Consumer willingness to pay for farm animal welfare: mobile abattoirs versus transportation to slaughter

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Summary
Consumer preferences and willingness-to-pay (WTP) for certain non-market food process attributes were investigated using a choice experiment. Swedish consumers were found to be willing to pay a price premium for the use of mobile abattoirs for cattle but not for broilers. We used two different survey versions, with and without an opt-out alternative. There is no evidence that omission of the opt-out alternative leads to biased choices. In addition, respondents who chose to opt-out were no different from those making trade-offs between attributes. The inclusion of an opt-out alternative has no significant effect on the marginal WTP. Based on estimated distributions of WTP and available cost estimates, the market share for mobile abattoirs is predicted. Here we do find differences between the two survey versions: the version with an opt-out alternative revealed greater unobserved heterogeneity.

Keywords: animal welfare, choice experiments, slaughter, willingness-to-pay

JEL classification: Q13, Q18, D12

1. Introduction
Long-distance transportation of live farm animals to slaughter in Europe has recently aroused great public and consumer concern for animal-welfare reasons. Europeans are generally very critical of long-distance transport of animals (Moynagh, 2000). Low transport costs relative to market values of meat, market demand and related seasonal variation, geographical concentration of production, increasing specialisation within livestock production,
contractual agreements and active livestock dealers explain why animals are transported live instead of as carcasses or meat products within the European Union (EU). Exports subsidies and strategic behaviour to influence domestic prices are additional factors driving the transportation of live animals outside the EU.

Recently, mobile abattoirs have been developed to alleviate animal welfare problems arising from long-distance transportation to slaughterhouses. Whether or not mobile abattoirs are a profitable alternative for producers and/or attractive from a social viewpoint depends on the costs and benefits of such a system. Cost assessment is relatively easy, but quantifying the benefits is rather more difficult, especially as there is no functioning market to study.

The objectives of this study were (i) to examine whether consumer preferences for the transport of farm animals to slaughter are reflected in willingness-to-pay (WTP) for any extra cost involved in the use of mobile abattoirs, (ii) to assess the share of consumers who would pay more for meat slaughtered therein and (iii) to investigate whether the WTP for use of mobile abattoirs and concern for animal welfare are species-specific. A study by Liljenstolpe (2003) assessed WTP based on a choice experiment (CE) using a mixed logit model for animal welfare attributes in pig production, including mobile slaughter and transport of live pigs limited by distance. Results presented by Liljenstolpe reveal substantial price premiums for the attributes included in the study. We extend that study by estimating consumer WTP using random parameter models for producers’ use of mobile abattoirs for broiler and cattle in Sweden, with data obtained from a large CE concerning a variety of process attributes relevant to each type of meat production. The two livestock types studied represent two of the major lines of meat production. A cheap-talk script was included following Carlsson et al. (2005) to mitigate problems of hypothetical bias.

An advantage of CE compared with other valuation techniques is its close resemblance to an actual purchase situation. An important question in the design of CEs concerns the decision to include an opt-out alternative. Several studies have investigated the form that such an option should take, and have provided recommendations on when to use this option in an experimental design (e.g. Rigby and Burton, 2005; Ryan and Skåtun, 2004; Kontoleon and Yabe, 2003; Banzhaf et al., 2001). We are, however, not aware of previous studies that have tested the effect of including or not including an opt-out on the marginal trade-off between attribute levels. To do so is the fourth objective of this study. It is an important issue because, from a welfare theoretical point of view, it is not necessary to include an outside option if we are primarily interested in a comparison between different clearly defined choice alternatives.

This article proceeds with a review of farm animal welfare problems involved in their transport to slaughter and a brief overview of mobile abattoirs. We then describe the CEs, including the survey design and the model
used to estimate consumer WTP. This is followed by the presentation of our results, and in conclusion, a discussion of our findings.

2. Transportation of farm livestock to slaughter and mobile abattoirs

Around 26.1 million bovine animals (including calves), 206 million pigs and 4.5 billion broiler hens were slaughtered in the EU in 2006 (Eurostat, 2006). Current EU legislation limits transport time to 8 hours and further requires that specified loading densities for the main livestock species be respected. However, extension of travel time is permitted, provided certain stipulated conditions are met (Council Directive 91/628/EEC). Implementation of the directive allows pigs and horses to be transported non-stop for 24 hours. Cattle and sheep can be transported non-stop for 14 hours. However, no comprehensive European data are available concerning the actual duration of transport of slaughter animals.

Animal production in the EU is currently undergoing restructuring, whereby the number of farms is decreasing, farm and herd sizes are increasing and farm operations are becoming increasingly specialised. This development is relevant to animal welfare, as some species are less robust than others to long distance transportation. Increasing use of production contracts may further exacerbate animal welfare problems due to transporting animals to slaughter, since factors other than transport time take priority when establishing such contracts.

The slaughter industry in Europe is also undergoing structural adjustment, leading to fewer but larger slaughterhouses, and a change in product composition. There were 3,890 large-scale slaughterhouses in 2002 compared with 2,863 in 2007 (Eurovetlink). In Sweden, 98.5 per cent of the total carcass weight is slaughtered at large-scale facilities (Swedish National Food Administration, 2003). In Sweden, there are currently (mid-2007) 27 large-scale slaughterhouses for red meat (compared with 30 in 2000), and 18 large-scale slaughterhouses for poultry. All these facilities are situated in southern and central Sweden. There are also eight small-scale slaughterhouses for red meat in northern Sweden, but none for poultry (Eurovetlink).

2.1. Animal health and welfare

There are numerous reports of animal health and welfare problems related to the handling and transport of live animals to slaughter. Humane treatment of animals prior to and during transit is crucial for animal wellbeing (Hemsworth and Coleman, 1998). Rough or insensitive handling is a well-known cause of physical trauma among animals (van Putten and Elshof, 1978). In general, four different issues have been identified: (i) stress, which reduces animal welfare and increases the risk of mortality, (ii) poorer meat quality, (iii) risk of the spread of infectious diseases and (iv) detrimental environmental effects of transportation (Gebresenbet, 2003).
Although factors affecting animal welfare during transport are fairly similar regardless of species, some results indicate that certain species are more sensitive than others to different factors (Ekesbo, 2003).

Change in animal behaviour is the most commonly used indicator of stress (Broom, 1993). Aspects of handling and transport create stress in animals (Gebresenbet, 2003). Kent and Ewbank (1983) grouped such aspects into five main categories: the original environment, loading, journey, unloading and new environment. In general, loading, unloading and the first hours in transit are found to be the most stressful aspects (Knowles, 1999). Kenny and Tarrant (1987) reported that stress increases with increasing complexity of the transport procedure; in particular, they found that confinement in a moving vehicle could be the most stressful aspect for beef cattle. Mixing animals from different herds causes additional stress reactions and increases the risk of injury to animals (Mohan-Raj et al., 1991). In addition, Tarrant and Grandin (2000) reported that space availability in vehicles is closely related to animal wellbeing. Crowding impedes natural behaviour, affects ambient conditions such as air temperature, purity and humidity during transport, and increases the incidence of PSE (Pale, Soft, Exudative) meat and mortality due to stress, especially for pigs (Warris, 1998). Good ambient conditions during transport are essential to the wellbeing of, especially, pigs and poultry, as both have thermo-regulatory problems due to their physiology; recommended upper temperature range is 10–20°C for pigs, and 15–20°C for poultry (Kettlewell and Mitchell, 1993). A survey by the Swedish National Board of Agriculture (SJV, 2000) using data from 1998–2000 found that 11 per cent of beef animals and pigs slaughtered in Sweden had injuries attributed to transportation. In addition, 6 per cent of inspected vehicles were found to be over-crowded.

Numerous studies have reported that transport time and transport distance are jointly related to animal wellbeing and also to meat quality immediately after slaughter. Lendfers (1971) reported that mortality rates doubled when pigs were transported more than 45 kilometres (km), compared with 10–15 km. Other studies report that DFD (Dark, Firm, Dry) problems in beef increase with transport distance (Poulanne and Alto, 1981). In addition, Ramsay (1977) found that the injury rate in cattle is positively correlated with transport duration. Stress levels and mortality rates for broilers are also closely and positively related to transport time (Freeman et al., 1984). Evidence for cattle is similar (Villarroel et al., 2003).

2.2. Mobile abattoirs

A mobile abattoir is defined as a complete system used for the slaughter of livestock. It is fully mobile, meaning it can be moved between locations. Prototypes of mobile abattoirs for use in Europe have been developed and approved in Britain, the USA and Canada (Benefalk et al., 2002). Current EU directives (91/495/EEG; 93/119 EC) do not explicitly allow mobile
abattoirs for animals other than reindeer.\(^1\) In Sweden, mobile slaughter systems are in use for reindeer and ‘spent’ hens.\(^2\)

A number of studies have been devised to evaluate these prototype systems with respect to production organisation, animal handling, sanitation and food hygiene (Helgesson, 2000; Benefalk et al., 2002). Although the use of mobile abattoirs would minimise stress-related and loading injuries associated with road transport of animals, several factors have been reported as problematic in these systems, such as achieving sufficiently rapid and even cooling of carcasses to guarantee food hygiene and ensuring availability of pure water supplies (Benefalk et al., 2002). Stunning before slaughter, especially of pigs, bleeding and the installation of suitable equipment to scald carcasses are also reported to be more problematic in mobile abattoirs than in regular slaughterhouses (Benefalk et al., 2002).

Cost evaluations of prototype mobile abattoirs in Sweden have been conducted in two studies: Benefalk et al., (2002) for cattle and pigs, and Helgesson (2000) for pigs. Both studies assumed mobile abattoirs to be stationed at existing large slaughterhouses and considered the distance to producers in their cost calculations. It is imperative to know distances, because the total cost of slaughter in a mobile system depends on time allocated to transportation, setting up (including washing and disinfection), slaughter and statutory veterinary inspection. For our purpose, the interesting aspect is the cost comparison between mobile abattoirs and large-scale abattoirs. Table 1 reports the difference in costs between the two mobile systems and large-scale abattoirs.

The cost difference for pigs is negative for the northern region, implying an advantage for the mobile slaughter system. The main explanation for this advantage is the smaller size of such abattoirs and longer transport distances (Helgesson, 2000). Observed cost differences for central and southern regions are shown in Table 1.

### Table 1. Difference in costs\(^a\) (SEK/kilogram) for slaughter in mobile systems versus large-scale abattoirs for cattle and pigs in different regions of Sweden

<table>
<thead>
<tr>
<th></th>
<th>North</th>
<th>Central</th>
<th>Southern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle(^b) (at 23 animals/day)</td>
<td>0.17</td>
<td>1.84</td>
<td>1.97</td>
</tr>
<tr>
<td>Pigs(^b) (at 120 animals/day)</td>
<td>−1.61</td>
<td>0.07</td>
<td>0.19</td>
</tr>
<tr>
<td>Pigs(^c) (at 100 animals/day)</td>
<td>−1.33</td>
<td>0.25</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Note: Positive figures imply higher costs for mobile systems; negative figures imply higher costs for stationary large-scale abattoirs.
\(^a\)Cost data have been indexed to year 2004 using the Swedish Consumer Price Index.
\(^b\)Data from Benefalk et al. (2002).
\(^c\)Data from Helgesson (2000).

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1 Current legislation (91/495/EEC; 93/119/EEC) does not mention or explicitly state that mobile abattoirs are allowed but the opinion is that these systems should be allowed when not explicitly prohibited. There is nothing in the legislation that formally prohibits these slaughter systems.
2 A ‘spent’ hen is a hen that has been used in egg production.
Sweden are attributed mainly to differences in transport distances between farmsteads and large abattoirs (Helgesson, 2000).

There is reason to believe that the actual costs of mobile systems are higher than reported, especially for cattle, the main reason being that the assumed capacity utilisation is relatively high. In Sweden, 65 per cent of slaughtered cattle come from dairy herds and as the average dairy herd size in Sweden is 36 cows (Statistics Sweden, 2000) and the typical recruitment rate is 30–40 per cent on an annual basis, the number of animals available for slaughter from each farm on each occasion will probably be smaller than the necessary capacity uptake of the mobile slaughter system. In addition, structural changes in the dairy sector have reduced the number of dairy farms. Hence, transport distances to and between remote farmsteads might prevent a mobile slaughter system from operating at more than one farm per day. The assumed capacity utilisation is high for pigs too. Fatter pigs are usually kept in batches of around 400 animals and payment at slaughter is matched to carcass weight. Due to individual variations in growth rate, pigs from the same batch are then sent to slaughter over a 4-week period to maximise payments obtained. The forgone profit from a more concentrated slaughter using a mobile system is not taken into account in the studies mentioned.

3. The choice experiment

Market data for sales of meat products where the animals were slaughtered at a mobile abattoir are not available, as mobile abattoirs have not yet been introduced. Primary data for the evaluation of transportation of animals for slaughter were instead collected using a CE, for which a questionnaire was mailed to consumers in Sweden. In a typical CE, the respondent is asked to choose one of two or more options. Each option is described by a number of attributes, where the levels of the attributes vary across the choice sets. Consumers were asked to make choices between minced (ground) beef and chicken fillets with varying levels of price, product labels, feed type, outdoor production, transportation to slaughter and growth rate. The process attributes used in the CE vary across product type, as relevant policy questions are product specific. Table 2 reports attributes and levels in the CE.

Several factors motivate the choice of using a CE to assess consumer WTP for transportation of live animals to slaughter. First, a CE is based on random utility theory and hence is consistent with consumers benefiting from the consumption of attributes embodied in a product, rather than from the product itself. Second, CE data can readily be combined with revealed preference data (Adamowicz et al., 1994). Third, a CE allows the estimation of marginal rates of substitution between different attributes. Several studies have also shown that the estimated marginal rates of substitution probably do not suffer from hypothetical bias (Carlsson and Martinsson, 2001; Lusk and Schroeder, 2004). Fourth, a CE closely resembles an actual purchase situation;

3 For an overview of choice experiments, see Alpizar et al. (2003) and Louviere et al. (2000).
specifically, it captures the trade-offs between attributes when a product is chosen from several competing options. Finally, a CE can provide an accurate prediction of the outcome of introducing a product into the marketplace (Jayne et al., 1996).

Several potential disadvantages associated with CE required attention in this study. The hypothetical nature of the experiments may induce respondents to exaggerate their stated WTP. Although Carlsson and Martinsson (2001) and Cameron et al. (2002) failed to reject the hypothesis of equal marginal WTP in a real and a hypothetical setting, Johansson-Stenman and Svedsäter (2003) rejected the equality of marginal WTPs while Lusk and Schroeder (2004) and Alfnes and Steine (2005) found that hypothetical choices overestimate

Table 2. Attributes and levels in the CE

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Chicken</th>
<th>Beef</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
<td>Minimum required by law. Labelling of farm-of-origin and choice of husbandry.</td>
<td>Genetically modified feed has been used in accordance with the current regulations. This is clearly labelled on the food product.</td>
</tr>
<tr>
<td>Feed&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Genetically modified feed has been used in accordance with the current regulations. This is clearly labelled on the food product.</td>
<td>Genetically modified feed has been used in accordance with the current regulations. This is clearly labelled on the food product.</td>
</tr>
<tr>
<td>Genetically modified feed has not been used.</td>
<td>Genetically modified feed has not been used.</td>
<td>The use of genetically modified products in feed is banned in the EU and their import from countries outside the EU is not allowed.</td>
</tr>
<tr>
<td>The use of genetically modified products in feed is banned in the EU and their import from countries outside the EU is not allowed.</td>
<td>The use of genetically modified products in feed is banned in the EU and their import from countries outside the EU is not allowed.</td>
<td></td>
</tr>
<tr>
<td>Outdoor</td>
<td>Flock always kept indoors. Flock kept outdoors in the summertime and in smaller groups during winter.</td>
<td>Herd kept outdoors in summer. Herd kept outdoors all year.</td>
</tr>
<tr>
<td>Transport</td>
<td>Transport of live birds to slaughterhouse in accordance with current regulations.</td>
<td>Transport of live animals to slaughterhouse in accordance with current regulations.</td>
</tr>
<tr>
<td>No transport of live birds to slaughterhouse. Broilers are slaughtered at the farm in a mobile abattoir.</td>
<td>Transport of live animals to slaughterhouse. Cattle are slaughtered at the farm in a mobile abattoir.</td>
<td></td>
</tr>
<tr>
<td>Growth</td>
<td>Fast growth chicken (35–39 days)</td>
<td>0 (80); +4 (84); +8 (88); +12 (92); +24 (104)</td>
</tr>
<tr>
<td>Slower growth chicken (at least 81 days)</td>
<td>0 (40); +4 (44); +8 (48); +12 (52); +24 (64)</td>
<td></td>
</tr>
<tr>
<td>Price&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 (80); +4 (84); +8 (88); +12 (92); +24 (104)</td>
<td>0 (40); +4 (44); +8 (48); +12 (52); +24 (64)</td>
</tr>
</tbody>
</table>

<sup>a</sup>The EU only requires labels on products where GM strains have been used. In addition, animal products from animals fed with GM feed do not need to be labelled.

<sup>b</sup>At the time of the survey, SEK1 ≈ EUR 0.11.
total WTP, but did not reject the equality of marginal WTPs for changes in individual attributes. This evidence suggests that one should always be careful when analysing any stated preferences data. In order to reduce the probability of any hypothetical bias, we follow Carlsson et al. (2005) and use a ‘cheap-talk’ script.

3.1. Survey design

The questionnaire used for the CE was devised together with industry representatives and academic researchers specialising in farm animal production. Our aim was to formulate a policy-relevant and meaningful questionnaire for respondents. The definitive questionnaire was pre-tested using two focus groups (each comprising five individuals) and three pilot studies. The resulting questionnaire consisted of three parts. The first included questions about the respondent’s and the household’s buying habits for each meat product in question. The CE constituted the second part. In the introduction to the CE, the purpose of the survey was explained briefly, followed by the ‘cheap-talk’ script. Furthermore, an information sheet was included in the survey to describe the product quality variables and provide a short explanation of the choices offered.4 The third part of the questionnaire contained questions about the respondent’s socio-economic and demographic status.

Consumers were asked to make binary choices between various specifications of chicken fillets and minced beefs. Each product was described by five quality attributes and one price variable in a set of four choices; in total, each respondent answered eight of these choices; four for each of two products. Figure 1 provides an example of a choice situation. The two types of meat products were selected because they are recognisable to most consumers. In addition, minced beef can contain meat from all bovine animals, thus not implying a preference for meat from a dairy or beef animal. The choice sets were created using a cyclical design principle (Bunch et al., 1996).5

In order to test the effect of including or not including an opt-out on the marginal trade-off between attribute levels, we administered two versions of the experiment: one with an opt-out alternative and one without such an alternative. In all other respects, such as the design and wording of the questionnaire, the two versions were identical.

The inclusion or exclusion of an opt-out alternative in a CE has several potential behavioural as well as econometric implications (Kontoleon and Yabe, 2003). Including an opt-out is thought to improve the realism of the

4 See the appendix for an example of the information provided to the respondents, and the cheap-talk script.

5 A cyclical design is a straightforward extension of the orthogonal approach. First, each of the alternatives from a fractional factorial design is allocated to different choice sets. Attributes of the additional alternatives are then constructed by cyclically adding alternatives into the choice set based on the attribute levels. The attribute level in the new alternative is the next highest attribute level to the one applied in the previous alternative. If the highest level is attained, the attribute level is set to its lowest level.
experiment (i.e. prevent a forced choice that could affect the ranking of attributes), to be necessary for the welfare estimates to be consistent with demand theory, and generally to improve the experimental design. The comparison between the levels of the attributes should, however, not require an outside option or an opt-out alternative. This is because we are primarily interested in the comparison between different clearly defined alternatives. Given this, it is not necessary, from a welfare theoretic point of view, to include an opt-out. We assume that the confusion on this point comes from the simple comparison with, say, a contingent valuation (CV) survey, where there is a clear scenario describing the status-quo. However, the status-quo in the CV survey could actually be a specific alternative in the CE, so one has to make sure to include the relevant alternative that one wants to compare when making the welfare evaluations.

An opt-out alternative can, on the other hand, be used as ‘an easy way out’ for respondents faced with a complex and difficult choice task or when the choice set does not contain enough distinct options. It also seems reasonable to assume that the opt-out alternative would be chosen in a CE where respondents are faced with options that do not meet a minimum acceptable standard. This is possible if, for example, respondents have preferences for animal welfare standards that are higher than any of those included in the choice set. In such a case, the IIA assumption would be violated if the opt-out alternative distorts the tradeoffs between choice options. Another problem is that respondents who choose an opt-out alternative may be different from those making trade-offs between attributes, in the sense that they make different trade-offs at the margin. If this occurs, then an opt-out option would indeed

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Minced beef 1</th>
<th>Minced beef 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
<td>Minimum required by law</td>
<td>Farm-of-origin and type of animal husbandry</td>
<td>1 choose not to buy minced beef</td>
</tr>
<tr>
<td>Feed</td>
<td>Genetically modified products in feed are banned</td>
<td>Genetically modified products in feed have been used. This is labelled on the food product</td>
<td></td>
</tr>
<tr>
<td>Outdoor production</td>
<td>Outdoors in summer</td>
<td>Outdoors all year around</td>
<td></td>
</tr>
<tr>
<td>Transport to slaughter</td>
<td>Mobile abattoir</td>
<td>Transport of live animals</td>
<td></td>
</tr>
<tr>
<td>Price surcharge SEK/kg (total cost)</td>
<td>+ 12 SEK (92 SEK)</td>
<td>+ 24 SEK (104 SEK)</td>
<td></td>
</tr>
<tr>
<td>Your choice (mark one alternative)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.** Example of choice set used in the beef questionnaire with an opt-out alternative.
affect the marginal WTP as well. It is therefore of interest to compare the results from the two survey versions.

The two most common forms of the opt-out alternative are the ‘no-purchase’ and the ‘own brand’ formats (see Kontoleon and Yabe, 2003 for further references). Studies comparing these formats report that choice shares as well as attribute weights are affected by the format used (Kontoleon and Yabe, 2003; Banzhaf et al., 2001). These studies argue that the no-purchase option systematically biases respondents’ choice towards certain types of response at the expense of others. In addition, a ‘no-purchase’ option could just introduce another forced choice or introduce a new option that the respondents envision, thus violating the criterion for incentive compatibility (Hensher, Shore and Train, 2005). An own brand option, on the other hand, has been found to be less subject to compromising and does not invite the use of simple choice heuristics by respondents (e.g. Kontoleon and Yabe, 2003). Ultimately, the recommendation is to choose an opt-out format that mimics the actual choice situation as closely as possible (Batsell and Louviere, 1991). Carson et al. (1994) suggested that the no-purchase alternative can be recommended when seeking enhanced task realism and when the objective is to measure market penetration. Alternatively, they suggested the own brand alternative when the objective is to investigate what attributes are important in order to induce consumers to shift from the own brand to a new product.

The opt-out alternative chosen in this study was a no-purchase option providing the respondents with a third alternative in each choice set formulated as ‘I choose not to by chicken fillet (minced beef)’. Typically, both chicken fillet and minced beef are marketed as non-differentiated products in Sweden, and it is therefore hard to see how an own brand opt-out alternative could be motivated here as it cannot be identified with respect to its characteristics. Use of such an alternative requires that respondents can distinguish certain attributes from their usual brand (i.e. respondents should be able to select away from choice alternatives offered when these alternatives do not meet the standards of the own brand). In addition, the CE in this study presents unlabelled generic alternatives that do not provide any information beyond that provided by their attributes, as the intention of the experiment is to assess consumer preferences (and relative rankings) for certain attributes rather than a brand association. Lusk, Roosen and Fox (2003) used ‘Neither A nor B is preferred’ as a third choice alternative in each choice set. Our opt-out should be less open to ambiguity of what the opt-out alternative represents (especially for a non-differentiated product for which a potential side option is likely to be unavailable).

3.2. The econometric model

In the analysis of the responses, we applied a random parameter logit model (Train, 2003). With this type of model, some (or all) parameters are assumed to have a specific random distribution (for example, a normal distribution). We define a latent utility function of alternative $j$ for individual $i$, ...
consisting of a systematic part, \( v_{ij} \), and a stochastic part, \( e_{ij} \),

\[
V_{ij} = v_{ij} + e_{ij} = \beta a_i + \gamma (M_i - c_{ij}) + e_{ij}
\]

where \( a_i \) is the attribute vector, \( \beta \) is the corresponding parameter vector, \( M_i \) is income, \( c_{ij} \) is the cost associated with alternative \( j \), \( \gamma \) is the marginal utility of income and \( e_{itk} \) is a disturbance term. The coefficient vector \( \beta \) varies among the population with density \( f(\beta|\theta) \), where \( \theta \) is a vector of the true parameters of the taste distribution. We assume that all the attribute parameters except cost are randomly distributed, with zero covariances. This means that the parameter for each attribute is the sum of population mean \( \beta \) and individual deviation \( \tilde{\beta}_i \), so that \( \beta_i = \beta + \tilde{\beta}_i \). These individual deviations are assumed to be normally distributed with zero mean. Consequently, for the parameters that are randomly distributed, we estimate both a mean and a standard deviation parameter. Furthermore, we assume that the utility coefficients vary among individuals, but are constant across the choice situations for each individual. This reflects an underlying assumption of stable preference structures for all individuals. Finally, in the survey version with an opt-out, we include an alternative specific constant for the opt-out alternative. This coefficient is assumed to be fixed.

If the random disturbances, \( e \), are IID type I extreme value variables, we have a random parameter logit, or a mixed logit, model. The likelihood function cannot be evaluated analytically. Therefore, we rely on a simulation method for the probabilities. Here, we use a simulated maximum likelihood estimator, using Halton draws, when estimating the models (see Train, 2003).

One interesting aspect of RPL models that has only recently been explored is the possibility of retrieving individual-level parameters from the estimated model, using Bayes Theorem. This means that we can get a notion of where a specific individual, or a group of individuals, is placed in the estimated distribution. Train (2003) showed that the mean, \( \beta_q \), for an individual \( q \) is

\[
E[\beta_q] = \frac{\int \beta P(y_q|\beta)f(\beta|\theta)d\beta}{\int P(y_q|\beta)f(\beta|\theta)d\beta}
\]

where \( P \) is the conditional probability of observing a sequence of choices, denoted \( y_q \), by individual \( q \). This expression does not have a closed form and therefore we again have to rely on simulation methods. The expression in equation (2) is thus an estimate of the preferences of a particular individual. This estimate in turn comes from the estimated population distribution that we obtain with the random parameter logit model.

4. Results

The sample was drawn from a population defined as those between 20 and 75 years of age with a permanent address in Sweden. A random sample of 1600
individuals (800 for each survey version) was selected from the Swedish census registry. A mail survey was conducted in November–December 2004. Two reminders were sent out after a 2-week interval to those who had not replied. In total, 413 (without opt-out) and 382 (with opt-out) individuals returned the questionnaire, of which 395 and 362, respectively, were available for analysis, due to non-responses to various questions. Not all of these answered all eight choice sets. However, we still chose to include these individuals in the analysis. Table 3 presents demographic and socio-economic statistics of the sample. Table 4 presents the results for the two random parameter logit models. For each random parameter, the estimated mean and standard deviation are reported. The model is estimated with simulated maximum likelihood using Halton draws with 500 replications. The models are estimated using Nlogit 3.0. We pooled the responses for the two food products and restricted the cost coefficient to be the same for the two food products (i.e. assuming equal marginal utility of money, irrespective of product). This means that we estimate only two models: one for the survey without an opt-out and one for the survey with an opt-out alternative.

Most of the attribute parameters are significantly different from zero at the 10 per cent significance level or lower. In addition, the estimated coefficient standard deviations are significant for the survey with an opt-out alternative, while most are highly insignificant for the survey without an opt-out alternative.

Table 3. Descriptive statistics of respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Version without opt-out</th>
<th>Version with opt-out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience</td>
<td>1 = responsible for most food purchases; 0 = otherwise</td>
<td>0.51 (0.50)</td>
<td>0.48 (0.50)</td>
</tr>
<tr>
<td>Gender</td>
<td>1 = Female; 0 = Male</td>
<td>0.53 (0.50)</td>
<td>0.55 (0.50)</td>
</tr>
<tr>
<td>Age</td>
<td>Age (years)</td>
<td>47.36 (14.82)</td>
<td>48.62 (13.41)</td>
</tr>
<tr>
<td>Members</td>
<td>Number of persons in household</td>
<td>2.56 (1.34)</td>
<td>2.59 (1.32)</td>
</tr>
<tr>
<td>Children</td>
<td>Number of dependants &lt;20 years</td>
<td>0.74 (1.21)</td>
<td>0.74 (1.02)</td>
</tr>
<tr>
<td>Highest standard of education</td>
<td>1 = University or College; 0 = other</td>
<td>0.36 (0.48)</td>
<td>0.36 (0.48)</td>
</tr>
<tr>
<td>Income</td>
<td>Household income net of taxes (SEK) per month</td>
<td>23,309 (10,352)</td>
<td>24,050 (10,563)</td>
</tr>
</tbody>
</table>

Mean (standard deviations in parentheses)

Note: According to Statistics Sweden on December 31, 2003, the Swedish population aged between 20 and 75 years comprised 50.24 per cent men and 49.76 per cent women. The official statistics presented for the situation on December 31, 2003, report a mean age of 45.8 (standard deviation 15.08). The official statistics (available only for December 31, 2001) report an average of 2.69 individuals per household (standard deviation 1.34). Official statistics report that 27.7 per cent has university or college education, and 48.6 per cent no more than high school.

6 See Train, 2003 for details on simulated maximum likelihood and Halton draws.
### Table 4. Estimated random parameter logit models

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Without opt-out</th>
<th>Minced beef</th>
<th>With opt-out</th>
<th>Minced beef</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chicken fillet</td>
<td>Minced beef</td>
<td>Chicken fillet</td>
<td>Minced beef</td>
</tr>
<tr>
<td></td>
<td>Coeff.</td>
<td>St.dev.</td>
<td>Coeff.</td>
<td>St.dev.</td>
</tr>
<tr>
<td></td>
<td>(P-value)</td>
<td>(P-value)</td>
<td>(P-value)</td>
<td>(P-value)</td>
</tr>
<tr>
<td>Label</td>
<td>Labelling of farm-of-origin and choice of husbandry</td>
<td>0.379 (0.000)</td>
<td>0.874 (0.000)</td>
<td>0.540 (0.000)</td>
</tr>
<tr>
<td>Feed</td>
<td>GM feed has not been used in the meat, but GM feed is allowed.</td>
<td>1.447 (0.000)</td>
<td>0.135 (0.704)</td>
<td>1.763 (0.000)</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Outdoor</td>
<td>Herd kept outdoors all year/summer time</td>
<td>0.672 (0.000)</td>
<td>0.832 (0.000)</td>
<td>0.087 (0.244)</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Transport</td>
<td>Mobile slaughter</td>
<td>-0.193 (0.005)</td>
<td>0.023 (0.918)</td>
<td>0.156 (0.029)</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Growth</td>
<td>Slower growth chicken</td>
<td>0.189 (0.019)</td>
<td>0.352 (0.123)</td>
<td>0.224 (0.092)</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.123)</td>
<td>(0.092)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Cost</td>
<td>-0.048 (0.000)</td>
<td>-0.059 (0.000)</td>
<td>0.333 (0.035)</td>
<td>-0.361 (0.024)</td>
</tr>
<tr>
<td>Opt-out</td>
<td>Chicken</td>
<td>395</td>
<td>362</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>Beef</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of</td>
<td>individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudo $R^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Standard deviation of the estimated coefficients.*
alternative. We included two alternative specific constants in the opt-out model, one for the opt-out alternative in the choice sets concerning chicken and one for the opt-out for the other choice sets. As can be seen, other things being equal, there is a tendency to choose the opt-out in the chicken experiment, since the alternative specific constant is positive. The opposite is true for the beef experiment. We will return to the comparison between the two survey versions later on in the paper.

4.1. WTP for mobile abattoir slaughter

First, our analysis focuses on the transport attribute. In both models, the coefficient for the mobile slaughter attribute is negative and significant for chicken, and positive and significant for beef. This means that, on average, respondents are only willing to pay a positive sum for mobile slaughter of cattle. Mobile slaughter of broilers, on the other hand, requires respondents to be compensated for a utility loss. These findings could be due to different trade-offs between animal welfare and food safety concerns, as well as to anthropomorphic reasons. It is, however, beyond the scope of this study to further disentangle the disutility result. It is worth noting that mobile slaughter is ranked as the next-to-last preferred attribute for minced beef.

To determine to what extent consumers are willing to pay for mobile slaughtered cattle, we need to calculate the marginal WTP for the mobile slaughter attribute; we report this for broilers as well, but note that the WTP is negative. Table 5 reports mean marginal WTP for both survey versions (with and without an opt-out alternative). The standard errors are estimated by the Delta method (Greene, 2000). There is a significant positive WTP for mobile abattoirs for cattle. The estimated mean price premiums are not excessive in relation to the base price of the products. The base price for minced beef was set at SEK 40 per kg. This implies a price premium for mobile abattoirs of around 10 per cent. These results differ considerably from those reported by Liljenstolpe (2003), who, for example, found a mean price premium for mobile slaughtered pork fillet of around 32 per cent.8 There

| Table 5. Average marginal WTP (in SEK/kg) (standard errors in parentheses) |
|--------------------------|--------------------------|
| without opt-out | with opt-out |
| Mobile abattoir versus transportation to large slaughterhouses: Chicken | −4.03 (1.48) | −3.86 (2.03) |
| Mobile abattoir versus transportation to large slaughterhouses: Minced beef | 3.26 (1.53) | 3.46 (1.85) |

7 In November 15, 2004, EUR 1 = 8.9875 SEK.
8 One possible explanation for this disparity might be that Liljenstolpe’s study (2003) did not include a ‘cheap-talk’ script.
are several interesting points arising from the results in Table 5. First, the marginal WTP for mobile slaughter is positive and significantly different from zero for minced beef, and negative and significantly different from zero for chicken. Second, there is no significant difference in marginal WTP between the two survey versions. Third, the marginal WTP for mobile abattoirs for cattle exceeds the cost estimates for such systems (from Table 1). Taking the results from the random parameter logit model and conditioning them on the individual choices, it is also possible to obtain individual-level parameters using equation (2). From these estimates, we can calculate the marginal WTP for each individual. Figure 2 reports the distribution of the individual WTP for mobile slaughter for cattle for both survey versions.

The mean WTP is almost identical to the mean WTP from the parametric analysis: SEK 3.3 per kg for the survey version without opt-out and SEK 3.6 per kg for the version with opt-out. The results also suggest that there are respondents with a relatively high marginal WTP. However, and more importantly, the implied distribution among the respondents differs between the two survey versions. In the version without an opt-out, the distribution is more centred around SEK 2–4 per kg. In the version with an opt-out, the distribution is more bi-polar with a large share of respondents with less than zero in WTP and a large share with more than SEK 10 in WTP. One reason for this could be that, in the version with the opt-out alternative, it is easier for the respondent to express his unwillingness to pay for the improvements by simply choosing the opt-out instead of making trade-offs. So there is
simply more heterogeneity in the survey version with opt-out; this is, of course, a result of the difference in the estimated standard deviations between the two survey versions.

The estimates from Figure 2 can be used to estimate the share of respondents who would buy mobile-slaughtered beef. Helgesson (2000) reported that the average cost, including transportation from farm to abattoir, for large-scale abattoirs was SEK 4.8 per kg in Northern Sweden, SEK 3.1 per kg in Central Sweden and SEK 3 per kg in Southern Sweden. If we base our calculations of respondent shares on the survey versions without an opt-out, we find that 18 per cent of respondents have an individual WTP for mobile abattoirs that exceeds SEK 4.8 per kg, 36 per cent have a WTP greater than SEK 3 per kg. If instead we use the survey version with an opt-out, we find that 45 (48) per cent have a WTP that exceeds SEK 4.8 (3) per kg, respectively. Of course, any use of these results to estimate a potential market size should take into account that final consumer prices likely will exceed the reported average costs.

The question then arises whether any niche groups of respondents can be identified. In order to investigate this, each of the socio-economic and demographic variables listed in Table 2 was interacted with the random parameters but none of the variables was found to be significant.

4.2. Comparison of with and without opt-out

We now return to a more general comparison of the results from the two survey versions. With respect to the ranking of attributes, the two models give similar results. The only difference is for the Feed attribute, but the difference in marginal WTP is small. Using a likelihood ratio test we tested whether the data from the two survey versions can be pooled, i.e. if the hypothesis of equal parameters can be rejected or not. The hypothesis of equal parameters had to be rejected at any conventional level of significance. So the two response formats do result in differences. This is mainly due to the difference in the parameter standard deviations. If we do the same test of pooling but for a standard multinomial logit model, where the standard deviations are set to zero, we cannot reject the hypothesis of equal parameters. In addition, if we compare the estimated marginal WTPs for all the attributes, using simple t-tests, we can only reject the hypothesis of equal WTP for one of the attributes: Outdoor production for minced beef. Thus, in our case, not including an

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9 Cost data were indexed to 2004 using the Swedish Consumer Price Index. These figures obviously do not take into account any trend in cost structures. Furthermore, Helgesson (2000) assumed equal costs between beef and pork.

10 When performing this test, we need to account for the fact that the estimated parameters are confounded with the respective scale parameters. One way of dealing with this problem is to first test for a difference in scale between the data sets. We did this using the grid search procedure proposed by Swait and Louivere (1993). Given the estimated scale parameter, one can then test the hypothesis of equal parameters. When estimating the random parameter model with the grid search procedure, 50 replications were used instead of 500.
opt-out alternative does not have any significant effect on the marginal WTP for the attribute. The only difference is with respect to the unobserved heterogeneity: the version with an opt-out alternative results in greater heterogeneity since most of the parameter standard deviations are significant in the model with an opt-out and insignificant in the model without opt-out.

If we then look at the individual-specific parameters, we find similar results for the other attributes as well: the distribution is bi-polar for the survey version with an opt-out alternative. Furthermore, we can divide the respondents into two groups: those that chose the opt-out alternative in more than 50 per cent of the choice sets and those that chose the opt-out alternative in not more than 50 per cent of the choice sets. Looking at the WTP for mobile abattoir-slaughtered chicken, we find that the average WTP is SEK \(-2\) per kg and SEK \(-4.3\) per kg for the first and second groups, respectively. Thus, the explanation for the bi-polar distribution is the respondents choosing the opt-out alternative.

5. Conclusions and implications

Using a CE, we investigated Swedish consumers’ preferences and WTP for mobile slaughter of broiler, cattle and pigs. Several important results were found in this study. First, mobile slaughter of farm animals was found to be ranked as the least important process attribute for broilers, and the second-least important attribute for cattle, given all the attributes considered in the study. This might be because people do not perceive animal transport to be a major concern in Sweden. It might, however, be that other attributes are viewed as even more pertinent. Second, Swedish consumers signal a significant positive WTP for having cattle slaughtered in mobile abattoirs, instead of transporting them to large slaughterhouses. The WTP for mobile slaughter of broilers is, however, negative. The importance of transportation as a process attribute related to animal welfare would therefore seem to be species-specific. Third, based on the estimated WTP and earlier available cost data, mobile slaughter appears to be a viable alternative for cattle and pigs, especially in northern Sweden. However, a dispersed geographical structure and small-scale agriculture in this region are two major caveats to the economic outcome of implementing a mobile slaughter system. These issues have not been fully addressed in the literature when attempting to estimate the cost of mobile slaughter systems. They therefore warrant further consideration before any definite conclusions can be drawn about the viability of mobile slaughter systems. Fourth, and related to the previous point, our results indicate that there is substantial diversity among consumers regarding WTP. In particular, the degree of heterogeneity is found to depend on the survey design when comparing versions with and without an opt-out alternative. This is important with respect to the usefulness of our own results as well as for results emerging from future CEs. As pointed out by Lusk and Hudson (2004), when deciding what product lines to adopt, agribusinesses are interested in WTP measures that can be used to construct compensated
demand curves to identify likely market shares. Moreover, identification of potential niche products requires knowledge of the distribution of WTP among consumers. In both versions, we found that there exist distinct niche markets, with a relatively high WTP for mobile slaughter of both broilers and cattle, although the distributions of WTP are fundamentally different depending on the use of an opt-out alternative. This suggests that reliance solely on mean WTP estimates, which is how results from CEs are typically used, might be misleading for agribusiness use.

We did not find any significant differences in mean WTP between the survey versions with and without an opt-out alternative, except that the version including an opt-out alternative reveals greater unobserved heterogeneity. This implies that including an opt-out increases the variance but does not have an effect on mean WTP or on the preference ordering. Our results here differ from those of Kontoleon and Yabe (2003) and Banzhaf et al. (2001) in that they do not point to a tendency for the opt-out alternative to bias respondents towards selecting certain types of responses at the expense of others, or to create bias due to forced choice. In addition, there is no evidence that respondents who chose the opt-out are different from those making trade-offs between attributes.

Of course, the actual implementation of mobile slaughter further depends not only on consumer preferences, but also on the actions of suppliers and the market structure within the food industry. This is a field where further research is called for. In their present form, however, our results should be useful in policy formation and when formulating communication strategies within the food market chain.

Acknowledgements

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References


**Appendix**

**Cheap-talk script**

“The experience from previous similar surveys is that people often respond in one way but act differently. It is particularly common that one states a higher willingness to pay than what one actually is willing to pay for the good in the store. We believe this to be due to the fact that one does not really consider how big an impact an extra cost actually has to the family budget. It is easy to be generous when one does not really need to make the choices in a store. If you have another idea or comment on what this behaviour depends on, please write this down on the last page of the questionnaire.”

Adapted from Carlsson, Frykblom and Lagerkvist (2005).

**Information sheet: Chicken fillet**

To facilitate your choices this sheet provides short presentations of product attributes of chicken fillet:

1. **Growth**
   
   The most common broiler is a fast growing type that is slaughtered after 35–39 days. Fast growth causes joint syndromes. Besides affecting
movement, these problems may inflict pain and suffering on the broiler. Scientific studies show that around 40 per cent of fast growing broilers exhibit leg defects. Broilers of slower growth breeds seldom exhibit joint syndromes but are more costly to produce.

Possible alternatives are:
- The broiler is from a fast growing breed that is slaughtered after 35–39 days.
- The broiler is from a slow growth breed that is slaughtered after at least 81 days.

2. Feed
Feedstuffs based on or containing genetically modified ingredients are currently not given to broilers raised in Sweden but this is allowed according to European regulations if it is shown that it does not inflict negative effects on humans, animals or the environment. Food product labels must clearly indicate use of genetically modified feed in rearing.

Possible alternatives are:
- Genetically modified feed has been used in accordance with current regulations. This is clearly labelled on the food product.
- Genetically modified feed has not been used.
- The use of genetically modified products in feed is banned in the EU and it is not allowed to import such products from countries outside the EU.

3. Outdoor production
Almost the entire broiler production takes place on single-level hard floors in large barns holding 10,000 animals. Usually chips are used as litter.

It is possible to keep broilers outdoors during the summer and in smaller groups on floors indoors during the winter. This requires more labour but broilers are considered to be better off. However, extra measures are required at slaughter as outdoor production increases the risk that the intestinal flora contains bacteria that can be transferred to humans.

Possible alternatives are:
- Flock always kept indoors.
- Flock kept outdoors in summer (May–September) and indoors in smaller groups in winter.

4. Transport
With a mobile abattoir the slaughter takes place where birds are raised. Transportation of live birds, with associated stress and loading injuries, is thereby avoided. A mobile abattoir is a system that involves killing, cutting and cooling. Mobile abattoirs are today in practice for slaughtering of reindeer and spent hens.

Possible alternatives are:
- Transport of live bird to slaughter according to current regulations.
Broilers are slaughtered at the place where they are raised using a mobile abattoir. No transport of live birds.

**Information sheet: Minced beef**

To facilitate your choices this sheet provides short descriptions of product attributes of minced beef:

1. **Labelling**
   
   Meat packages shall according to the law be labelled with country of origin and country of slaughter. Additional labelling can provide information about farm of origin and type of husbandry.
   
   Possible alternatives are:
   
   - Minimum labelling required by law.
   - As required by law and farm of origin and type of husbandry.

2. **Feed**
   
   Feedstuffs based on or containing genetically modified ingredients are currently not given to cattle raised in Sweden but they are allowed according to European regulations if they do not inflict negative effects on humans, animals or the environment. Food product labels must clearly indicate use of genetically modified feed in production.
   
   Possible alternatives are:
   
   - Genetically modified feed has been used in accordance with current regulations. This is clearly labelled on the food product.
   - Genetically modified feed has not been used.
   - The use of genetically modified products in feed is banned in the EU and it is not allowed to import such products from countries outside the EU.

3. **Outdoor production**
   
   Almost all beef animals are kept outdoors in summer. Scientific studies show that beef animals manage, and indeed thrive, when kept outdoors all year. Keeping animals outdoors permits their natural behaviour, such as being in a herd. Grazing beef animals are an appreciated landscape feature.
   
   Keeping beef animals outdoors during autumn, winter and spring requires that animals have access to wind and water protection as well as a dry and clean place to rest. Animals also need to be vaccinated as they are more exposed to parasites.
   
   Possible alternatives are:
   
   - Herd kept outdoors in summer.
   - Herd kept outdoors all year.

4. **Transport**
   
   With a mobile abattoir, slaughter takes place where animals are raised. Transport of live animals, with associated stress and loading injuries, is thereby avoided. A mobile abattoir is a system that involves killing,
cutting and cooling. Mobile abattoirs are today in practice for slaughtering of reindeer and spent hens.

Possible alternatives are:

- Transport of live animal to slaughter according to current regulations.
- Beef animals are slaughtered at the place where they are raised using a mobile abattoir. No transport of live animals.