Consumer willingness to pay for farm animal welfare - transportation of farm animals to slaughter versus the use of mobile abattoirs

Fredrik Carlsson[1]
Peter Frykblom[2]
Carl Johan Lagerkvist[3]

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Department of Economics
Gothenburg University

Abstract
This study employed a choice experiment (CE) to ascertain consumer preferences and willingness to pay (WTP) for non-market food product quality attributes. Data were obtained from a large mail survey and estimated with a random parameter logit model. The results indicate that Swedish consumers place greater monetary worth on the use of mobile abattoirs for cattle than for pigs, and even place a negative monetary value for mobile abattoirs in broiler production. We show how CE data can be used to estimate individual WTP, using a random parameter logit model. We find that there is a substantial difference in heterogeneity between consumers WTP for mobile abattoirs for the types of livestock included. Based on estimated distributions of WTP and available cost estimates, the market share for mobile abattoirs is predicted. The approach taken is vital to agribusinesses intending to serve specialized niche markets. Our results are useful for forming product differentiation strategies within the food industry as well as for the formation of food policy.

Keywords: Animal welfare, Choice experiments, Slaughter, Willingness to pay

JEL Classification: Q13, Q18, D12.

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[1] Department of Economics, Göteborg University, Box 640, 405 30 Göteborg, Sweden, fredrik.carlsson@economics.gu.se.
[2] Department of Economics, Swedish University of Agricultural Sciences, P. O. Box 7013, SE-750 07 Uppsala, Sweden, peter.frykblom@ekon.slu.se.
[3] (Corresponding author) Department of Economics, Swedish University of Agricultural Sciences, P. O. Box 7013, SE-750 07 Uppsala, Sweden, carl-johan.lagerkvist@ekon.slu.se.

Introduction

Transportation of live farm animals to slaughter in Europe has recently attracted great public and consumer interest concerning animal welfare relating to long transports. Europeans generally are very critical of transporting animals long distances for slaughter (Moynagh, 2000). Several factors such as tradition and culture as well as economic and social aspects, explain why animals are transported live instead of as carcasses or meat products, despite reported concerns about animal welfare.

Recently, mobile abattoirs have been developed as an alternative to alleviate animal welfare problems engendered by current transportation procedures to slaughterhouses. Whether or not mobile abattoirs are a profitable alternative for producers depends on the costs and benefits of such a system, as does whether they are attractive from a social point of view. Assessment of costs is relatively easy, but to quantify the benefits is rather more difficult, especially as there is no existing market to study.

In this study the objectives were: (a) to ascertain whether consumer preferences for transportation of farm animals to slaughter are reflected in willingness-to-pay (WTP) for any extra cost involved in the use of mobile abattoirs, (b) to assess the possible extent of a market share for mobile abattoirs, and (c) to investigate if WTP for use of mobile abattoirs and concern regarding animal welfare are species specific. We estimate consumer WTP for producer's use of mobile abattoirs for broiler, beef, and pig production in Sweden, using data obtained from a large choice experiment concerning a variety of quality attributes relevant to each type of food production. The three types of livestock studied represent the three major lines of meat production. Using the distribution of individual WTP estimates and available cost estimates for mobile abattoirs, we drew inferences about the potential of implementing such a system. Our results indicate that Swedish consumers are willing to pay a greater additional cost for producer's use of mobile abattoirs for cattle than for pigs, but are less willing to defray such extra cost for mobile abattoirs in broiler production. Furthermore, there are substantial differences in disparity in consumer WTP for mobile abattoirs for the types of livestock studied. This finding is vital to any agribusiness intending to supply specialised niche markets.

This article proceeds with a review of farm animal welfare problems involved in their transportation to slaughter and a brief overview of mobile abattoirs. We then describe the choice experiments, including the survey's 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.

Transportation of farm livestock to slaughter and mobile abattoirs

Around 27 million bovine animals (including calves), 203 million pigs and 4.5 billion broiler fowl were slaughtered in the EU in AD 2002 (Eurostat, 2004). Current EU legislation limits transportation time to 8 hours and further requires that loading densities for the main livestock species must be respected. However, extension of travel time is permitted, provided certain stipulated conditions are complied with (Council Directive 91/628/EEC, http://europa.eu.int/eur-lex). 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 specialized. This development is of relevance 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 regarding transport of animals to slaughter; factors other than transport time are prominent 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 3,846 in 2004 (www.eurovetlink.com). In Sweden, 98.5% of the total carcass weight is slaughtered at large-scale facilities (Swedish National Food Administration, 2003). In Sweden there are currently 27 large-scale slaughterhouses for red meat (compared with 30 in 2000), and 16 large-scale slaughterhouses for poultry. All of these facilities are situated in southern and central Sweden. There are also eight small-scale slaughterhouses for red meat in northern Sweden, but none at all for poultry (Eurovetlink).

Animal health and welfare

There are numerous reports of animal health and welfare problems related to handling and transportation of live animals to slaughter. In general, four different issues have been identified: (i) stress, which impinges on 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, irrespective of species, some results indicate that certain species are more sensitive than others to different factors (Ekesbo, 2003). In addition, human treatment of animals in connection with transport is crucial for animal wellbeing (Hemsworth & Coleman, 1998). Rough or insensitive handling is a well-known cause of physical trauma among animals (van Putten & Elshof, 1978).

Change in animal behaviour is the most commonly used indicator of stress (Broom, 1993). Aspects of handling and transport causing involuntary movements by animals elicit stress in animals (Gebresenbet, 2003). Kent & Ewbank (1983) placed such aspects into five main categories: the original environment, loading, journey, unloading, and new environment. In general, loading, unloading and the first hours of transportation have been found to be the most stressful aspects (Knowles, 1999). Kenny & 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 of animals from different herds induces additional stress reactions and increases the risk of injury to animals (Mohan Raj *et al*., 1991; Bradshaw & Hall, 1996). In addition, Tarrant & Grandin (2000) reported that space availability in vehicles is closely related to animal wellbeing. Crowding impedes natural behaviour, affects climatic 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 climatic 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 (Warris, 1994; Kettlewell & Mitchell, 1993). A too high temperature during transport is reportedly the most common cause of death among pigs (Warris, 1994). A survey by The Swedish National Board of Agriculture (SJV, 2000) using data from 1998-2000 found that 11% of beef animals and pigs slaughtered in Sweden had injuries attributed to transportation. In addition, 6% of inspected vechiles were found to be over-crowded.

Numerous studies have reported that transport time and transport distance are interdependently 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 km, compared with 10-15 km. Other studies report that DFD (Dark, Firm, Dry) problems in pork and beef increase with transport distance (Malmfors, 1982; Poulanne & Alto, 1981) but that PSE rates in pigs slaughtered directly after transport are negatively related to transport distance (Malmfors, 1982). In addition, Ramsay (1971) found that the injury rate in cattle is positively correlated to transport duration. Studies in poultry show that stress levels and mortality rates are closely and positively related to transport time (Freeman *et al*., 1984; Warris *et al*., 1992). Results for cattle were similar (Villarroel *et al*., 2003).

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 (http://europa.eu.int/eur-lex)) do not explicitly allow mobile abattoirs for animals other than reindeer. In Sweden, mobile slaughter systems are in use for reindeer and 'spent' hens.

A number of studies have been devised to evaluate these prototype systems from the aspects of production organization, animal handling, sanitation and food hygiene (Hedberg & Gebresenbet, 1999; Helgesson, 2000; Benefalk *et al*., 2002). Although the use of mobile abattoirs would minimize stress-related and loading injuries associated with road transportation of animals, several factors have been reported to be problematic in these systems. A sufficiently rapid and even cooling of carcasses is vital to food hygiene. So too is availability of pure water supplies (Benefalk *et al*., 2002).

Stunning before slaughter, especially of pigs, bleeding and the development 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 Sweden are attributed mainly to differences in transport distances between farmsteads and large abattoirs (Helgesson, 2000).

Table 1. Difference in costs* (SEK/kilogram) for slaughter in mobile systems versus large-scale abattoirs for cattle and pigs in different geographical regions Positive figures imply higher costs for mobile systems; negative figures imply higher costs for stationary large-scale abattoirs.

	North	**Central**	**Southern**
Cattle** (at 23 animals/day)	0.17	1.84	1.96
Pigs** (at 120 animals/day)	-1.60	0.07	0.19
Pigs*** (at 100 animals/day)	-1.33	0.25	0.42

* Cost data have been indexed to year 2003 using the Swedish Consumer Price Index
** data from Benefalk *et al*., 2002
*** data from Helgesson, 2000

There is reason to believe that the actual costs of mobile systems are higher as the reported, especially for cattle, the main reason being that the assumed capacity utilization is relatively high. In Sweden, 65% 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% 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 the mobile slaughter systems from operating at more than one farm each day. The assumed capacity utilization is high for pigs too. Fatters 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 maximize payments obtained. The forgone profit from a more concentrated slaughter using a mobile system is not taken into account in the studies mentioned.

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 through a survey developed and mailed to consumers in Sweden. It comprised a choice experiment (CE). 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; for an overview of choice experiments, see Alpizar et al. (2003) and Louviere et al. (2000). Consumers were asked to make choices between ground beef, chicken fillet and pork chops with varying levels of price, product labels, fodder, outdoor production, transport to slaughter, and growth. The product 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 willingness to pay for transportation of live animals to slaughter. First, CE is based on random utility theory and hence is consistent with consumers benefitting 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; 1997). Third, CE allows the estimation of marginal rates of substitution between different attributes. Several studies also show that the estimated marginal rates of substitution probably do not suffer from hypothetical bias (Carlsson & Martinsson, 2001; Lusk & Schroeder, 2004). Fourth, CE closely resembles an actual purchase situation; specifically the trade-offs between attributes where a product is chosen from several competing options. Finally, CE can provide an accurate prediction of the outcome of product introductions in the marketplace (Jayne *et al*., 1996).

Table 2. Attributes and levels in the CE

Attribute	Levels	Goods			
		Broiler	Beef	Pork	Egg
1. Label	1.1 Minimum required by law				
	1.2 Farm of origin and type of husbandry		x	x	
2. Fodder	2.1 No information whether or not GM fodder is used				
	2.2 Label whether or not GM fodder has been used				
	2.3 Use of GM fodder banned	x	x	x	x
3. Outdoor production	3.1 Herd kept outdoors in summer/herd always kept indoors				
	3.2 Herd kept outdoors all year/Herd kept outdoors in summer	x	x	x	
4. Transport	4.1 Transport of live animals to slaughterhouse				
	4.2 Mobile abottoir	x	x	x	
5. Growth	5.1 Fast growth chicken (35-39 days)				
	5.2 Slower growth chicken (at least 81 days)	x			
6. Cages	6.1 Only battery cages				
	6.2 Battery cages and free range system co-exist				
	6.3 Battery cages banned				x
7. Omega3	7.1 Not Omega 3 enriched				
	7.2 Omega 3 enriched				x

As with other valuation methods, there were several potential disadvantages associated with CE requiring attention in this study. The hypothetical nature of the experiments may induce respondents to exaggerate their stated willingness to pay (WTP). Both Carlsson & Martinsson (2001) and Cameron *et al*. (2002) failed to reject a hypothesis of equal marginal WTP in a real and a hypothetical setting, while Johansson-Stenman & Svedsäter (2003) rejected the equality of marginal WTPs and Lusk & Schroeder (2004) found that hypothetical choices overestimate total WTP, but did not reject the equality of marginal WTPs for changes in individual attributes. Following Carlsson *et al*. (2004) and List & Sinha (2004) we use a ‘cheap-talk’ script to diminish problems of hypothetical bias

Survey design

The questionnaire used for the CE was devised together with industry representatives and academic researchers specializing in farm animal production aiming to formulate a policy-relevant and meaningful questionnaire for respondents. The definitive questionnaire was preceded by pre-tests using two focus groups (each comprising 5 individuals) and three pilot surveys, each distributed to a random sample of 200 individuals. 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 a 'cheap-talk' script suggested by Carlsson *et al*. (2004). Furthermore, an information sheet was included in the survey to describe the product quality variables and provide a short explanation of the choices offered. The third part of the questionnaire contained questions regarding the respondent's socio-economic and demographic status.

Consumers were asked to make binary choices between chicken fillets, pork chops, ground beef, and eggs, each of which was described by five quality attributes and one price variable in a set of four choices. Figure 1 provides an example of a choice situation. The three types of meat products were selected because they are recognizable to most consumers. In addition, ground beef can contain meat from all bovine animals, thus not implying a preference for dairy or beef type meat. Each respondent was offered choices for only two products, in order to ease the complexity of the CE. The product combinations were: chicken fillet and ground beef, pork chops and eggs. The choice sets were created using a cyclical design principle (Bunch *et al.*, 1996). A cyclical design is a straightforward extension of the orthogonal approach. First, each of the options from a fractional factorial design is allocated to different choice sets. Attributes of the additional options are then constructed by cyclically adding options to the choice set, based on attribute levels. An attribute level in the new option is the next higher attribute level to the one applied in the previous option. If the highest level is attained, the attribute level is set to its lowest level. Strictly dominant choice sets were deleted from the possible set of choices. Moreover, we wanted to avoid "too" dominant choice sets. This was done by calculating so-called code sums for each option (Wiley, 1978). In order to calculate the code sum, we arrange the levels of the attributes from worst to best, the lowest attribute level being assigned the value 0; the next, 1; the next 2, and so on. Thus for a four-level attribute, the highest value is 3. The code sum is the sum of all these values for each option. By comparing the code sums, one can get a simple indication of which alternatives are particularly dominant. This is obviously a crude approach, and in order for it to work reasonably well, the utility difference between two levels should not differ too greatly across attributes. In our case, we deleted all design alternatives with a code sum difference exceeding 4; there were altogether 13 such alternatives.

The CE did not include an opt-out alternative. Each respondent was, however, instructed to answer the CE only if he or she actually consumes the product. Furthermore, for all attributes, the current level was included as the base level when designing the choice sets. As we were primarily interested in estimating the marginal WTP for given attributes, this ought to be an appropriate design.

Figure 1. Example of choice set used in the beef questionnaire

Attributes ground beef	**Ground beef 1**	**Ground beef 2**
Label	Minimum required by law	Farm of origin and type of animal husbandry
Fodder	GM products in feed banned	No information whether or not genetically modified feed has been used
Outdoor production	Outdoor summertime	Outdoor all-year around
Transport to slaughter	Mobile abattoir	Transport of live animals
Price surcharge SEK/kg (total cost)	+ 4 SEK (44 SEK)	+ 8 SEK (48 SEK)
Your choice (mark one alternative)		

The Econometric Model

In the analysis of the responses, we apply 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. Define a latent utility function of alternative *i* for individual *q*, at choice situation *t*, consisting of a systematic and a stochastic part,

$$V_{itq} = \beta' a_{it} + \varepsilon_{itq} \tag{1}$$

where a_i is the attribute vector, β is the corresponding parameter vector and ε_{itk} is an error term. The coefficient vector β varies among the population with density $f(\beta \mid \theta)$, where θ is a vector of the true parameters of the taste distribution. We assume that all the attribute parameters (except cost) are randomly distributed. This means that the parameter for each attribute is the sum of population mean $\overline{\beta}$ and individual deviation $\tilde{\beta}_i$, so that $\beta_i = \overline{\beta} + \tilde{\beta}_i$. These individual deviations are assumed to be normally distributed with zero mean and a standard deviation. Consequently, for the parameters that are randomly distributed, we estimate both a mean and a standard deviation parameter. If the $\varepsilon's$ are IID type I extreme value we have a random parameter logit, or a mixed logit, model. The conditional probability of alternative *i* for individual *q* in choice situation *t* is then

$$L_q(it \mid \beta) = \frac{\exp(\beta a_{it})}{\sum_{j \in \mathbf{A}_t} \exp(\beta a_{jt})} \tag{2}$$

where $\mathbf{A}_t = \{A_1, ..., A_N\}$ is the choice set. The conditional probability of observing a sequence of choices, denoted y_q, from the choice sets is the product of the conditional probabilities

$$P(y_q \mid \beta) = \prod_t L_q(y_{qt} \mid \beta) \tag{3}$$

In the choice experiment, the sequence of choices is the number of hypothetical choices each respondent makes in the survey. The unconditional probability for a sequence of choices for individual *q* is then the integral of the conditional probability in equation (3) over all values of β:

$$P(y_q \mid \theta) = \int P(y_q \mid \beta) f(\beta \mid \theta) d\beta \tag{4}$$

In this simple form, the utility coefficients vary among individuals, but are constant among the choice situations for each individual. This reflects an underlying assumption of stable preference structures for all individuals. Since the integral in equation (4) cannot be evaluated analytically, we have to 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 is placed in the estimated distribution. Train (2003) showed that the mean β for an individual q is

$$E[\beta_q] = \frac{\int \beta P(y_q \mid \beta) f(\beta \mid \theta) d\beta}{\int P(y_q \mid \beta) f(\beta \mid \theta) d\beta} \qquad (5)$$

This expression does not have a close form either, so a simulation method would have to be applied here as well.

Results

In the autumn of 2003, 1,600 surveys were mailed to a random sample of Swedish citizens and legal aliens between 20 and 75 years of age, drawn from the Swedish census registry. Two reminders were sent out within a 2-week period to those who had not replied. Altogether 747 (47%) individuals returned the questionnaire, of whom 710 were available for analysis because of non-response to various questions. Although not all of these answered all four choice sets, we still chose to include them in the analysis. Table 3 presents concise demographic and socio-economic statistics of the sample.

Table 3. Concise statistics of respondents

Variable	Definition	Mean	Standard deviation
Experience	1 = responsible for most food purchases; 0 = otherwise	0.42	0.49
Sex	1 = Female; 0 = Male	0.50	0.50
Age	Age (years)	55.75	14.93
Members	No. of persons in household	2.67	1.32
Children	No. of dependants < 20 years	0.78	1.35
Highest standard of education	1 = University or College; 0 = other	0.36	0.48
	1 = High School; 0 = other	0.43	0.49
Income	Household income net of taxes (SEK) per month	24,050	10,177

Table 4 presents the results obtained with the random parameter logit model. We estimated two models, one for chicken and beef and one for pig and egg, where the cost coefficient was assumed to be the same for the two products. For each random parameter, the estimated mean and standard deviation are reported. The model was estimated by using a simulated maximum likelihood with Halton draws (see Train (2003) for detailed explanation) with 250 replications. Nlogit 3.0 was applied.

The estimates in Table 4 indicate that most of the improved quality attributes were significant, and that many of the estimated standard deviations were also significant, illustrating the diversity of preferences among the respondents. The coefficient for the price attribute was, as expected, negative for both product combinations, suggesting that a price increase would lessen the probability that respondents choose the improved quality attributes in question.

The estimates in Table 4 are instructive for comparing the ranking of product attributes within each product type. It is worth noting that mobile slaughter is ranked as the least important attribute for chicken fillet and pork chops and the next to last preferred attribute for ground beef, of the attributes included in the study.

To determine whether consumers are willing to pay an extra cost for mobile slaughtered poultry, cattle and pigs, we tested the hypothesis: H_0: $WTP^{transport} = WTP_{mobile\ slaughter}$. For each product type included in the study, a significant WTP for mobile slaughter should be interpreted as a rejection of that hypothesis, as the WTP for transport is the reference case. The hypothesis was tested using a bilateral test, as it is possible to suppose both a higher and a lower WTP price premium. The latter would be conceivable if respondents associated mobile abattoirs with a disutility due for example to perceived poorer animal welfare, or food safety risk, etc.

Table 5 reports estimates and confidence levels for mean marginal WTP for mobile slaughter for each animal (e.g. product) type. The 95% confidence intervals are based on standard errors estimated with the Delta method. There is a significant positive WTP for mobile abattoirs for cattle and pig, while it is negative for fowl. The estimated price premiums are not excessive (i.e. the mean WTP in relation to the base price of the products). The base price for chicken was set at 80 SEK/kg and at 40 SEK/kg for both ground beef and pork chops respectively to reflect current retail prices of products without the quality attributes investigated in this study. These results strongly differ considerably from those reported by Liljenstolpe (2003): e.g. for pork fillet, a mean price premium for mobile slaughter of 32.7%.[4]

Table 5. Average marginal WTP (in SEK/kg) with 95% confidence intervals

	Chicken fillet	**Ground beef**	**Pork chops**
Mobile abattoir versus transportation to large slaughterhouses	-3.15 (-5.2; -1.06)	4.18 (1.96; 6.40)	3.09 (0.10; 6.08)

The estimates in Table 5 show that the average consumer WTP for mobile abattoirs exceeds the cost estimates for such systems (from Table 1) concerning cattle and pigs. Furthermore, the associated confidence intervals lie almost entirely to the right of the cost estimates.

The relative magnitude of the standard deviations in the random parameter estimates in Table 4 implies that the probability that people have an inverse preference for a particular quality attribute varies widely according to product. A larger relative difference implies a greater likelihood of inverse preference across the population. The coefficient of variation is large for mobile slaughter for both chicken and beef, but substantially smaller for pork. The estimated *p*-values of the estimated standard deviations are highly significant for chicken and beef but not for pork, thus confirming the observation of diversity among respondents.

[4] One possible explanation for this disparity might be that Liljenstolpe's study (2003) did not include a 'cheap-talk' script.

Table 4. Estimated random parameter logit model

Attribute		**Chicken**		**Ground Beef**		**Pig**		**Egg**	
		Coeff (*p*-value)	Coeff stdv (*p*-value)	Coeff (*p*-value)	Coeff stdv (*p*-value)	Coeff (*p*-value)	Coeff stdv (*p*-value)	Coeff (*p*-value)	Coeff stdv (*p*-value)
Label	Labelling of farm of origin and type of husbandry			0.4525 (0.000)	0.7696 (0.000)	0.1723 (0.084)	0.2714 (0.366)		
Fodder	1. Label whether or not GM fodder is used	0.4425 (0.000)	0.4395 (0.115)	0.3566 (0.001)	0.0065 (0.979)	0.1517 (0.267)	0.3625 (0.303)	0.6353 (0.000)	0.1502 (0.642)
	2. Use of GM fodder banned	0.8483 (0.000)	0.0651 (0.846)	1.1053 (0.000)	0.3946 (0.344)	0.9828 (0.00)	0.0786 (0.755)	1.2226 (0.000)	0.5912 (0.070)
Outdoor	Herd kept outdoors all year/summer-time	0.3583 (0.000)	0.5532 (0.000)	0.1124 (0.149)	0.5497 (0.004)	1.2643 (0.000)	0.8607 (0.000)		
Transport	Mobile abattoir	-0.1786 (0.13)	0.4801 (0.006)	0.2370 (0.001)	0.5413 (0.002)	0.1462 (0.076)	0.0581 (0.858)		
Growth	Slower growth chicken	0.5961 (0.000)	0.3652 (0.114)						
Cages	1. Battery cages and free range system co-exist							1.5244 (0.000)	0.9212 (0.001)
	2. Battery cages banned							2.3421 (0.000)	1.8556 (0.000)
Omega 3	Omega 3 enriched							0.2387 (0.044)	0.9067 (0.000)
		Chicken/Beef				**Pork/Egg**			
		Coeff (*p*-value)				Coeff (*p*-value)			
Cost		-0.0567 (0.000)				-0.0473 (0.000)			

As discussed earlier, it is possible to derive individual specific parameters from the estimated distribution of the random parameters. Figures 2-4 reveal the distribution of the individual WTP for mobile slaughter for each product type: chicken, beef, and pork. The results suggest that there are respondents with a distinctive relatively high marginal WTP for chicken and especially for beef.

The estimates from Figures 3-4 can be used to calculate the potential market share for mobile slaughter of cattle and pigs. Helgesson (2000) reported that the average cost, including transportation from farm to abattoir, for large-scale abattoirs was 4.83 SEK/kg in Northern Sweden, 3.13 SEK/kg in Central Sweden, and 3.02 SEK/kg in Southern Sweden[5]. For cattle, 39.5% of the respondents had an individual WTP for mobile abattoirs exceeding 4.83 SEK/kg, for 61.7% had the individual WTP exceeded 3.13 SEK/kg, while for 63.2%, WTP exceeded 3.02 SEK/kg. For pigs, the corresponding shares of respondents were 0%, 30%, and 74.8%, respectively.

The question then arises whether any niche groups of respondents can be identified. 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.

[5] Cost data have been indexed to 2003 using the Swedish Consumer Price Index. These figures obviously do not take into account any development in cost structures. Furthermore, Helgesson (2000) assumed equal costs between beef and pork.

Figure 2. Distribution of individual WTP for mobile slaughter of broiler

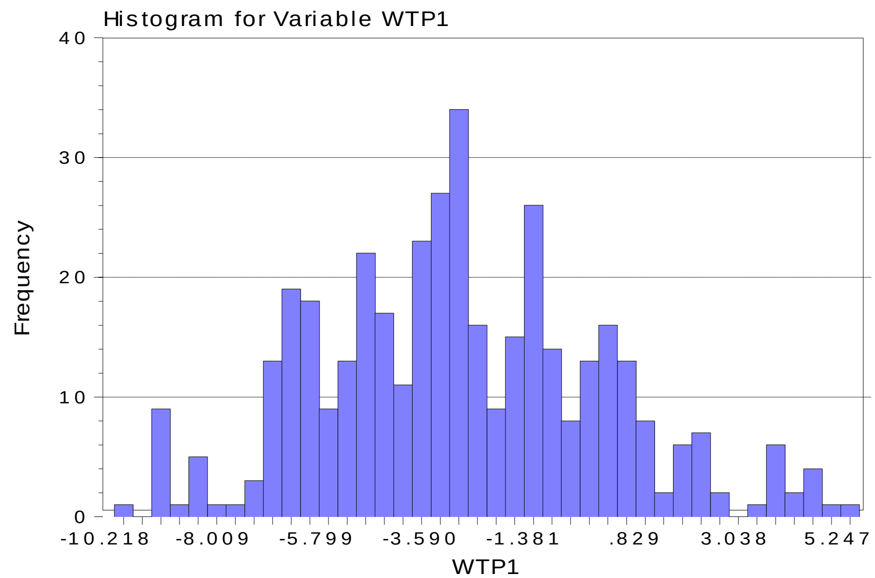


Figure 3. Distribution of individual WTP for mobile slaughter of cattle

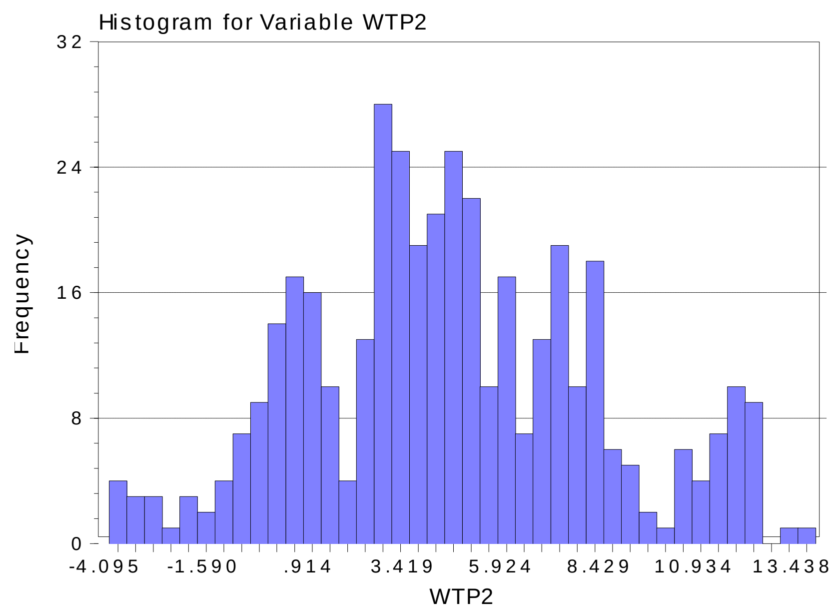
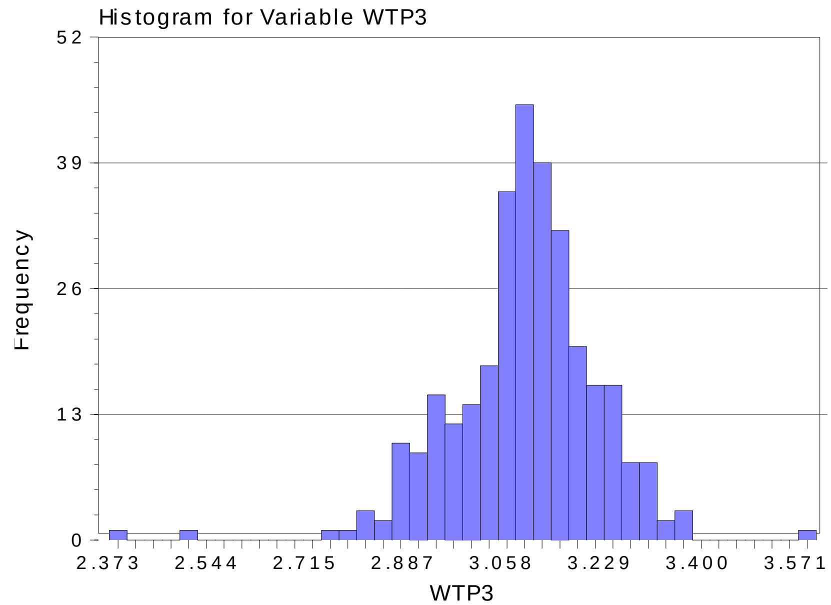


Figure 4. Distribution of individual WTP for mobile slaughter of pigs



Conclusions and implications

Using a choice experiment, we estimated preferences of Swedish consumers and willingness-to-pay for mobile slaughter of broiler, cattle and pigs. Several important results were found in this study. First, we obtained evidence of intra-product differences in consumer preferences for identical attributes as well as inter-product disparancies in ranking of attributes. Mobile slaughter of farm animals is found to be ranked as the least important quality attribute for chicken and pork, and the next to least important attribute for beef, given the attributes included. 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 more pertinent. Secondly, Swedish consumers attribute a significant positive WTP for having cattle and pigs slaughtered in mobile abattoirs, instead of transporting them to large slaughterhouses. The WTP for mobile slaughter of chickens is negative, however. The importance of transportation as a product quality attribute related to animal welfare would therefore seem to be species specific. Thirdly, based on the estimated WTP and earlier available cost data, mobile slaughter appears to be a viable alternative for cattle and pigs, especially in the 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. Fourthly, and related to the latter point, our results indicate that there is a substantial diversity among consumers regarding WTP. 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 & 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. As a novel result, we can now show how CE can be used to estimate the distribution of individual WTP. We found that there exist distinct niche markets, with a relatively high WTP for mobile slaughter of both broiler and cattle. This points to an observation that reliance solely on mean WTP estimates, which is the way that results from CE are typically used, might be misleading for agribusiness use. The actual implementation of mobile slaughter further depends 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.

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