of residence to ensure representativeness. Quota sampling was based on data for German milk buyers aged 18-95 years in the past 12 months from the German marketing study best4planning 2016. Table B. 2 provides an overview of sample statistics based on the quota

[1] as stipulated in Article 39 of Commission Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control

sampling procedure. The proportion of females in the sample is greater than that of males, as more often women are responsible for shopping.

3.3. Experimental design

Respondents had to choose between 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 in how often and why customers would choose the lowest-price milk, even though it involved the lowest levels for all ethical attributes. The definition of the opt-out as a ‘no-buy’ alternative also 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. By defining a fixed alternative and a ‘no-buy’ alternative we were able to 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. An example of a choice card used in the experiment is provided in Figure 1.

The attributes and levels for the experiment were chosen based on the research aims, literature review and focus group discussion. For the animal welfare attribute we focus on particular aspects of animal welfare, namely housing system and pasture access. We distinguish between four different housing systems: tie-stall, tie-stall with summer pasture, free-stall, and free-stall with summer pasture. Other housing systems do exist, e.g. free-stall with outdoor exercise area, but we included only the main housing systems to keep the complexity of the trade-offs at an acceptable level.

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 conservation	good for biodiversity conservation	no special biodiversity conservation	no special biodiversity conservation
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 Example of a choice card used in the survey

We considered fairness to farmers as support for dairy farms by providing "fair prices", whereby a specific part of the consumer milk price goes to a special fund for the support of either all milk farms or only small milk farms with below-average income. This leads to three options: no support, support for all farms, and support for small, below-average income farms. Support for small, below-average income farms is related to Rawls' (1971) maximin principle, which postulates that inequalities (in our case in financial support) should be 'to the benefit of the least advantaged', and the needs principle (Miller ,1976; Dobson, 1998), which postulates that those in need should get higher support.

As already mentioned, in Germany, small dairy farms predominantly use tie-stalls, often in combination with pasture, whereas large farms rarely use tie-stalls, but also rarely provide pasture access. So, whether milk buyers gain utility from supporting small farms despite cow tethering[2] is an interesting question. To analyse this trade-off between animal welfare and fairness to small, below-average income farms we estimate two interaction effects: support for

[2] For small farms, tethering is allowed in organic milk production, provided that summer pasture is used and the cows have access to open air at least twice a week in winter (Article 39 of Commission Regulation (EC) No 889/2008).

small, below-average income farms with tethering and summer pasture; and support for small, below-average income farms (henceforth small farms) with tethering.

We are also concerned with milk buyers' preferences for biodiversity conservation through milk production practices. Traditional extensive dairy farming supports biodiversity, whereas 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 positive effect on grassland biodiversity. In the CE the biodiversity-conservation attribute has two levels – 'good for biodiversity conservation' with the conservation of many endangered species, and 'no special biodiversity conservation', whereby loss of grassland biodiversity is not mitigated due to intensification. We explicitly stated that especially meadow birds and butterflies can profit from extensive grassland management by dairy farmers. As Lienhoop and Brouwer (2015) conclude, information on the type of species protected is instrumental for valuing biodiversity by respondents in stated-preference studies.

For the origin of milk we set two levels – regional and national origin – to keep the complexity of trade-offs within acceptable limits. In Germany, consumer milk is rarely imported; in recent years imports account for only about 7% of the total milk production in dairy factories (MIV, 2017). To analyse preferences for fairness to farmers when buying regional milk, we estimate two interaction effects: between regional origin and support for either small farms or all farms.

The questionnaire included questions on respondents' milk purchases, the importance of/ attitude towards different ethical aspects in buying decisions in general, and information on the CE, the different milk attributes, and the choice cards. Debriefing questions on the choice of the fixed and 'no-buy' alternatives and on the importance of cows' welfare and support to dairy farms to respondents, as well as an explicit question on individual WTP for milk with additional ethical attributes, and socio-demographic questions were also included.

Table 1 provides an overview of the attributes and levels included in the CE and Table B. 3 includes a complete description of attributes and levels from the survey questionnaire.

Table 1 Attributes and levels included in the CE

Attributes	Levels
Animal welfare/ Housing system of dairy cows	- **Tie-stall** - Tie-stall with summer pasture - Free-stall - Free-stall with summer pasture
Biodiversity conservation	- Good for biodiversity conservation – many endangered species protected - **No special biodiversity conservation – 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[3]	**0.60 €;** 0.78 €; 0.96 €; 1.14 €; 1.32€

Note: Reference levels (of the fixed milk alternative) in bold type

Ngene software was used to create a Bayesian D-efficient design (Bliemer et al., 2008) with a fixed alternative and a 'no-buy' alternative for the estimation of main effects and the four interaction effects mentioned. Ignoring any interaction effect by assuming its insignificance can lead to loss of information and confounding, whereas including many interaction effects leads to larger designs (Hensher et al., 2015). We only estimate the interaction effects of interest and acknowledge this as a limitation of the design.

The design included a requirement for combining 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' alternatives. 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 no

[3] The different price levels were based on real consumer prices in Germany in February 2017.

regional-production attribute was included, but a three-level biodiversity-conservation attribute (high, medium and no biodiversity conservation level). In the second pretest the choices included regionality of milk production and a two-level biodiversity conservation attribute. Since the estimated two parameters for the three effects-coded levels of biodiversity conservation in the first pretest - without regionality - were insignificant, whereas the parameter for the one effects-coded biodiversity-conservation variable in the second pretest was highly significant, we decided to use two biodiversity conservation levels in the main survey. With three levels for biodiversity conservation, it might have been difficult for respondents to distinguish between them, since limiting information load is important in eliciting preferences (Hensher, 2006).

In the main survey, normally distributed Bayesian priors based on the results of the pretest were used to generate an MNL D-efficient Bayesian design with 24 choice sets in three blocks with 8 choice sets each. Respondents were randomly assigned to 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 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 'only lowest-price-alternative choosers' currently pay the lowest milk price - 0.60 € to 0.69 €. Overall, the lowest-price alternative accounted for 20% of all the choices made.

An overview of the estimated utility parameters in the choice models and goodness-of-fit indicators is provided in Table B. 5 and Table B. 6. The LCM 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 specification we tested different buying behaviour variables and socio-demographic characteristics as predictors of preference heterogeneity in the class membership function and selected only the significant ones. The estimated LCM with significant covariates and best fit (see section 4.3), includes a class membership function based on gender, frequent organic milk purchasing, lowest currently paid price - 0.60 € to 0.69 € per litre (in the following referred to as cheapest-milk buyers), currently paid price between 0.70 and 0.79 €/litre, high currently paid price (above 1 €/litre), having a farmer as friend or family member and having donated to animal protection in the last two years (see list of variables used in Table B. 4).

The LCM was estimated with up to six classes. The five-class LCM showed lowest values for the information criteria BIC and CAIC and highest Pseudo R^2 and was therefore selected for further analysis. Another possible criterion for LCM model selection is the posterior probability of segment membership (see Beharry-Borg et al., 2012 for an application). Increasing the number of segments to five leads to higher number of respondents with posterior probabilities of membership less than 90%, but it also results in considerable improvement in model-fit (lower BIC and CAIC and higher Pseudo R^2 values). The six-class model is inferior regarding both selection criteria.

We also investigated whether heterogeneity of preferences was present depending on the socio-demographic characteristics income, education, age, having children, and rural or urban residents (differentiated according to data on district type from BBSR, 2015). However, the influence of these characteristics was insignificant. Stated buying behaviour variables which were tested and also had no significant influence on heterogeneity of preferences were: frequently buying pasture milk, frequently buying regional milk, and having donated to environmental protection in the last two years.

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

4.2. WTP estimation

The coefficients derived from the MLM were used in the estimation of overall mean WTP values over all respondents. MLM estimation with fixed price and all other parameters being random and normally distributed leads to significant standard deviation values, except for the last, fourth, interaction effect (support for all farms in one’s own region). Here we present the results from the estimation with fixed fourth interaction effect.

The WTP resulting from the MLM is highest for the highest level of animal welfare (free-stall plus summer pasture) and equals 24 cents/litre (Table 2). Biodiversity conservation is valued at 9 cents/litre. The second most preferred housing system (tie-stall plus summer pasture) and support for small farms are similarly valued at 7 cents/litre. Regional production is valued less than the aforementioned ethical attributes, at 3 cents/litre. The WTP as well as the marginal utility estimate for free-stall from the MLM are negative and significant.

The combinations of tethering (with and without pasture) and support for small farms are positively valued by respondents, at 8 cents/litre. The WTP for the interaction between support for all farms and regional milk is 13 cents/litre, which is the second highest estimated WTP from the MLM.

As expected, support for small farms is in general valued more than support for all farms. Surprisingly, respondents’ marginal utility for supporting all farms in general is negative and insignificant (Table B. 5), whereas in case of regional milk, respondents show positive WTP for supporting all farms and insignificant utility and WTP for supporting only small farms.

Table 2 WTP from mixed logit model (MLM)

Attributes/ Interactions	**WTP (€)**	**95% Confidence interval**	
Free-stall+pasture	0.24***	0.21	0.27
Free-stall	-0.02**	-0.05	0.00
Tie-stall+pasture	0.07***	0.05	0.10
Tie-stall[a]	-0.29		
Biodiversity conservation	0.09***	0.07	0.11
No special biodiversity conservation[a]	-0.09		
Support small farms	0.07***	0.03	0.10
Support all farms	-0.02	-0.05	0.01
No support[a]	-0.05		
Regional milk	0.03**	0.01	0.05
From Germany[a]	-0.03		
Interactions			
Tie-stall+pasture*Support for small farms	0.08***	0.02	0.15
Tie-stall*Support for small farms	0.08***	0.02	0.15
Regional milk*Support for small farms	-0.03	-0.08	0.03
Regional milk*Support for all farms	0.13***	0.07	0.19

Note: *** significant at 1%, ** significant at 5%, * significant at 10%
[a]The WTP for the effects-coded base levels is calculated as the negative sum of the WTP for the other levels (Cooper et al., 2012).

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

Cheapest-milk buyers are more likely to belong to classes 3 and 4, whereas high-price milk buyers are more likely to belong to classes 1 and 2. Class 5 has a higher proportion of buyers with currently paid prices in the mid-range (0.70 – 1 €/litre).

We do not find a significant WTP for ethical milk attributes among respondents in class 4, since the utility parameter estimates for this class are all insignificant, including the price parameter. Therefore WTP of class 4 is not reported in Table 3. All respondents who chose the fixed lowest-price alternative on all cards are members of class 4 and make up 88.5% of it. The other 16 (11.5%) of the 139 assigned members in class 4 have chosen the fixed alternative seven times and another alternative only on one card. Members of this class are on average highly price sensitive, with lower mean income and lower mean education level. There are no statistically significant differences in mean education among the other classes 1, 2, 3 and 5. Mean age is also not significantly different between the LCM classes.

Respondents in class 3 also tend to be highly price-sensitive, with lower currently paid milk prices, and lower mean income, but show WTP for highest animal welfare (free-stall with summer pasture) and support for small farms with tethering (with and without summer pasture).

Members in class 1 show overall highest WTP values and would support small farms (also in combination with tethering and summer pasture), but not all farms. Class 1 includes many higher income, mainly female (69%), organic and regional milk buyers, who currently pay higher milk prices. 71% of the frequent organic milk buyers and half of the frequent pasture milk buyers in the sample are members of this class (Table B. 7).

Class 2, with the second highest WTP values, also has higher female representation (67%), and a higher proportion of members who currently pay higher milk prices. Overall, respondents in this class show preferences for highest animal welfare (free-stall plus summer pasture), biodiversity conservation and regional production and would support small farms who use tethering with summer pasture.

Class 5 respondents have in general significant WTP for animal welfare, biodiversity conservation and small farmers' support, and for supporting all farms within their region.

Table 3 WTP from LCM panel model

	Class 1 - 'organic, regional, animal and farmer fairness milk buyers'			Class 2 - 'highest animal welfare, biodiversity and regional milk buyers'			Class 3 - 'lower income, price-sensitive milk buyers with preferences for animal and farmer fairness'			Class 4 - 'lower income, cheapest-milk buyers with no WTP for ethical attributes'			Class 5 - 'animal and farmer fairness milk buyers'		
Attributes/ interactions	**WTP**	**95% Confidence interval**		**WTP**	**95% Confidence interval**		**WTP**	**95% Confidence interval**		**WTP**	**95% Confidence interval**		**WTP**	**95% Confidence interval**	
Free-stall+pasture	1.71***	0.79	2.63	0.45***	0.37	0.52	0.06***	0.02	0.10	-	-	-	0.10***	0.07	0.13
Free-stall	-0.38***	-0.64	-0.13	0.04	-0.02	0.11	0.00	-0.04	0.03	-	-	-	-0.01	-0.04	0.01
Tie-stall+pasture	0.49***	0.18	0.80	0.04	-0.03	0.12	0.01	-0.02	0.04	-	-	-	0.04***	0.02	0.07
Tie-stall	-1.82			-0.53			-0.07			-	-	-	-0.13		
Biodiversity conservation	0.70***	0.37	1.03	0.16***	0.13	0.19	0.01	0.00	0.03	-	-	-	0.06***	0.05	0.07
No special biodiversity conservation	-0.70			-0.16			-0.01			-	-	-	-0.06		
Support small farms	0.58***	0.17	0.98	0.06	-0.01	0.13	-0.02	-0.07	0.03	-	-	-	0.05***	0.02	0.08
Support all farms	0.00	-0.21	0.22	0.00	-0.08	0.07	0.03	-0.01	0.06	-	-	-	-0.03**	-0.06	0.00
No support	-0.58			-0.06			-0.01			-	-	-	-0.02		
Regional milk	0.30**	0.07	0.53	0.06*	-0.01	0.12	0.01	-0.01	0.03	-	-	-	0.01	-0.02	0.03
From Germany	-0.30			-0.06			-0.01			-	-	-	-0.01		
Tie-stall+pasture* Support small farms	0.54**	0.08	0.99	0.21***	0.06	0.36	0.10**	0.01	0.18	-	-	-	0.00	-0.06	0.07
Tie-stall* Support small farms	0.35	-0.08	0.77	-0.02	-0.31	0.28	0.09*	0.00	0.18	-	-	-	0.08**	0.02	0.15
Regional milk* Support small farms	0.26	-0.15	0.66	-0.10	-0.26	0.06	0.01	-0.05	0.08	-	-	-	0.00	-0.06	0.06
Regional milk* Support all farms	0.22	-0.33	0.76	0.15	-0.04	0.34	-0.01	-0.09	0.06	-	-	-	0.09**	0.01	0.18
Members as % of all respondents		34.0			13.6			10.6			13.4			28.5	

Note: *** significant at 1%, ** significant at 5%, * significant at 10%; - No WTP calculated for class 4 due to insignificant price parameter.
[a]The WTP for the effects-coded base levels is calculated as the negative sum of the WTP for the other levels (Cooper et al., 2012).

Paired-classes income comparisons show that the mean income in class 1 is higher than in class 3 and 4, but not higher than that of class 2, and only on the 10% significance level higher than the mean income of class 5. The higher income classes (above 3,000 €/month household net income) are most represented in class 1 and class 5 and less in class 2, but all the other (lower) income classes are also represented in these LCM classes (Figure B. 1). The class with no significant WTP values, class 4, has the highest proportion of low-income individuals (below 1,000 €/ month household net income), and the lowest proportion of high-income individuals together with class 3. Thus, income seems to play a role in milk preferences, but not always.

All respondents who chose the fixed lowest-price alternative on all cards are members of class 4 and make up 88.5% of it. 86.3% of this class also currently pay the lowest milk price (Figure B. 2). In class 3 these respondents account for 71.8% of the members. Thus, class 3 and 4 are the classes with highest proportion of cheapest-milk buyers, one third of them are members of class 4. Cheapest-milk buyers are, however, represented in all LCM classes and account for about one third of the members of class 5 and one fourth of the members in class 2.

Cheapest-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 B. 3). 76% of all cheapest-milk buyers stated higher WTP for ethical milk attributes than their currently paid milk price.

The class with no significant WTP values (class 4) has higher mean milk consumption than the other classes and the two classes with highest WTP values (1 and 2) have lower mean meat consumption (Table B. 8).

Individuals who have donated to animal protection and those having donated to environmental protection are most represented in class 1 (Table B. 7). Respondents in class 1, with the highest WTP values, also have on average the most positive attitude to agriculture followed by class 2 and 5; class 4 respondents have the least positive attitude.

5. Discussion and conclusions

We analyse preferences and WTP for ethical attributes of milk among conventional milk buyers in Germany. Based on the mean WTP values over all respondents, the ethical attributes from our experiment can be ranked as follows: animal welfare, regional milk plus fair prices for all farms in the region, biodiversity conservation, support for small, below-average income farms (with and without tethering and in general), regional milk, fair prices to all farms. These results are in line with insights by Zander and Hamm (2010) into the preferences of regular and occasional consumers of organic food in five European countries for ethical attributes of organic milk. However, in their study WTP values were not elicited and the focus was exclusively on the preferences of organic milk buyers.

We employed different buying and socio-demographic variables in the analysis of preference heterogeneity among buyers, and found price-consciousness, gender and frequency of organic milk consumption to be the most important determinants of respondents' ethical preferences for milk production. In line with our results, Emberger-Klein et al. (2016) identified price-consciousness as the most important determinant of WTP for fairly produced, local milk.

Similarly to our study, Illichmann and Abdulai (2013) found significant differences in preferences between males and females with women having lower WTP values for organic milk than men. By contrast, in our experiment women represent two thirds of the buyers with highest WTP values for ethical milk. This is in line with other research, which suggests that women are more likely to buy organic products (Gil et al., 2000) and place higher value on local origin (Weatherell et al., 2003).

Income also partly plays a role as a determinant of WTP for ethical milk with lower income respondents showing lower WTP. However, we also find that cheapest-milk buyers are represented in all income classes and many of them show a willingness to spend more (than what they currently pay) to buy milk with ethical attributes, in particular, if it concerns animal welfare – free-stall plus summer pasture. This result is consistent with insights of a recent survey (Eurobarometer, 2016) on animal welfare attitudes of EU citizens, where the majority of respondents (94%) shows high concern about animal welfare and 59% of respondents also state WTP a premium for animal friendly products.

The observed change in price sensitivity regarding milk in our CE could have been triggered by the provision of information on ethical milk attributes through the CE. 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 is also confirmed by Wägeli et al. (2016). Therefore, better information provision with respect to dairy production practices, for example credible and accountable statements on housing and pasture access displayed on packaging, could change the price sensitivity of buyers.

Interestingly, in Illichmann and Abdulai (2013), respondents were willing to pay a much higher premium for organic milk from their region - 0.58 € more. One reason for the higher premium for regional origin might be that their study focused on organic milk. Another reason could be the so-called embedding effect. In our CE respondents faced trade-offs between several ethical attributes. As Waldrop et al. (2017) suggest, adding multiple sustainability claims or certifications to a product may result in lower price premiums for the additional claims.

The more detailed and differentiated definition of fairness to farmers in our study leads to some interesting results, too. Overall, respondents would support small, below-average income farms, but not all farms. This is in contrast to previous studies which find WTP for fair production - defined as all farmers getting back a fixed amount of the price per litre (e.g. Klein 2011). Our experiment, however, includes an additional level of fairness – fairness to small, poorer farmers – which is valued higher by consumers. Interestingly, when buyers buy regional milk, they prefer support to all farms. Possible explanations for this result might be a willingness to support dairy production as a whole in one's own region and consumers' different viewpoints concerning fairness to farmers on the national and regional level. In general, respondents show greater support for small, below-average income farms. 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 in their region. Another possible reason for this result might be confounding of dropped interaction effects, which as mentioned earlier might be a limitation of the experimental design.

The existing WTP for a combination of tethering (with and without pasture) and support for small, below-average income farms among milk buyers suggests that to many consumers fairness to farmers is more important than animal welfare, when it comes to small, below-average income farms. This argument to some extent supports those who still reject a complete ban on tie-stalls in Germany, as it would affect mainly small farms where investment in free-stalls is often not economically viable. However, this might change, if consumers support animal-friendly housing practices through higher milk prices. The presence of preferences among respondents for fairness to weak income groups has also been found in other contexts in CE (e.g. see Markova-Nenova and Wätzold, 2017 for donations for forest conservation in developing countries).

From an economic perspective, the design of public policies should follow citizens' preferences (Page and Shapiro, 2010) and our survey captures the preferences of a substantial portion of citizens with respect to ethical attributes of dairy production. Hence, the insights from our study can be used to support the design of labels and other agri-environmental policies.

We found that many conventional milk buyers are willing to pay a premium for ethical milk attributes. However, consumers typically only pay this premium, if they have trustworthy information that the ethical standards are met in the production process (Ibanez and Stenger, 2000). Credible and traceable labels are needed for this purpose.

Since the highest WTP was elicited for the highest level of animal welfare – free-stall plus summer pasture – developing a nationwide pasture milk label seems appropriate, similar to the pasture milk label in the Netherlands (Stichting Weidegang, 2017). The significant WTP for support for 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 is the newly developed pasture milk label for the German federal state of Lower Saxony. Here, tethering is allowed 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 (Lower Saxony ML, 2017).

The substantial WTP for biodiversity conservation suggests that this could also be an attractive characteristic for a milk label. A possible difficulty involved in marketing such a label could be to convey to customers how milk production impacts on biodiversity conservation. Moreover, biodiversity conservation can have different meanings for different individuals (Lienhoop and Brouwer 2015). Therefore, more research is needed to address the challenges in designing a milk label for biodiversity conservation.

Two further aspects need to be considered in this context. (1) There are already a few labels related to dairy farming, for example the labels on organic farming and on regional production. If there are too many different labels, customers might get confused and might refrain from buying labelled milk products. Research is needed to understand how many labels are tolerable and how milk labels should be designed to help customers understand the ethical impacts of their buying decisions. (2) Through the introduction of ethical attributes, the costs of milk production increase, e.g. due to specific production restrictions. Additional costs also arise in the processing of milk, e.g. milk collection trucks need to have different tank compartments for different types of milk instead of one compartment for conventional milk. Research is needed to compare these costs with the WTP of consumers for ethical milk attributes.

The insights from our study can be used to support the design of agri-environmental policies other than labelling. We find that, generally, citizens support measures directed at animal welfare, biodiversity conservation and small, below-average income farms. Notably, citizens have preferences for a general farm support only if they see a link to their own region. This suggests that the policies adopted by governments in the recent EU milk price crisis (buying up and storage of skimmed milk powder, providing financial support to dairy farms) are inconsistent with public preferences.

Other agri-environmental policies that can address the challenges of dairy farming in terms of biodiversity conservation and animal welfare are mandatory production standards and agri-environment schemes (AES). From an economic perspective, the choice of policy instrument is a matter of the allocation of property rights (Bromley and Hodge 1990). If society is given the right to decide how farmers should treat their animals, mandatory production standards are the appropriate policy instrument. If farmers are given the right to treat their animals as they wish, they should be compensated for measures to increase animal welfare through AES. A discussion of the appropriate allocation of property rights is beyond the scope of this paper. However, our results indicate that citizens do care about animal welfare, small, below-average income farms and biodiversity conservation related to dairy farming. Hence, further developing agri-environmental policies in these directions seems appropriate. Whereas this is often straightforward for production standards, designing effective and cost-effective AES can be a complex challenge and requires further research, e.g. because spatial and temporal considerations need to be included in the design (Wätzold et al. 2016).

WTP for regional products suggests that policies directed at local and regional cooperation among farmers are in line with public preferences. Support for cooperation among farmers is debated in the current discussion on the CAP reform beyond 2020 (e.g. Feindt et al. 2018). Cooperation among local farmers and actors in the agricultural sector is expected to bring substantial benefits and cost reductions. The German Federal State of Hesse, for example, has introduced a public support programme for cooperation in short supply chains and local markets among farmers, local actors from the agricultural and silvicultural sector, and research and development institutions (Regional Council of Giessen, 2018). An example of a public programme directed at cooperation of farmers in the context of biodiversity conservation is the Swiss 'network bonus' where farmers receive an additional payment on top of a base payment for conservation measures, if they coordinate these measures on a local level (Krämer and

Wätzold 2018). However, there is little knowledge on how to design public incentive programmes for local and regional cooperation that not only lead to improvements of the economic situation of small, below-average income farmers but also address the other challenges that dairy farming is facing, such as grassland biodiversity loss and animal welfare concerns. We conclude that further research is also needed in this context.

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Appendix A

Overview of basic choice modelling approach

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 the 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 element ε_{nsi}, which is not observable to the researcher.

$$U_{nsi} = V_{nsi} + \varepsilon_{nsi} \qquad \text{(A. 1)}$$

The observable part of utility 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.

$$V_{nsi} = \beta_0 + \beta'_n x_{nsi} \qquad \text{(A. 2)}$$

where β_0 represents an alternative-specific constant.

The general form of choice models is represented by equations A. 3 and A. 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 (J-1) alternatives in a choice set (Hensher et al., 2015).

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

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

Different choice models can be employed depending on the assumptions made on the distribution of the stochastic component ε_{nsi}. In a mixed logit model (MLM) the marginal utility parameter estimates are assumed to vary over all respondents with a predefined distribution (cf. Train, 2009), whereas in a latent class model (LCM) the parameter estimates are assumed to vary between classes of respondents (Boxall and Adamowicz, 2002).

The panel specification for LCM is shown in equations A. 5 and A. 6 (based on Hensher et al., 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.

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

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

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

Appendix B

Tables and figures

Table B. 1 Percent of 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).

	Tie-stall	Free-stall	Access to pasture	% of cows
According to farm size:				
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 whereas in free-stalls they can move around the stall.

Table B. 2 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 qualification	5.7	(59)
Secondary general school-leaving certificate with apprenticeship qualification	33.0	(343)
Intermediate school-leaving certificate	31.4	(327)
University/ polytechnic entrance qualification	14.5	(151)
Higher education (university/ 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	

Table B. 3 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 conservation – 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 conservation 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 conservation– 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 conservation – 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 B. 4 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 conservation	Biodiversity conservation	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 -1, if no
Price	Price in € per litre	0.60, 0.78, 0.96, 1.14, 1.32
Alternative-specific constants (ASC)		
A-ASC	ASC for the A-Alternative	1, for A-alternative 0, otherwise
SQ-ASC	ASC for the lowest fixed-price alternative	1, for fixed alternative 0, otherwise
NO-ASC	ASC for the 'no-buy' alternative	1, for 'no-buy' alternative 0, otherwise
Covariates		
Gender	Female Male	1, if female 0, if male
BuyerOrg	Frequent organic milk buyers	1, if yes 0, if no
SQPlow 'cheapest-milk buyers'	Buyers with lowest currently paid price (0.60 € – 0.69 € per litre)	1, if yes 0, if no
SQP70	Buyers with currently paid price between 0.70 € – 0.79 € per litre	1, if yes 0, if no
SQPhigh	Buyers with high currently paid price (≥1.00 € per litre)	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 to animal protection in the last two years	1, if yes 0, if no

Table B. 5 Results of panel mixed logit model

Attribute	Marginal utility	Standard error	95% Confidence interval	
Random parameters in utility functions				
Free-stall+pasture	1.15***	0.08	1.00	1.31
Free-stall	-0.11**	0.06	-0.23	0.00
Tie-stall+pasture	0.35***	0.07	0.22	0.48
Tie-stall[a]	-1.39			
Biodiversity conservation	0.43***	0.04	0.35	0.51
No special biodiversity conservation[a]	-0.43			
Support small farms	0.31***	0.08	0.16	0.47
Support all farms	-0.10	0.06	-0.22	0.03
No support[a]	-0.21			
Regional milk	0.13**	0.05	0.02	0.23
From Germany[a]	-0.13			
Tie-stall+pasture*Support small farms	0.40***	0.15	0.10	0.70
Tie-stall*Support small farms	0.40***	0.15	0.10	0.71
Regional milk*Support small farms	-0.12	0.13	-0.38	0.14
Nonrandom parameters in utility functions				
Regional milk*Support all farms	0.62***	0.15	0.33	0.91
Price	-4.77***	0.18	-5.13	-4.42
A-ASC	-0.33***	0.06	-0.44	-0.21
SQ-ASC	-1.21***	0.11	-1.41	-1.00
NO-ASC	-6.39***	0.20	-6.79	-6.00
Standard deviation of random parameters				
NsFree-stall+pasture	1.59***	0.08	1.43	1.75
NsFree-stall	0.52***	0.11	0.30	0.75
NsTie-stall+pasture	0.89***	0.08	0.74	1.05
NsBiodiversity conservation	0.88***	0.04	0.80	0.97
NsSupport small farms	1.09***	0.06	0.97	1.21
NsSupport all farms	0.39***	0.07	0.26	0.53
NsRegional milk	0.51***	0.05	0.42	0.61
NsTie-stall+pasture*Support small farms	1.22***	0.22	0.78	1.65
NsTie-stall*Support small farms	1.02***	0.22	0.58	1.45
NsRegional milk*Support small farms	0.83***	0.17	0.50	1.17
Goodness of fit				
Number of respondents	1,040			
Number of observations	8,320			
Log-likelihood	-7,521.17			
McFadden Pseudo-R^2	34.79%			
BIC	15,267.99			
CAIC	15,292.99			
AIC (normalized)	1.81			

Note: *** significant at 1%, ** significant at 5%, * significant at 10%.
[a]The utility parameters of the effects-coded base levels are calculated as the negative sum of the estimates for the other levels (Cooper et al., 2012).

Table B. 6 a. Results from latent class model with class membership function

Class	Class 1 - 'organic, regional, animal and farmer fairness milk buyers'			Class 2 - 'highest animal welfare, biodiversity and regional milk buyers'			Class 3 - 'lower income, price sensitive milk buyers with preferences for animal and farmer fairness'			Class 4 - 'lower income, cheapest-milk buyers with no WTP for ethical attributes'			Class 5 - 'animal and farmer fairness milk buyers'		
Attribute	**Marg. utility**	**95% Confidence interval**		**Marg. utility**	**95% Confidence interval**		**Marg. utility**	**95% Confidence interval**		**Marg. utility**	**95% Confidence interval**		**Marg. utility**	**95% Confidence interval**	
Utility parameters															
Free-stall+pasture	1.35***	1.19	1.51	1.74***	1.50	1.98	0.69**	0.16	1.23	-0.51	-176.36	175.33	0.68***	0.46	0.90
Free-stall	-0.30***	-0.45	-0.16	0.17	-0.08	0.42	-0.05	-0.42	0.31	3.53	-178.55	185.61	-0.10	-0.27	0.07
Tie-stall+pasture	0.39***	0.21	0.56	0.16	-0.13	0.44	0.11	-0.18	0.41	-1.77	-119.83	116.29	0.29***	0.12	0.46
Tie-stall[a]	-1.44			-2.07			-0.75			-1.25			-0.87		
Biodiversity conservation	0.55***	0.44	0.67	0.63***	0.49	0.76	0.14	-0.06	0.34	-1.37	-61.58	58.84	0.41***	0.32	0.50
No special biodiversity conservation[a]	-0.55			-0.63			-0.14			1.37			-0.41		
Support small farms	0.46***	0.29	0.62	0.22	-0.06	0.49	-0.28	-0.88	0.31	2.80	-5042	5048	0.33***	0.10	0.56
Support all farms	0.00	-0.17	0.17	-0.02	-0.30	0.26	0.31	-0.13	0.75	0.09	-5459	5459	-0.19**	-0.38	0.00
No support[a]	-0.46			-0.20			-0.03			-2.89			-0.14		
Regional milk	0.24***	0.09	0.38	0.22*	-0.01	0.46	0.12	-0.15	0.38	3.35	-7971	7977	0.04	-0.11	0.20
From Germany[a]	-0.24			-0.22			-0.12			-3.35			-0.04		
Price	-0.79***	-1.25	-0.33	-3.87***	-4.67	-3.07	-11.53***	-13.46	-9.60	-12.97	-1391	1365	-6.68***	-7.27	-6.09
Tie-stall+pasture *Support small farms	0.42**	0.07	0.78	0.82***	0.25	1.39	1.10**	0.08	2.13	8.62	-442.16	459.41	0.03	-0.40	0.47
Tie-stall*Support small farms	0.28	-0.10	0.65	-0.06	-1.19	1.06	1.01*	-0.11	2.12	-4.47	*********	52993	0.56**	0.10	1.01
Regional milk*Support small farms	0.20	-0.12	0.53	-0.40	-1.01	0.20	0.14	-0.60	0.88	-7.64	*********	15788	0.00	-0.37	0.37
Regional milk*Support all farms	0.17	-0.24	0.58	0.60	-0.14	1.33	-0.13	-1.01	0.74	4.36	*********	16317	0.63**	0.07	1.18
SQ-ASC	-2.94***	-4.03	-1.85	-2.94***	-5.05	-0.82	-1.44***	-2.03	-0.85	11.46	-15949	15972	-3.05***	-3.37	-2.73
NO-ASC	-3.93***	-4.51	-3.36	-3.17***	-3.90	-2.44	-13.03***	-14.59	-11.47	-7.76	-2310	2294	-9.86***	-10.61	-9.12
A-ASC	-0.27***	-0.43	-0.11	-0.26	-0.59	0.08	-0.12	-0.53	0.28	-3.82	-272.92	265.28	-0.19**	-0.37	-0.01

Note: *** significant at 1%, ** significant at 5%, * significant at 10%. Fixed parameter is constrained to equal the value.
[a]The utility parameters of the effects-coded base levels are calculated as the negative sum of the estimates for the other levels (Cooper et al., 2012).

Table B. 6 a. Results from latent class model with class membership function (continued)

Class	**Class 1 - 'organic, regional, animal and farmer fairness milk buyers'**			**Class 2 - 'highest animal welfare, biodiversity and regional milk buyers'**			**Class 3 - 'lower income, price sensitive milk buyers with preferences for animal and farmer fairness'**			**Class 4 - 'lower income, cheapest-milk buyers with no WTP for ethical attributes'**			**Class 5 - 'animal and farmer fairness milk buyers'**	
Class membership function parameters	**Coeffi-cient**	**95% Confidence interval**		**Coeffi-cient**	**95% Confidence interval**		**Coeffi-cient**	**95% Confidence interval**		**Coeffi-cient**	**95% Confidence interval**		**Coeffi-cient**	**95% Confidence interval**
Constant	-0.69***	-1.17	-0.20	-1.58***	-2.16	-1.01	-2.16***	-3.13	-1.19	-3.32***	-4.86	-1.78	0.00	(Fixed Parameter)
Gender	0.89***	0.47	1.32	0.73***	0.23	1.23	-0.15	-0.71	0.40	-0.33	-0.83	0.17	0.00	(Fixed Parameter)
BuyerOrg	0.93**	0.13	1.72	0.61	-0.40	1.61	0.46	-7.13	8.04	-5.68	-4008	3997	0.00	(Fixed Parameter)
SQPlow	-0.60**	-1.17	-0.02	0.08	-0.61	0.77	2.30***	1.30	3.29	3.97***	2.41	5.54	0.00	(Fixed Parameter)
SQP70	-056*	-1.13	0.02	-0.10	-0.77	0.57	0.95*	-0.12	2.01	1.70**	0.04	3.35	0.00	(Fixed Parameter)
SQPhigh	1.79***	1.16	2.42	1.17***	0.41	1.93	-0.44	-8.12	7.24	1.77*	-0.10	3.64	0.00	(Fixed Parameter)
Friendfarm	-0.41	-0.94	0.12	0.27	-0.28	0.82	-0.69*	-1.44	0.07	-0.72**	-1.39	-0.06	0.00	(Fixed Parameter)
DonAnimal	0.91***	0.23	1.60	0.84**	0.08	1.59	-0.33	-1.60	0.94	-2.22**	-4.32	-0.11	0.00	(Fixed Parameter)

Note: *** significant at 1%, ** significant at 5%, * significant at 10%. Fixed parameter is constrained to equal the value.
[a]The utility parameters of the effects-coded base levels are calculated as the negative sum of the estimates for the other levels (Cooper et al., 2012).

Table B. 6 b. Results for goodness of fit from latent class model with class membership function

Indicator	**Value**
Number of respondents	1,040
Number of observations	8,320
Log-likelihood	-5,999.60
McFadden Pseudo-R^2	47.98%
BIC	12,965.02
CAIC	13,072.02
AIC(normalized)	1.47

Table B. 7 Different characteristics and LCM class membership of milk buyers in the sample

LCM class		Category						Count in class and as % of respondents
		Female	**Frequent organic milk buyers**	**Frequent pasture milk buyers**	**Donors for animal protection**	**Donors for environmental protection**	**Having farmer as family or friend**	
1	Count	245	71	78	62	49	62	354
	% within class	69.2%	20.1%	22.0%	17.5%	13.8%	17.5%	34.0%
	% within category	41.0%	71.0%	49.1%	54.4%	56.3%	31.2%	
2	Count	95	15	22	25	16	40	141
	% within class	67.4%	10.6%	15.6%	17.7%	11.3%	28.4%	13.6%
	% within category	15.9%	15.0%	13.8%	21.9%	18.4%	20.1%	
3	Count	53	2	10	5	5	14	110
	% within class	48.2%	1.8%	9.1%	4.5%	4.5%	12.7%	10.6%
	% within category	8.9%	2.0%	6.3%	4.4%	5.7%	7.0%	
4	Count	61	0	12	1	2	18	139
	% within class	43.9%	0.0%	8.6%	0.7%	1.4%	12.9%	13.4%
	% within category	10.2%	0.0%	7.5%	0.9%	2.3%	9.0%	
5	Count	144	12	37	21	15	65	296
	% within class	48.6%	4.1%	12.5%	7.1%	5.1%	22.0%	28.5%
	% within category	24.1%	12.0%	23.3%	18.4%	17.2%	32.7%	
Total	Count	598	100	159	114	87	199	1040
Count in category as % of respondents		57.5%	9.6%	15.3%	11.0%	8.4%	19.1%	

Table B. 8 Ranking comparison of the LCM classes based on tests for statistical significance of differences

Category/ LCM class characteristics	**Lowest**		**to**		**Highest**
WTP values	Class 4	Class 3	Class 5	Class 2	Class 1
Mean monthly net household income[4]	Class 3 and 4		Class 1, 2 and 5		
Mean education level	Class 4	Class 1, 2, 3 and 5			
Mean milk consumption	Class 1, 2, 3 and 5				Class 4
Mean meat consumption per week	Class 1	Class 2	Class 3, 4 and 5		
Attitude to agriculture in general	Class 4	Class 3	Class 2 and 5		Class 1
Importance of ethical issues in buying decisions (fair production, regional production, climate protection, environmental and nature protection, animal welfare)	Class 4	Class 3	Class 5	Class 2	Class 1
Importance of price in buying decisions	Class 1 and 2		Class 5	Class 3	Class 4
Importance of cows' welfare (freedom to move and pasture access)	Class 4	Class 3	Class 5	Class 1 and 2	
Importance of farmers' fairness (support/ fair prices to farmers)	Class 4	Class 3	Class 2 and 5		Class 1

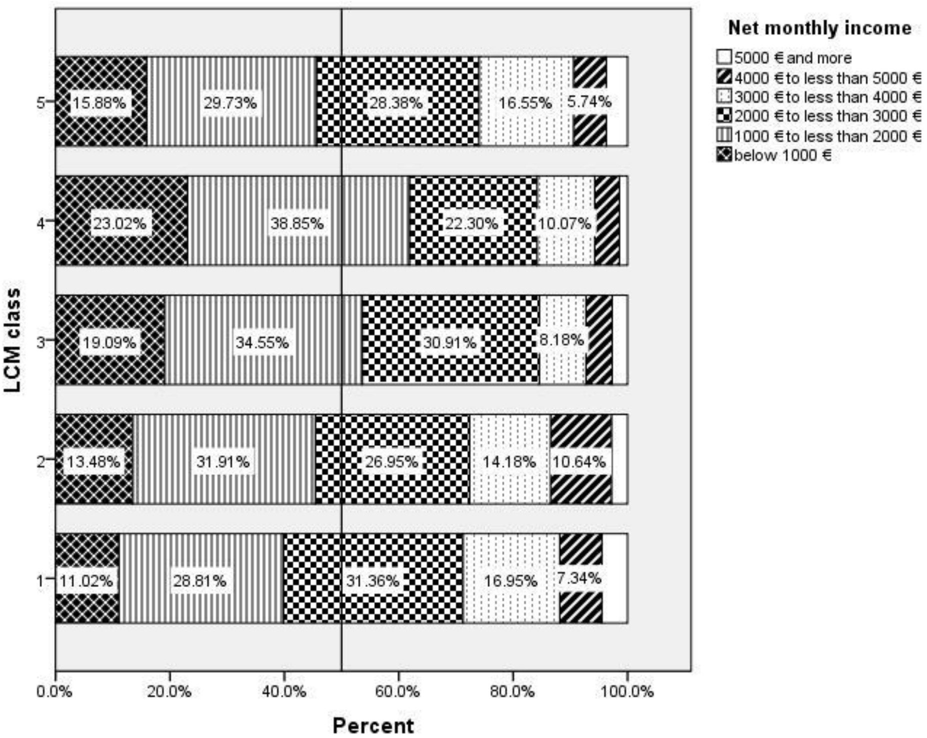

Figure B. 1 Net monthly income vs. LCM class

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[4] Paired-classes income comparisons show that the mean income in class 1 is higher than in class 3 and 4, but not higher than that of class 2, and only on the 10% significance level higher than the mean income of class 5. There is no statistical difference in income between classes 2 and 5. Mean income is, however, lower in class 3 and class 4.

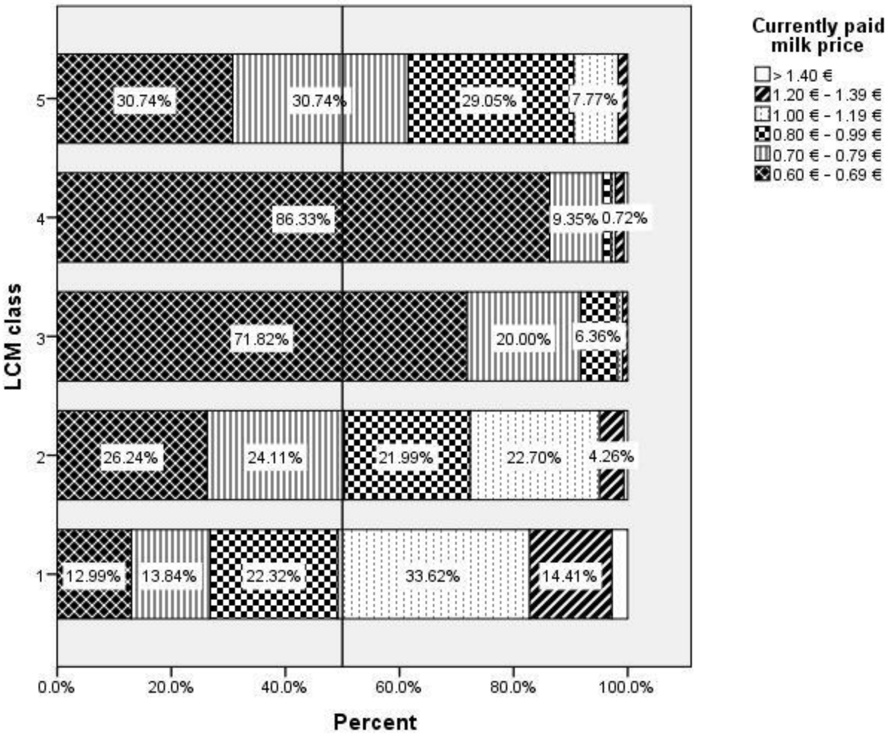

Figure B. 2 Currently paid milk price vs. LCM class

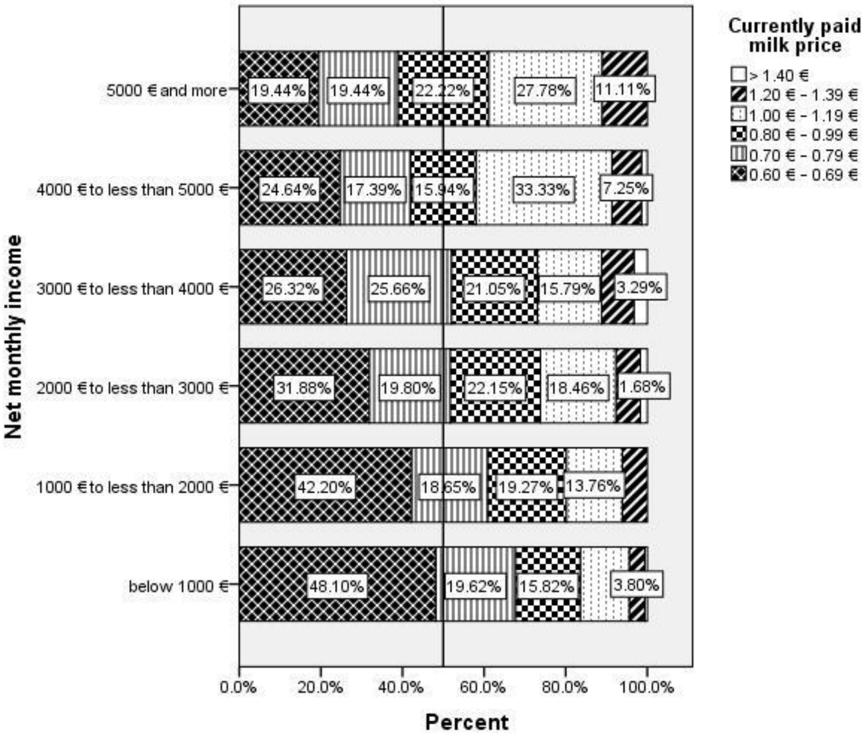

Figure B. 3 Currently paid milk price vs. net monthly income