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# Animal Welfare and Eggs
# – Cheap Talk or Money on the Counter?

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**Abstract**

*We estimate revealed willingness to pay for animal welfare using a panel mixed logit model. We utilize a unique household level panel, combining real purchases with survey data on perceived public and private good attributes of different types of eggs. We estimate willingness to pay for organic eggs controlling for trust in a positive connection between the public good animal welfare and the organic label and the private good food safety also connected to the label. Our results suggest that in the real world, animal welfare plays a minor role in the demand for agricultural products.*

Key words: Animal welfare, panel mixed logit, market purchase data, labelling, willingness to pay, altruism

JEL codes: Q35, D12

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Interest in animal welfare has been increasing, both within the population in general and among the legislators who try to frame laws to match these new concerns. If society wishes to improve the level of animal welfare it may either prohibit production methods that lead to unacceptably low levels of animal welfare or it may improve market conditions for producers who use more animal-friendly production methods. The growing concern among legislators has lead to the EU Action Plan to improve animal welfare (IP/05/698), which was adopted by the European Union in 2006. The concern among consumers is reflected in the fact that in 2005, 74 percent of European citizens believed that they could to some degree have a positive impact on the welfare of farm animals by buying animal-friendly products, and more than 60 percent stated that they were willing to pay a price premium in order to do so (Eurobarometer 2005).

One of the principles behind organic livestock farming is to give all livestock conditions of life which allow them to perform basic aspects of their innate behaviour. Whether this leads to a higher level of animal welfare for the individual animal is often debated, and the average consumer is likely to find it difficult to determine the exact level of animal welfare e.g. for different types of eggs. In this paper we do not attempt to define animal welfare (as done in e.g. Broom, 1991), but leave this definition to the individual consumers. A study using focus groups conducted in 1999 (Harper and Makatouni, 2002) find that consumers associate organic products with better animal welfare, and that this plays a significant role when purchasing organic food. However, the same study indicates that animal welfare is used as an indicator of food safety and health, and that these factors are the main drivers behind organic purchases. When estimating willingness to pay for animal welfare it is therefore important to control for other perceived attributes of organic products, as it will be done in this paper.

The labelling of eggs described in this paper provides consumers with a chance to signal willingness to pay for extra animal welfare. However, since it is not possible to exclude others from enjoying the improved animal welfare induced by one’s own purchase of a certified product this attribute is a public good, and therefore prone to free-riding which might undermine the effectiveness of labelling schemes. Early economic contributions (e.g. Sen, 1973) suggest that consumers may, in addition to self-interest, be motivated by what Sen called “sympathy” or “commitment” (and others refer to as “altruism”, e.g. Andreoni, 1990). If this type of altruistic behaviour is present among consumers it will reduce the problem of free-riding. Other studies such as Gregory and Grandin (2007) and Woodward and Fernádez (1999) and Fernández and Woodward (1999) find that increased animal welfare leads to better meat, which might indicate that animal welfare also has a 'private good' dimension. The willingness to pay for this private attribute should be added to the willingness to pay for animal welfare as such, and whether the labels increase the level of animal welfare to the optimal level of consideration for the hens therefore depends crucially on whether the stated willingness to pay in opinion polls and contingent valuations is real or just cheap talk. The previous literature has mainly investigated stated willingness to pay, and it is therefore still not clear whether consumers truly are willing to pay higher market prices for increased animal welfare even though it is a public good.

This paper utilises a unique dataset combining time series of actual purchase data for 844 households with survey data on the same households, providing background information about the individual households along with information on the household specific perception of the organic label with respect to animal welfare and food safety. This allows us to compare willingness to pay between different socio-demographic groups as well as between groups with different perceptions of animal welfare in relation to organic eggs and food safety in relation to organic chicken. This means that we can establish whether the willingness to pay originates solely from 'private good' attributes, such as lower risk of falling ill, or if there is also willingness to pay for 'public good' attributes like animal welfare, which may imply altruistic motives.

The results in this paper suggest that consumers are willing to put money on the counter for animal welfare, but only to a small degree. Our results suggest that the stated willingness to pay observed in opinion polls, hypothetical discrete choice experiments or contingent valuation studies to a large extent is just cheap talk. The results also indicate that animal welfare is a significant purchase motive, even when we control for the private good characteristic food safety, and that households with positive willingness to pay for animal welfare in one type of eggs are more likely to be willing to pay for other types of eggs with increased levels of animal welfare.

The remainder of this paper is structured as follows. Section 2 summarises the results of the previous literature on willingness to pay for animal welfare and food safety and section 3 outlines the features of Danish egg labels. Section 4 describes the data, followed by an introduction to the theory behind willingness to pay and the panel mixed multinomial logit model in section 5. Section 6 discuses the practical problems of using market data at household level, and explains the chosen approach. Section 7 presents the results and section 8 concludes.

## 2 Existing Knowledge

Most previous studies of willingness to pay for animal welfare (see Norwood and Lusk, forthcomming; Bennet, 1997; Bennet and Blaney, 2003 and Rolfe, 1999 for animal welfare related to eggs, Carlsson et al. 2005 and 2007; Lagerkvist et al., 2006; Liljenstolpe, 2008 and Mørkbak et al. (forthcoming) for animal welfare related to pork) are based on stated willingness to pay, elicited through e.g. choice experiments or contingent valuation. Most studies find positive willingness to pay for animal welfare, but as numerous studies suggest, the estimated values may be subject to hypothetical bias (Cummings et al., 1995; Cummings and Taylor, 1999; Fox et al. 1998; List, 2001; List and Shogren, 1998 and Niell et al. 1994). In a meta-analysis of 29 experimental studies (not specifically about animal welfare) List and Gallet (2001) find that the estimated willingness to pay in experimental studies on average is overstated by a factor of about three in hypothetical settings, and that the bias is bigger for public goods than for private goods.

Olesen et al. (2010) find willingness to pay for animal welfare labelled salmon by asking 115 Norwegian consumers to make actual purchasing decisions choosing between different types of salmon and an opt-out choice. This kind of experimental market is less hypothetical than the stated studies mentioned above. A few studies such as Teisl et al. (2002) and Baltzer (2004) use *market data*. Both studies find positive (revealed) willingness to pay for animal welfare. Teisl et al. find positive willingness to pay for a label indicating dolphin-safe tuna catching and Baltzer finds positive willingness to pay for eggs carrying labels indicating improved animal welfare (non-battery eggs, see below). However, the suspicion here is that other 'private good' attributes like healthiness/safety of the product - which consumers perceive as correlated with animal welfare - may be driving behaviour. Several studies have found willingness to pay for food safety (Alfnes, 2004; Alfnes and Rickertsen, 2003; Baker and Burnham, 2001; Carlsson et al., 2005; Lagerkvist et al., 2006; Liljenstolpe, 2008 and Lusk et al., 2003). However, these studies also use stated willingness to pay and are therefore also subject to hypothetical bias.

To our knowledge, only Baltzer (2004) has previously estimated revealed willingness to pay for different types of eggs from actual purchases, and the present study is the only one which uses both observed purchases, background information about buyers and information about buyers' perception of animal welfare and food safety, and thereby separates revealed willingness to pay for animal welfare from cheap talk *and* from willingness to pay for food safety.

## 3 The Egg Labels

The Danish egg market is dominated by four different types of eggs, carrying labels indicating production methods with different implications for animal welfare. To bear a given label the production has to meet certain minimum standards, as described in various EU regulations. Table 1 shows the most important differences between the egg labels, and figure 1 shows the distribution of price premiums compared to the price of battery eggs.

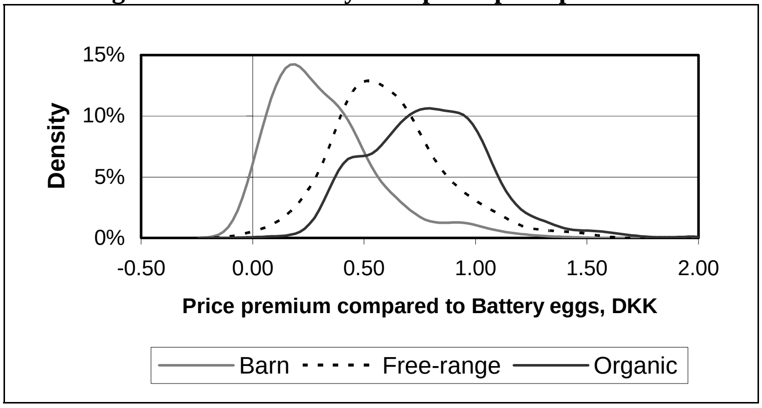
**Table 1 Main Points of the Rules for Different Danish Production Types**[1]

| Egg label | Conditions for the egg-laying hens |
|---|---|
| Battery eggs | • Live in cages with 4 hens in each cage<br>• 16 hens per $m^2$ |
| Barn eggs | • Live in open barns<br>• 7 hens per $m^2$ |
| Free-range eggs | • Indoors: As for barn hens<br>• Access to outdoor areas<br>• 10 $m^2$ per hen on outdoor areas |
| Organic eggs | • 6 hens per $m^2$ indoors<br>• Access to outdoor areas<br>• 4 $m^2$ per hen on outdoor areas<br>• Organic feed<br>• No beak trimming |

Source: The Danish Poultry Council.

[1] For more details of the rules for different production types, see Andersen (2006).

**Figure 1 Kernel density of imputed price premiums**




Estimations using GfK purchase data on eggs from 26 June 1999 to 30 June 2000. Only households with answers to questionnaire. Nadaraya-Watson kernel regression estimator using the Gaussian kernel. Purchases made directly from farms excluded. Imputed prices are means of all observed prices within a given chain of stores and a given week. More information on this is provided in Section 6, 'Implementation of the model'. The average price of a battery egg is 1.27 DKK.

The welfare of hen is considered to improve from the battery system (soon to be outlawed in the EU) through the barn system to free-range and organic. According to Harper and Makatouni (2002) consumers often confuse free-range and organic products. In Denmark, one of the differences between organic hens and free-range hens is that free-range hens may have their beaks trimmed, which is known to cause immediate and subsequent pain. However, severe welfare problems such as injurious pecking and cannibalism is much greater among non-trimmed hens (ADAS/IGER/University of Bristol, 2001). Whether organic hens have a better quality of life than free-range hens is therefore sometimes debated, but apart from the differences in rules for production, organic eggs have the advantage of using a familiar label that is used on many different food products (the Danish 'Ø-label', which identifies organically-produced goods). Consumers have a generalised image of goods bearing the Ø-label, and do not have to spend time and energy studying new labels such as 'barn eggs' or 'free-range eggs'. In this paper it is therefore expected that willingness to pay for the different egg labels can be ranked as *battery, barn, free-range* and *organic*, where *battery eggs* are expected to yield the lowest willingness to pay and *organic eggs* are expected to yield the highest willingness to pay.

## 4 Data

The data are from an unbalanced Danish panel of approximately 2,000 households reporting all food purchases on a daily basis (GfK ConsumerScan Denmark, GfK). A substantial amount of socio-demographics are collected once a year, and in 2002 a large questionnaire on organic food was completed by the main shoppers of the households, including information about knowledge of and attitudes towards organic foods in general at household level. Single men younger than 30 years are underrepresented in the panel (9.2 percent in the panel, 18.8 percent in the population), while families with children are overrepresented (30.9 percent of the GfK households have children, only 22.4 percent of the households in the population).

The purchase data cover the period from 26 June 1999 to 30 June 2000.[2] This is the only period where all four different egg labels are recorded, before and after it is only recorded whether the eggs purchased were organic or not. The time delay between purchases and attitudes is far from optimal, but differentiated purchase data is not available for 2002.[3] The data allow estimation of willingness to pay for labels, accounting for different perceptions of the labels, and different purchasing motives. Among the 1,834 families who reported purchases of eggs during the period, 878 families also answered the 2002 questionnaire, and 844 of these answered the perception questions used here. On average, the 844 households in the sample purchase

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[2] The Danish organic market is relatively mature. In the period 1999 to 2000 the organic budget share for all types of food was more than 3.5 percent. The results in this paper will therefore most likely be relevant for many other countries which are now approaching the same level of organic consumption.

[3] The background data allows us to identify the individuals in the household by date of birth, and thereby to establish that only 4.5 percent of the households changed their composition of adults between the time of purchase and the questionnaire. If perceptions about eggs are assumed to be stable over time, the questionnaire makes it possible to use the information about household perceptions of the level of animal welfare and food safety. In 2007 another questionnaire was issued to the same panel, and 564 of the 844 households used in this paper also answered this new questionnaire. In general they had increased their level of trust in positive animal welfare related to organic farming in general (the specific question about eggs was not repeated). If this increasing trend was also present between 1999 and 2002, some of the households which are categorized as positive in this paper may have been less positive at the time of purchase. The estimated willingness to pay may therefore have a small bias towards zero.

eggs 13 times during the one-year period (10,800 observed purchases).[4] As can be seen in table 2, the households who answered the questionnaire represent the sample almost perfectly, at least as far as the overall distribution on types of eggs is concerned.

**Table 2 Aggregate Consumption of the Four Different Types of Eggs**

| **Households:** | **All** | **With answers to questionnaire in general** | **With answers to both animal welfare and food safety** |
|---|---|---|---|
| *Purchase shares:* | | | |
| Battery eggs | 47 | 47 | 47 |
| Barn eggs | 17 | 17 | 17 |
| Free-range eggs | 10 | 10 | 10 |
| Organic eggs | 27 | 26 | 26 |
| *Total* | *100* | *100* | *100* |
| No. of purchases | 20,676 | 11,178 | 10,800 |
| No. of households | 1,834 | 878 | 844 |

Source: GfK purchase data on eggs from 26 June 1999 to 30 June 2000. Purchases made directly from farms excluded, see endnote 8 in 'Implementation of the Model'.

Two of the questions in the questionnaire regarded perception of animal welfare related to eggs and food safety related to chicken. As can be seen in table 3, very few households believe that organic production has a negative impact on animal welfare related to eggs or food safety related to chicken, and a substantial number of households believe it has positive effects, though 42 percent perceived no difference in animal welfare. This indicates that for a very large share of the sample, organic production is not synonymous with animal welfare. It also appears that trust in better animal welfare and improved food safety are correlated. It is, however, still possible to identify the effects on willingness to pay separately for animal welfare and food safety, as the correlation is not perfect. The answers to the two questions enter separately in the estimation, and the cross tabulation in table 3 is merely included to illustrate the level of correlation. Willingness to pay among households with different perceptions of animal welfare and food safety is measured relative to the groups of households who perceive 'no difference' (control groups).

[4] 23 percent of the households purchase eggs 4 times or less, 26 percent purchase eggs 17 times or more.

**Table 3 Answers to Questionnaire on Perception of Animal Welfare and Food Safety**[5]

| No. of households (share of households): | | Total | How do you perceive the risk of falling ill with bacteria when you eat organic chicken? Higher (Negative organic food safety) | No difference | Lower (Positive organic food safety) |
|---|---|---|---|---|---|
| | *Total* | *844 (100%)* | *27 (3%)* | ***571 (68%)*** | *246 (29%)* |
| How do you perceive animal welfare for hens laying organic eggs? | Worse (Negative organic animal welfare) | *23 (3%)* | 6 (1%) | 9 (1%) | 8 (1%) |
| | **No difference** | ***355 (42%)*** | 15 (2%) | 294 (35%) | 46 (5%) |
| | Better (Positive organic animal welfare) | *466 (55%)* | 6 (1%) | 268 (32%) | 192 (23%) |

Source: AKF/GfK questionnaire from 2002. The Cronbach alpha for the two questions is 0.46, and the answers to the two questions enter separately in the estimation.

**Bold means Control group:** Willingness to pay in the other groups is measured relative to this group. The estimated willingness to pay for households who perceive animal welfare to be better is the difference between the mean willingness to pay among households with perceived *positive* effect and households with *no* perceived effect.

Our data allow actual purchases to be linked to socio-demographic information, so that the effects of income, age, degree of urbanisation and level of education on the willingness to pay for different types of eggs can be explored. Each of the socio-demographic variables is split into sub-groups, and the willingness to pay within each sub-group is estimated relative to the control group indicated in table 4.

[5] Note that the question about food safety is not related directly to organic eggs, but rather to organic chickens. However, the origin of food safety problems is the same in chickens and eggs (mainly salmonella during the period in question) and the answers are therefore used as a general indication of perception of food safety related to organic poultry, acknowledging that the signal cannot be expected to be as strong as for animal welfare.

**Table 4 Socio-demographic Data Used in Estimations**

| Variable | Sub-groups | Number of households | Share of households | Control group[a] |
|---|---|---|---|---|
| Income[b] | Lowest 25% | 254 | 30 | X |
| | Middle 50% | 400 | 47 | |
| | Highest 25% | 190 | 23 | |
| | *Total* | *844* | *100* | |
| Age[c] | 18 to 44 years | 230 | 27 | |
| | 45 to 59 years | 304 | 36 | |
| | 60 years or more | 310 | 37 | X |
| | *Total* | *844* | *100* | |
| Degree of urbanisation[d] | Rural municipality | 247 | 29 | X |
| | Urban municipality | 390 | 46 | |
| | Capital area (Copenhagen) | 207 | 25 | |
| | *Total* | *844* | *100* | |
| Level of education[e] | No further education stated | 206 | 24 | X |
| | Vocationally oriented high-school | 304 | 36 | |
| | Short further education | 138 | 16 | |
| | Medium further education | 150 | 18 | |
| | Long further education | 46 | 5 | |
| | *Total* | *844* | *100* | |

a: Willingness to pay in the other groups is measured relative to this group. The estimated willingness to pay in the Capital area is the difference between the mean willingness to pay in households in the Capital area and those in the rural municipalities. If the parameter for Capital area is significant, it means that the difference between the utility in the Capital area and that in the rural municipalities is significantly different from zero.
b: Income is recorded in brackets of DKK 50,000 (~€6,700). These brackets are divided by the number of persons in the household, weighted by the OECD-modified scale i.e. 1 for the first adult, 0.5 for the next adults and 0.3 for children (OECD). Income is split into three categories indicating relative levels of income. Due to the discrete nature of the income brackets, it is not possible to split the sample into perfect quartiles.
c: Age is defined by the age of the oldest person in the household.
d: GfK divides the 270 Danish municipalities into categories depending on how urbanised they are and on their geographical location. The geographical location is ignored here, and the sample is split into rural, urban and Capital area municipalities.
e: Highest level of education within the household.

## 5 Theoretical Framework

The utility of household $i$ from purchasing an egg of type $j \in \{1,...,J\}$ at time $t \in \{1,...,T_i\}$ is assumed to depend on the type of egg $j$ and the price of the egg $p_{jt}$. As in Hanemann (1984), the utility function for household $i$ is assumed to have the simple linear form

$$U_i(e_i, p) = \sum_{t=1}^{T_i} U_{it}(e_{it}, p_t) = \sum_{t=1}^{T_i} \left( \beta_i^j + \beta^p p_{jt} + \varepsilon_{ijt} \right) \qquad (1)$$

Where $e_i$ is the vector of individual choices $e_{it}$ made by household $i$ at time $t \in \{1,...,T_i\}$, $p$ is the $T_i \times J$ vector of prices of all types of eggs at all choice occasions, $\beta_i^j$ is an alternative specific constant, measuring the household specific utility of egg type *j*, $-\beta^p$ is the utility of money (assumed constant across households, time and purchase choice) and $\varepsilon_{ijt}$ is an unobserved error term. The panel dimension of the data is utilised by assuming that $\beta_i^j$ is constant over time for the individual household, but varies between households and types of eggs. The marginal willingness to pay for a specific type of egg (*j*) is therefore the utility of the egg divided by the utility of money (Hanemann, 1984):

$$wtp_i^j = \frac{\beta_i^j}{-\beta^p} \tag{2}$$

The price parameter – and thereby the utility of money – is assumed to be constant over egg types, whereas the choice specific parameters – and thereby the utility of the different egg types – are allowed to vary between egg types. The error terms $\varepsilon_{ijt}$ in (1) are assumed to be extreme value distributed, which means that the parameters can be estimated using a multinomial logit model.

As usual in a discrete model, we can only estimate relative utility, which means that we estimate differences in utility (between types of eggs) and must choose an arbitrary normalisation to identify the scale. In order to estimate willingness to pay for eggs carrying labels indicating higher levels of animal welfare, the differences between the utility of battery eggs and the utilities of all other types of eggs are estimated.

In the simplest version of the model the utility depends only on the type of egg purchased and the price paid:

$$\begin{aligned} U_i\left(e_i, p\right) - U_i\left(battery, p\right) &= \sum_{t=1}^{T_i}\left(\beta_i^j + \beta^p p_{jt} + \varepsilon_{ijt}\right) - \sum_{t=1}^{T_i}\left(\beta_i^{bat} + \beta^p p_{bat,t} + \varepsilon_{i,bat,t}\right) \\ &= \sum_{t=1}^{T_i}\left(\left(\beta_i^j - \beta_i^{bat}\right) + \beta^p\left(p_{jt} - p_{bat,t}\right) + \left(\varepsilon_{ijt} - \varepsilon_{i,bat,t}\right)\right) \\ &\equiv \sum_{t=1}^{T_i}\left(\tilde{\beta}_i^j + \beta^p\left(p_{jt} - p_{bat,t}\right) + \tilde{\varepsilon}_{ijt}\right) \end{aligned} \tag{3}$$

where $\tilde{\beta}_i^j$ is the difference in utility between type *j* and battery eggs.

The utility of barn and free-range eggs is assumed to vary systematically with the socio-demographics presented in table 4. For a household with a high income (inc = H), aged 45 to 59 (age = 45-59), living in the Capital area (urb = Cap) and having a long further education (edu = long) the utility of purchasing a barn egg at time *t* is modelled as:

(4)
$$\begin{aligned}&U_{it}\left(barn, p_t\right) - U_{it}\left(battery, p_t\right) = \\ &\tilde{\beta}_i^{barn} + \tilde{\beta}_{inc=H}^{barn} + \tilde{\beta}_{age=45-59}^{barn} + \tilde{\beta}_{urb=Cap}^{barn} + \tilde{\beta}_{edu=long}^{barn} + \beta^p\left(p_{barn,t} - p_{bat,t}\right) + \tilde{\varepsilon}_{i,barn,t}\end{aligned}$$

Note that the utility of the egg type $\tilde{\beta}_i^j$ in equation (3) is $\tilde{\beta}_i^{barn}$ in this example, and now expresses the household specific utility of barn eggs compared to battery eggs, for the *control group* defined in table 3 and 4.

As described in table 3 we have answers to questions about perception of animal welfare related to organic eggs and food safety related to organic chicken. This means that we can separate private utility (food safety) from potentially altruistic utility (animal welfare) when it comes to organic eggs. It is therefore possible to investigate whether altruistic motives actually play a significant role in the willingness to pay for organic eggs.

It is assumed that the effect of trust in animal welfare or food safety is the same for all socio-demographic groups, and the utility of the public good (animal welfare) and the private good (food safety) is therefore added to the utility function without any interaction terms with socio-demographics. ‘No perceived difference’ is used as control group. If a household with the same characteristics as in (4) perceives the animal welfare as better for organic eggs and the food safety as worse the utility is therefore modelled as:

(5)
$$\begin{aligned}&U_i\left(organic, p_t\right) - U_i\left(battery, p_t\right) = \\ &\tilde{\beta}_i^{org} + \tilde{\beta}_{animal+}^{org} + \tilde{\beta}_{safety\div}^{org} + \\ &\tilde{\beta}_{inc=H}^{org} + \tilde{\beta}_{age=45-59}^{org} + \tilde{\beta}_{urb=Cap}^{org} + \tilde{\beta}_{edu=long}^{org} + \beta^p\left(p_{org,t} - p_{bat,t}\right) + \tilde{\varepsilon}_{i,org,t}\end{aligned}$$

Data show that some households buy organic eggs more frequently than others, which suggests variation in the household utility of organic eggs. To capture this variation and to avoid Independence of Irrelevant Alternatives (IIA)[6] it is therefore assumed that the household utility is drawn from a distribution, and that the household utility is known to the household, but only the distribution is observable to the econometrician. The household likelihood function then becomes the likelihood function in the conventional multinomial logit model integrated over all possible values of $\beta$:

(6) $$L_i\left(\theta, e_i, p\right) = \int L_i^{conv}\left(\beta, e_i, p\right) f\left(\beta \middle| \theta\right) d\beta$$

where $f\left(\beta \middle| \theta\right)$ is the density of $\beta$ given the parameters $\theta$. The parameters $\theta$ of the distribution of the utility $\beta$ are therefore estimated, instead of $\beta$ itself. This is known as the Mixed MultiNomial Logit (MMNL) model (McFadden and Train, 2000). For applications of this model see for example Alfnes (2004), Carlsson et al. (2007), Bjørner et al. (2004), Liljenstolpe (2008), Lusk et al. (2003), McFadden and Train (2000), Revelt and Train (1998) or Train (1998, 1999). The MMNL model does not suffer from IIA, as long as at least one parameter is assumed to be drawn from a common distribution (mixed); see for example Train (1998).

In this paper it is assumed that the utility of the three types of non-battery eggs compared to battery eggs $\left(\tilde{\beta}_i^{barn}, \tilde{\beta}_i^{free}, \tilde{\beta}_i^{org}\right)$ follows a multivariate normal distribution with correlation. The utility functions defined in (4) and (5) means that the *variance* of utility for a specific type of egg is assumed to be the same in all subsets of the population; only the *mean* is allowed to vary between groups of households. It is important to note that the estimated variances and covariances do not describe the utility of the different types of eggs, but rather the 'utility premium' compared to battery eggs.

As in the conventional logit, the problem of the scale is solved by normalising the variance of the extreme value distributed error terms (the $\varepsilon$'s). Mixed logit models generally have a lower level of unexplained noise, because more variance is captured by the mixing. This means that the variance of the extreme value distributed error term which defines the normalisation is smaller and therefore that all parameters of a mixed logit are expected to have a higher absolute level than the parameters of a conventional

[6] For more on IIA and mixed logit see Andersen, 2006.

logit. The ratios of parameters are not influenced by differences in scale, so the willingness to pay is not systematically affected by the mixing.

## 6 Implementation of the Model

Only the price of the chosen egg is observed, not the price of the alternatives, nor which alternatives are present in the purchase situation. As in Bjørner et al. 2004,[7] the prices are therefore imputed as the mean of all observed prices of eggs with a given label within a given week in the chain of stores in which the purchase was actually made.

There are many unknown attributes of the purchased egg. The size of the egg is not recorded, and the store in which the purchase was made is only recorded at chain level. The freshness of the eggs is also unknown. These factors all contribute to unobserved heterogeneity in the prices. Using the observed price as an estimate of the price of the egg that was purchased, and comparing this price to mean prices for the types of eggs that were not purchased (by this household on this occasion) would mean that one was comparing the price of an egg of a given size, purchased in a given store and having a given freshness, with the price of an egg with a mixture of sizes, a mixture of stores and a mixture of different degrees of freshness. This would disturb the estimated effect of the prices, and thereby the estimated effect of the labels and other variables entering the model. It was therefore decided to impute all of the prices, including the price of the egg that was purchased.

The definition of the choice set is also important. It may not be reasonable to expect eggs with all labels to be present in all purchase situations.[8] If eggs with a given label are not present, the type is said to be rationed. If rationing occurs, but is not revealed, it might mean that a person is perceived as choosing not to buy eggs with a specific label even though this label might have been preferred if it had been present. This will lead to

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[7] Bjørner et al. (2004) use GfK data to estimate willingness to pay for the Nordic Swan label, indicating environmentally friendly products. They use a mixed logit but in contrast to this paper they do not allow for correlation between mixed parameters.

[8] In some purchase situations the labels are not necessarily certified and/or no alternative can be expected to be available. This is e.g. the case for purchases directly from farms. These purchases are therefore excluded from the analysis, along with purchases where the price of battery eggs cannot be imputed.

a lower estimate of marginal willingness to pay for this label. This is an important fact to keep in mind when interpreting the results of the estimations, especially for barn and free-range eggs that have relatively low purchase shares.[9] In this application, eggs with a specific label are assumed to be rationed in a particular observation (and are therefore excluded from the choice set in this particular observation) if nobody purchased eggs with this label in the relevant group of stores during the week in question.

The mixed multinomial logit models are estimated using a modified version of a programme developed by Kenneth Train, David Revelt, and Paul Ruud. This is an extension of the programme used in for example Bjørner et al. (2004), Revelt and Train (1998) and Train (1998). The extension allows estimation of correlations between normally distributed parameters. One of the virtues of this programme is that it takes account of the panel structure of the data. In this paper the simple Halton draws used in the extended programme by Train, Revelt and Ruud are replaced by antithetic Halton draws. This practically eliminates the noise in the log-likelihood values of different models, and thereby improves the reliability of the Likelihood Ratio tests. See Andersen (2008) for more on antithetic versus conventional Halton draws.

The parameter for the utility of money is assumed to be the same for all households, whereas the parameters for eggs with different labels is assumed to follow a multivariate normal distribution.This implies that the estimated marginal willingness to pay is also assumed to be normally distributed. In MMNL language this means that the price parameter is fixed, and the reactions to egg labels are mixed. The utility of money is probably not the same for everyone, but in this case it is a question of semantics. It is not possible to tell whether the difference in willingness to pay origins from differences in utility of money or from utility of non-battery labels. The assumption that everyone has the same utility of money whereas the utility of labels is normally distributed is merely a convenient way of assuming that the willingness to pay is normally distributed.

[9] Even if there was no rationing, the average purchase shares may influence the results. Types with a low purchase share are likely to have less shelf space, and are therefore less likely to be chosen at random. This may bias the results for e.g. free-range eggs negatively.

## 7 Results

First, the model is estimated using only the price and the type of egg as explanatory variables. This version illustrates the results that could be obtained from data with no information on socio-demographics. To illustrate the difference between a conventional and a mixed logit, the results of a conventional model are compared with a mixed version of the same model. The conventional model is rejected, and information about socio-demographic factors and perception of animal welfare and food safety is then included in the mixed model and the results are discussed.

The mixed multinomial logit estimates a distribution of the mixed parameters. The standard deviation of the normal distribution can be used as a measure of the degree of heterogeneity related to the utility of a given type of egg compared to battery eggs, and thereby also to the degree of heterogeneity of willingness to pay. Note that not only the variance but also the covariance is estimated. This provides interesting results about the relationship between the willingness to pay for eggs with different levels of animal welfare. The estimated correlations indicate the extent to which a high willingness to pay for e.g. organic eggs compared to battery eggs is correlated with a high willingness to pay for other types of eggs compared to battery eggs.

The main hypotheses are:

- the willingness to pay compared to battery eggs is expected to be highest for organic eggs, lower for free-range eggs and lowest for barn eggs
- the correlation between willingness to pay for different types of eggs is expected to be highest between organic and free-range eggs
- The degree of heterogeneity is expected to be greater for organic eggs than for barn and free-range eggs
- households which perceive animal welfare as better for hens laying organic eggs are expected to have a higher willingness to pay, even when perception of food safety is controlled for

The organic label is familiar from other goods and to some people it also includes a health aspect. This means that there are more potential sources of willingness to pay for organic eggs than for free-range and barn eggs, which only differ from battery eggs in terms of animal welfare. The ranking of willingness to pay for organic, free-range and barn eggs compared to battery eggs is therefore expected to be highest for organic eggs. Free-range hens have access to outdoor areas and are therefore expected to have a better animal welfare than battery eggs. The willingness to pay is therefore expected to be lowest for barn eggs. The correlation between willingness to pay for different types of eggs is expected to be highest between organic and free-range eggs, because the production methods are very similar, and lowest between organic and barn eggs (but the correlation is still expected to be positive). The different sources of willingness to pay for organic eggs are expected to be positively correlated (people who believe that organic products are healthier are more familiar with the organic label). The degree of heterogeneity is therefore expected to be greater for organic eggs than for the other types. Perception of food safety is observed to be positively correlated with perception of animal welfare (see table 3), but is a private attribute (non-altruistic). It is therefore important to control for this private good when estimating the willingness to pay for the public good animal welfare.

Table 5 compares the result of the conventional logit with the results of the simplest mixed logit. In both the estimated models the utility of price is negative and significantly different from zero, which means that the utility of money is positive, as expected. In the conventional logit the ranking of willingness to pay comes directly from the estimated parameters of the utility function. These are all negative, which means that the willingness to pay for non-battery eggs is lower than the willingness to pay for battery eggs. As an example, the willingness to pay for organic eggs compared to battery eggs is $-\left(0.21/\left(-0.45\right)\right) = -0.47$. The conventional logit thus suggests that all households prefer to buy battery eggs unless the organic eggs are DKK 0.47 cheaper. At a first glance this is somewhat contra intuitive, as the price of non-battery eggs is usually higher than the price of battery eggs. But what it actually means is that the price difference is not enough to explain the low purchase shares of non-battery eggs. The logit model therefore estimates negative utility of the labels.

**Table 5 Results of Estimations Based on All Households, Including Only Type of Egg and Price (Model 1)**

| | | Conventional logit | | | Mixed logit | | |
|---|---|---|---|---|---|---|---|
| | | Estimate | SD | Signific. | Estimate | SD | Signific. |
| Price | | -0.45 | 0.032 | *** | -0.39 | 0.122 | *** |
| **Type of egg, utility relative to utility of battery eggs** | | | | | | | |
| Means: | Organic | -0.21 | 0.026 | *** | -1.72 | (0.200) | *** |
| | Free-range | -1.17 | 0.024 | *** | -1.40 | (0.134) | *** |
| | Barn | -0.77 | 0.013 | *** | -0.80 | (0.094) | *** |
| Variance: | Organic | | | | 20.73 | (1.819) | *** |
| | Free-range | | | | 7.56 | (0.706) | *** |
| | Barn | | | | 4.31 | (0.395) | *** |
| Correlation: | (Organic, free-range) | | | | 0.84 | | |
| | (Organic, barn) | | | | 0.66 | | |
| | (Free-range, barn) | | | | 0.79 | | |
| Log-likelihood | | | -12,950 | | | -8,385 | |
| No. of households | | | 844 | | | 844 | |
| No. of observations | | | 10,800 | | | 10,800 | |

Estimations using GfK purchase data on eggs from 26 June 1999 to 30 June 2000. Purchases made directly from farms excluded. Rationing is allowed. Number of antithetic Halton Draws is 7,500. '***' is significant at the 1% level.

The willingness to pay is higher for organic eggs than for barn eggs, as expected, but the willingness to pay for free-range eggs is lower than for barn eggs. This does not correspond with the expectation that willingness to pay for free-range eggs should lie between the willingness to pay for barn eggs and that for organic eggs. On the other hand, it fits well with the fact that free-range eggs have the lowest market share (see table 2). One explanation is that households may find it difficult to distinguish free-range eggs from barn and organic eggs. If a household believes that there is no difference between barn and free-range eggs, barn eggs will be chosen because they are cheaper. If a household believes that there is almost no difference between free-range and organic eggs, organic eggs are more likely to be chosen, because organic eggs have a familiar label and may even be perceived as healthier, and are often not more expensive than free-range eggs. Baltzer (2004), who used scanner data from a large Danish retail chain, also found that the willingness to pay for free-range eggs was lower than for organic and barn eggs.

A conventional logit can be seen as the special case of a mixed logit in which all standard deviations are zero. It is therefore possible to test the need for mixing by a likelihood ratio test with degrees of freedom equal to the number of mixed parameters. In the example in table 5 the likelihood ratio test becomes $-2 \cdot (-12,950 + 8,385) = 9,130$. The degrees of freedom are equal to the number of parameters in the variance covariance matrix in the mixed model i.e. six in this case.

The conventional logit is therefore *strongly* rejected. The estimated negative willingness to pay underlines the fact that the conventional logit does a very poor job of explaining the willingness to pay, because it estimates *one* willingness to pay for all households. The rest of the paper therefore focuses on the mixed model.[10]

In this version of the mixed multinomial logit model both the mean and the variance-covariance matrix of the willingness to pay are estimated, so the ranking of willingness to pay now depends on the share of the population who are willing to pay a given percentage extra, compared to the cost of a battery egg. The expectation is that the share of the population with a given willingness to pay for non-battery eggs is largest for organic eggs and smallest for barn eggs.

The mean willingness to pay in the mixed logit in table 5 becomes negative for all three types of eggs, but now this simply means that the share of households with positive willingness to pay is less than 50 percent, and this does not seem unreasonable given the market shares presented in table 2 (between 10 percent and 26 percent). Based on the marginal distributions, the estimated share of households with positive willingness to pay is 35 percent for organic as well as barn eggs, and 31 percent for free-range eggs.

The willingness to pay for organic eggs has the lowest mean, but the highest standard deviation. In this case the bigger standard deviation implies that the share of the population with willingness to pay higher than a given amount is bigger for organic eggs, once the amount becomes positive, even though the mean was lower than for the other types. The mixing changes not only the magnitude, but also the ranking of the means. However, as mentioned above, the ranking of the means is not necessarily the same as the ranking of willingness to pay. This difference between conventional and mixed logit is important to keep in mind whenever one tries to interpret results of a mixed logit.

The standard deviation of the willingness to pay for organic eggs is 4.6 ($20.73^{½}$) and the standard deviations for free-range and barn eggs are 2.7 and 2.1. This supports the hypothesis that the organic label suggests other attributes in addition to animal welfare.

[10] The mixed logit model relaxes the strict assumption of identical willingness to pay, but as in Alfnes (2004), Bjørner et al. (2004), Carlsson et al. (2005 and 2007) and Lusk et al. (2003), we do not capture the skewness which one might expect to find in willingness to pay for e.g. the organic attribute.

The correlation matrix estimated in this paper allows us to investigate the *relationship* between the willingness to pay for eggs with different levels of animal welfare. As expected, the estimated correlation between organic eggs and free-range eggs is larger than the other correlations, which Supports the findings in Harper and Makatouni (2002). The correlation between barn and free-range eggs is also higher than the correlation between barn and organic eggs, confirming that barn eggs and free-range eggs are closer substitutes than barn eggs and organic eggs.

The simple mixed model in table 5 thus confirms the hypothesis that some share of the population has positive willingness to pay for non-battery eggs, that willingness to pay for barn eggs is lower than for organic eggs, that the variation in willingness to pay for organic eggs is higher than in the willingness to pay for barn and free-range eggs and that the correlation between willingness to pay is positive for all three types of non-battery eggs, highest between organic and free-range eggs and lowest between organic and barn eggs.

The mixed model from table 5 is repeated in table 6, together with a model where socio-demographics and perceptions of animal welfare and food safety are included. The new variables are allowed to influence the mean utility of each type of egg separately, but not the standard deviations. This means that the model estimates differences in mean willingness to pay between households with different perceptions of eggs, and between different socio-demographic groups. The effect of perceptions of animal welfare and food safety is only allowed to influence the willingness to pay for organic eggs, whereas the socio-demographics are allowed to influence the willingness to pay differently for each of the three types of non-battery eggs.

It is important to understand that the parameters for types cannot be compared directly between the two models (and not only because of the change in scale mentioned in the theory section). When socio-demographic factors and perception of organic eggs are included, it means that the estimated means no longer relate to the entire sample, but only to the control group. The utility of organic eggs is allowed to be influenced not only by socio-demographic factors, but also by perception of organic eggs. The result is that the mean utility for the control group becomes -4.00 which is radically different from the -1.72 for the entire sample in the simple model.

**Table 6 Summary of Mixing Results**

| | | Model 1: Only types | | | Model 2: With perceptions and socio-demographics | | | |
|---|---|---|---|---|---|---|---|---|
| **Explanatory variable:** | | **Estimate** | **St. dev.** | | **Estimate** | **St. dev.** | | **LR test** |
| Price | | -0.39 | (0.122) | *** | -0.38 | (0.122) | *** | |
| **Types of eggs, measured relative to battery eggs** | | | | | | | | |
| Means: | Organic | -1.72 | (0.200) | *** | -4.00 | (0.512) | *** | |
| | Free-range | -1.40 | (0.134) | *** | -2.43 | (0.333) | *** | |
| | Barn | -0.80 | (0.094) | *** | -0.84 | (0.241) | *** | |
| Variance: | Organic | 20.73 | (1.819) | *** | 17.16 | (1.552) | *** | |
| | Free-range | 7.56 | (0.706) | *** | 6.77 | (0.687) | *** | |
| | Barn | 4.31 | (0.395) | *** | 4.17 | (0.383) | *** | |
| Correlation: | (Organic, free-range) | 0.84 | | | 0.81 | | | |
| | (Organic, barn) | 0.66 | | | 0.67 | | | |
| | (Free-range, barn) | 0.79 | | | 0.71 | | | |
| **Perception of animal welfare in organic eggs, no difference is control group** | | | | | | | | |
| Organic | Negative organic animal welfare | | | | -0.17 | (0.727) | | |
| | Positive organic animal welfare | | | | 0.99 | (0.285) | *** | $\chi_2^2(15.24) = 0.000$ |
| **Perception of food safety in organic chicken, no difference is control group** | | | | | | | | |
| Organic | Negative organic food safety | | | | -0.55 | (0.697) | | |
| | Positive organic food safety | | | | 0.91 | (0.274) | *** | $\chi_2^2(12.21) = 0.002$ |
| **Income, lowest 25% is control group** | | | | | | | | |
| Organic | Mid 50% | | | | 0.24 | (0.329) | | |
| | Highest 25% | | | | 0.71 | (0.393) | * | $\chi_2^2(5.56) = 0.062$ |
| Free-range | Mid 50% | | | | 0.08 | (0.230) | | |
| | Highest 25% | | | | 0.49 | (0.278) | * | $\chi_2^2(4.95) = 0.084$ |
| Barn | Mid 50% | | | | 0.10 | (0.189) | | |
| | Highest 25% | | | | 0.18 | (0.239) | | $\chi_2^2(0.68) = 0.712$ |
| **Age, 60+ is control group** | | | | | | | | |
| Organic | Age 18 to 44 | | | | -0.88 | (0.392) | ** | |
| | Age 45 to 59 | | | | -0.53 | (0.305) | * | $\chi_2^2(5.27) = 0.072$ |
| Free-range | Age 18 to 44 | | | | -0.49 | (0.276) | * | |
| | Age 45 to 59 | | | | -0.47 | (0.248) | * | $\chi_2^2(4.53) = 0.104$ |
| Barn | Age 18 to 44 | | | | -0.70 | (0.213) | *** | |
| | Age 45 to 59 | | | | -0.43 | (0.205) | ** | $\chi_2^2(10.18) = 0.006$ |
| **Urbanisation, rural municipalities is control group** | | | | | | | | |
| Organic | Capital area | | | | 2.64 | (0.438) | *** | |
| | Urban municipality | | | | 0.72 | (0.368) | * | $\chi_2^2(39.84) = 0.000$ |
| Free-range | Capital area | | | | 1.21 | (0.292) | *** | |
| | Urban municipality | | | | 0.64 | (0.270) | ** | $\chi_2^2(17.42) = 0.000$ |
| Barn | Capital area | | | | 0.09 | (0.240) | | |
| | Urban municipality | | | | -0.04 | (0.209) | | $\chi_2^2(0.35) = 0.839$ |
| **Highest level of education, no further education stated is control group** | | | | | | | | |
| Organic | Voc.-oriented high-school | | | | 0.51 | (0.462) | | |
| | Short further education | | | | 0.77 | (0.530) | | |
| | Medium further education | | | | 1.12 | (0.493) | ** | |
| | Long further education | | | | 1.69 | (0.852) | ** | $\chi_4^2(7.14) = 0.128$ |
| Free-range | Voc.-oriented high-school | | | | 0.58 | (0.287) | ** | |
| | Short further education | | | | 0.82 | (0.357) | ** | |
| | Medium further education | | | | 0.80 | (0.337) | ** | |
| | Long further education | | | | 1.09 | (0.692) | | $\chi_4^2(7.92) = 0.095$ |
| Barn | Voc.-oriented high-school | | | | 0.37 | (0.229) | | |
| | Short further education | | | | 0.26 | (0.276) | | |
| | Medium further education | | | | 0.59 | (0.271) | ** | |
| | Long further education | | | | -0.03 | (0.499) | | $\chi_4^2(5.48) = 0.241$ |
| Log-likelihood | | -8,384.65 | | | -8,305.71 | | | |
| No. of households | | 844 | | | 844 | | | |
| No. of observations | | 10,800 | | | 10,800 | | | |

Estimations using GfK purchase data on eggs from 26 June 1999 to 30 June 2000 combined with answers to AKF/GfK questionnaire from 2002. Purchases made directly from farms excluded. Rationing is allowed. Number of antithetic Halton Draws is 7,500. '***' is significant at the 1% level, '**' at the 5% level and '*' at the 10% level. The LR tests show the results of comparing model 2 with a model excluding variables group by group.

The estimations show that the only socio–demographic factor which influences the utility of barn eggs significantly is age, and the utility of barn eggs for the control group is therefore very close to the utility of barn eggs in the simple model. Introducing socio-demographic factors reduces the estimated variation a little because some of the variation is now captured in the socio-demographics, but the effect is not dramatic. The correlations remain practically the same as in the simple model. Just as in table 5, the standard deviations are large, indicating that the model explains little of the heterogeneity of preferences in the population. The heterogeneity seems to be driven by either other socio-demographic factors, or more likely, by differences in general view of the world; and attitudes towards food related topics in particular.

Simulating the *multivariate* normal distribution (Alfnes, 2004), and adjusting the simulation for number of purchases made by each household, shows that non-battery eggs are chosen by only 39 percent of the control group, even if the price premium for all types of non-battery eggs is zero (see table 8).[11] Using the observed characteristics of the sample rather than the control group, we still find that only 51 percent of the purchases would be non-battery eggs, still with zero price premium.

[11] The panel version of the mixed logit model used in this paper assumes that the individual willingness to pay is constant over time, but varies between individuals. In order to maintain this panel dimension of the model, the purchase shares have been simulated by drawing 100 possible values of willingness to pay for each of the 844 households in the sample. The draws are from the tree dimensional normal distribution estimated in Table 6, using also the estimated correlation between the utility of barn, free-range and organic eggs. The estimated utility parameters have been normalised by the price parameter in order to simulate the willingness to pay. The original sample consisted of 10,800 actual choices made by the 844 households. Each of these choices has been repeated 100 times using the simulated values of willingness to pay. The predicted choice is in each of the 1,080,000 simulated cases the type of eggs which gives the highest consumer surplus, i.e. the type with the biggest positive difference between willingness to pay and price (which for simplicity is always equal to the price of battery eggs). If the difference is negative for all three types of non-battery eggs, battery eggs are chosen.

Table 8 shows the simulated purchase shares[12] (Alfnes, 2004) for different scenarios defined in table 3. Scenario A is the control group, scenario B is the actual sample and scenario C to N are scenarios where one characteristic of all households is fixed, while all other characteristics are allowed to vary. These latter scenarios tell us how the purchase shares would change if everyone in the sample e.g. had a high income (scenario C) or a low income (scenario D). Scenario O and P describes scenarios related to combinations of animal welfare and food safety. Table 9 highlights the differences between certain scenarios, e.g. the difference between the scenario where everyone has a high income and the one where everyone has a low income (scenario C-D).

**Table 7 Scenario definition, simulated purchase shares**

| Scenario | | Animal welfare | Food safety | Income | Age | Urbani-sation | Education |
|---|---|---|---|---|---|---|---|
| A | Control household | No dif. | No dif. | Lowest | 60+ | Rural | No further |
| B | Sample households | * | * | * | * | * | * |
| C | Sample + high income | * | * | Highest | * | * | * |
| D | Sample + low income | * | * | Lowest | * | * | * |
| E | Sample + age 60+ | * | * | * | 60+ | * | * |
| F | Sample + age 18-44 | * | * | * | 18-44 | * | * |
| G | Sample + capital | * | * | * | * | Capital | * |
| H | Sample + rural | * | * | * | * | Rural | * |
| I | Sample + long educ | * | * | * | * | * | Long |
| J | Sample + no educ | * | * | * | * | * | No further |
| K | Sample + animal | Better | * | * | * | * | * |
| L | Sample + no dif. animal | No dif. | * | * | * | * | * |
| M | Sample + safety | * | Better | * | * | * | * |
| N | Sample + no dif. safety | * | No dif. | * | * | * | * |
| O | Sample + animal, safety | Better | Better | * | * | * | * |
| P | Sample + no dif. Animal, safety | No dif. | No dif. | * | * | * | * |

* Varies between households.

[12] The panel version of the mixed logit model used in this paper assumes that the individual willingness to pay is constant over time, but varies between individuals. In order to maintain this panel dimension of the model, the purchase shares have been simulated by drawing 100 possible values of willingness to pay for each of the 844 households in the sample. The draws are from the tree dimensional normal distribution estimated in Table 2, using also the estimated correlation between the utility of barn, free-range and organic eggs. The estimated utility parameters have been normalised by the price parameter in order to simulate the willingness to pay. The original sample consisted of 10,800 actual choices made by the 844 households. Each of these choices has been repeated 100 times using the simulated values of willingness to pay. The predicted choice is in each of the 1,080,000 simulated cases the type of eggs which gives the highest consumer surplus, i.e. the type with the biggest positive difference between willingness to pay and price (which for simplicity is always equal to the price of battery eggs). If the difference is negative for all three types of non-battery eggs, battery eggs are chosen.

The results in table 8 are influenced both by the estimated parameters presented in table 6, and the composition of the sample presented in table 3 and 4. In table 6, the highest absolute difference in utility is 2.46 which is for purchases of organic eggs in the capital area compared to rural municipalities (control group). From table 4 we know that only 25 percent of the households live in the capital area, while 46 percent live in an urban municipality and 29 percent live in a rural municipality. Letting everyone live in the capital area in scenario G therefore changes the utility of organic eggs a lot, and for a large share of the sample. The result is that only 40 percent of all purchases are predicted to be battery eggs in this scenario, while 43 percent are predicted to be organic.

**Table 8 Simulated purchase shares, percent**

| Scenario | | Battery | Barn | Free-range | Organic | Total |
|---|---|---|---|---|---|---|
| A | Control household | 61 | 24 | 4 | 11 | 100 |
| B | Sample households | 49 | 14 | 8 | 28 | 100 |
| C | Sample + high income | 46 | 13 | 9 | 31 | 100 |
| D | Sample + low income | 52 | 14 | 7 | 26 | 100 |
| E | Sample + age 60+ | 44 | 17 | 8 | 30 | 100 |
| F | Sample + age 18-44 | 55 | 11 | 8 | 25 | 100 |
| G | Sample + capital | 40 | 9 | 8 | 43 | 100 |
| H | Sample + rural | 55 | 20 | 5 | 20 | 100 |
| I | Sample + long educ | 45 | 7 | 10 | 38 | 100 |
| J | Sample + no educ | 56 | 14 | 6 | 25 | 100 |
| K | Sample + animal | 49 | 14 | 8 | 28 | 100 |
| L | Sample + no dif. animal | 53 | 17 | 11 | 20 | 100 |
| M | Sample + safety | 49 | 14 | 8 | 29 | 100 |
| N | Sample + no dif .safety | 52 | 17 | 10 | 21 | 100 |
| O | Sample + animal, safety | 49 | 14 | 8 | 29 | 100 |
| P | Sample + no dif. Animal, no dif. safety | 55 | 19 | 13 | 13 | 100 |

Source: Own calculations based on estimations using GfK purchase data on eggs from 26 June 1999 to 30 June 2000 combined with answers to AKF/GfK questionnaire from 2002. Estimations are presented in table 6, households in table 4 and scenarios in table 7.

From table 9, scenario G-H, it is evident that the difference in probability of choosing organic eggs in rural municipalities and the capital area comes not only from a decrease in the probability of purchasing battery eggs, but also from a decrease in the probability of purchasing barn eggs. The probability of purchasing free-range eggs increase when the scenario is moved from rural municipalities to the capital area, so in this case both free-range and organic eggs cannibalise barn eggs as well as battery eggs. This means that the increase in probability of purchasing organic eggs cannot be translated directly to a decrease in the probability of purchasing non-battery eggs.

**Table 9 Differences between scenarios, percentage points**

| Scenario | | Battery | Barn | Free-range | Organic | Total |
|---|---|---|---|---|---|---|
| C-D | High - low income | -6 | -1 | 2 | 5 | 0 |
| E-F | age 60+ - '18-44' | -11 | 6 | 0 | 5 | 0 |
| G-H | Capital - rural | -15 | -10 | 3 | 23 | 0 |
| I-J | Long - no educ. | -11 | -7 | 5 | 13 | 0 |
| K-L | Better - no dif animal | -3 | -2 | -3 | 9 | 0 |
| M-N | Better - no dif safety | -3 | -2 | -3 | 8 | 0 |
| O-P | Better - no dif. Animal, safety | -5 | -4 | -6 | 15 | 0 |

Source: Own calculations based on table 8.

From table 9 it is clear that differences in degree of urbanisation are the most important demographic effect in the model, whereas differences in income have the lowest effect. In table 6 we see that the utility of organic eggs increases significantly when the household trusts that organic production has positive effects on either animal welfare or food safety. This means that purchases of organic eggs are not solely driven by private motives (such as food safety), but also by potentially altruistic motives (animal welfare). However, the effect of trust in better animal welfare for hens laying organic eggs compared to no difference in animal welfare between organic and conventional production is only a nine percentage point increase from 20 to 28 percent in positive willingness to pay for organic eggs, (see table 9 and table 8). The rest of the organic purchases are explained by other factors than animal welfare. The results therefore indicate that stated willingness to pay is to a very large extent cheap talk. It is also worth noting that even in the scenario where no one believes in better animal welfare or better food safety, the organic purchase share is still predicted to be 13 percent (scenario P). This means that organic purchases are also motivated by other factors.

Turning to the significance of the estimated differences, the LR tests in table 6 show the results of comparing the model with perception and socio-demographics (model 2) with a model excluding variables group by group. The difference between the log-likelihood of model 2 and a model without perception of organic animal welfare is 7.62 = 15.24/2, which means that the LR test rejects that animal welfare can be excluded, and therefore has a significant effect. At the other end of the scale, the test for the effect of income on barn eggs (probability 71.2 percent) shows that income has no significant effect on barn eggs.

The effect of socio-demographics is very similar for organic and free-range eggs. Income is barely significant, and neither is age. However, urbanisation and to some degree education has a positive effect on the utility of these types of eggs. The picture is somewhat different for barn eggs, where only age seems to make a difference.

## 8 Conclusion

The results in this paper show that expressed concern for animal welfare as in e.g. the Eurobarometer from 2005 is to a large extent just cheap talk. Although a significant share of the population is willing to pay in order to increase animal welfare, even controlling for food safety, the effect of animal welfare on predicted purchase shares is relatively small. Labelling eggs for increased animal welfare may raise the level of animal welfare a little, but purchases appear to be driven largely by other attributes than animal welfare. The results suggest that hypothetical bias is considerable when estimating the willingness to pay for animal welfare.

The estimated correlation between willingness to pay for barn, free-range and organic egg compared to battery eggs are positive for all three types of non-battery eggs, highest between organic and free-range eggs and lowest between organic and barn eggs. This indicates that organic and free-range eggs are considered very similar, while barn eggs are considered as quite different from organic eggs.

As expected, the willingness to pay for organic eggs displayed more heterogeneity than either barn or free-range eggs (multiple sources of value, e.g. familiar label and health), and the willingness to pay for organic eggs was generally higher than for barn eggs. Contrary to expectation, the willingness to pay was lowest for free-range eggs. However, this result has been seen in at least one other study using completely different methods (Baltzer, 2004). A plausible explanation could be that people either confuse barn eggs with free-range and prefer the cheaper barn eggs, or realise that free-range eggs are close to organic both in attributes and price and therefore prefer organic eggs, which yield both a familiar label and perhaps also an expected positive health effect.

Finally, willingness to pay for free-range and organic eggs is higher in urbanised municipalities and for households with relatively high incomes. Higher levels of education also influence the willingness to pay positively. The willingness to pay for barn eggs is mainly influenced by age; the older the household, the greater the willingness to pay.

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