

A method for the economic valuation of animal welfare benefits using a single welfare score

R Bennett*, A Kehlbacher and K Balcombe

Department of Agricultural and Food Economics, School of Agriculture, Policy and Development, University of Reading RG6 6AR, UK

* Contact for correspondence and requests for reprints: r.m.bennett@reading.ac.uk

Abstract

Unless the benefits to society of measures to protect and improve the welfare of animals are made transparent by means of their valuation they are likely to go unrecognised and cannot easily be weighed against the costs of such measures as required, for example, by policy-makers. A simple single measure scoring system, based on the Welfare Quality® index, is used, together with a choice experiment economic valuation method, to estimate the value that people place on improvements to the welfare of different farm animal species measured on a continuous (0–100) scale. Results from using the method on a survey sample of some 300 people show that it is able to elicit apparently credible values. The survey found that 96% of respondents thought that we have a moral obligation to safeguard the welfare of animals and that over 72% were concerned about the way farm animals are treated. Estimated mean annual willingness to pay for meat from animals with improved welfare of just one point on the scale was £5.24 for beef cattle, £4.57 for pigs and £5.10 for meat chickens. Further development of the method is required to capture the total economic value of animal welfare benefits. Despite this, the method is considered a practical means for obtaining economic values that can be used in the cost-benefit appraisal of policy measures intended to improve the welfare of animals.

Keywords: animal welfare, benefit valuation, economics, methodology, policy, welfare score

Introduction

Government intervention will always be necessary to protect the welfare of animals. There are three main economic arguments for this (Bennett 1995; Bennett & Thompson 2011). (NB There are, of course other arguments from ethical and other viewpoints). These are: (i) animal welfare is not a ‘market good’, although a number of animal products may be perceived as having animal welfare attributes, and so people’s wants for animal welfare cannot be adequately catered for in markets; (ii) animal welfare is an externality of our use of animals for economic purposes, such as farming, with animal suffering taking the form of an unwanted by-product; and (iii) animal welfare is a ‘public good’ where the knowledge that animals have good or poor welfare affects the human welfare of many people in society who themselves may have little influence on how animals are treated.

There are many ways in which governments can, and do, intervene to protect animal welfare (FAWC 2008). Legislation has been a major policy instrument within Europe (Bennett & Appleby 2011). Within Europe, the European Commission requires an assessment of the potential economic, social and environmental consequences of any new policy initiatives (European Commission 2011) whilst, in the UK, impact assessments are generally

required for all UK Government interventions of a regulatory nature. Core to an impact assessment is an economic assessment of the proposal’s social costs and benefits (HM Treasury 2003) in order to ‘be confident that taxpayers’ money is being properly spent’ and that ‘public funds are spent on activities that provide the greatest possible economic and social return’ (HM Treasury 2011).

Thus, for any policy designed to protect or improve the welfare of animals, an economic assessment is needed of the costs and benefits associated with it. The costs of an animal welfare policy are often relatively straightforward to estimate — for example, in terms of the additional resources (labour, bedding, building and equipment costs etc) required to provide improved conditions for animals. However, assessment of the benefits of policy in terms of improved animal welfare and the value that we in society place on it is somewhat more problematic.

There is a number of economic tools that can be used to value ‘non-market goods’ such as animal welfare. Bennett *et al* (2011) provide a review of these methods in the context of animal welfare. Stated preference approaches such as contingent valuation (CV; Mitchell & Carson 1989) and choice experiment (CE; Louviere *et al* 2000) methods have been used to elicit people’s willingness to pay (WTP)

Table 1 Relationship between the Welfare Quality® welfare classes and the welfare scoring system.

Welfare Quality® index	Welfare score
Welfare class 3	81–100
Welfare class 2	61–80
Welfare class 1	40–60
Welfare class 0	0–39

for, and hence the value they give to, welfare improvements. Bennett *et al* (2011) provide a review and critique of valuation studies applied to animal welfare whilst Lagerkvist and Hess (2010) present a meta-analysis of consumer willingness to pay for farm animal welfare based on a range of valuation studies.

The CE approach characterises a good in terms of its main attributes and presents respondents with different sets of attribute bundles (with attributes set at varying levels) from which they have to choose their preferred bundle. This enables respondents' trade-offs between attributes to be estimated and scaled against each other. Because one of the attributes is usually price, the monetary value that people ascribe to any individual attribute of the good can be estimated. The main advantage of CE is that it can estimate these attribute values separately and not just the value of the whole good, as is the case with CV. A variety of CE studies have been carried out in the last ten years to value different aspects of (farm) animal welfare (eg Lagerkvist *et al* 2006; McVittie *et al* 2006; Carlsson *et al* 2007a,b; Lusk *et al* 2007; Bennett & Willis 2008; Liljenstolpe 2008; Tonsor *et al* 2009; Morkbak *et al* 2010; Nocella *et al* 2010).

A common feature of these studies is that they elicit WTP values from citizens regarding specific changes in husbandry or other practices to improve welfare. These values can then provide useful information which can be used to estimate the likely magnitude of benefits that citizens perceive to be associated with each of these animal husbandry or other measures. However, there is a number of problems with this approach. The first problem is that policies and people's WTP to support them are not linked to explicit animal welfare changes. The second problem is that the elicited WTP/value applies only to the specific policy or husbandry measure being considered and that WTP is not transferable to other policies or changes in animal husbandry. The third and related problem is that this means that separate WTP elicitation studies have to be carried out every time there is a policy proposal or change in husbandry practice, no matter how small, potentially leading to the need for hundreds of (relatively costly) studies over time. In addition, all of the animal welfare valuation studies use variations in methodology with valuations sometimes varying substantially depending on the method and how it has been applied.

This paper describes an approach to valuing animal welfare benefits that potentially overcomes each of the above problems. It uses a framework for measuring animal welfare changes based on the Welfare Quality® index (Welfare Quality® 2011) which then enables citizens to value specified quantitative changes in the welfare status of animals. The paper presents the results from testing this approach using the CE method of valuation.

Materials and methods

Welfare score

A single measure of animal welfare represented by a quantitative score was considered necessary to clearly communicate to citizens the change in welfare status of the animals for which they are asked their willingness to pay. The current Welfare Quality® system of measurement aggregates scores into four principle areas (good feed, good housing, good health and appropriate behaviour) which are then used to assign the welfare status of animals into one of four different classes (excellent, enhanced, acceptable or not classified). The cognitive effort for laypeople to consider animal welfare on a four-dimensional scale is substantial and is considered by the authors to be an unrealistic expectation in the context of willingness-to-pay surveys of citizens. Moreover, assignment of welfare status of animals to just one of four classes (levels) does not allow for marginal changes in welfare that might result from a policy or other measure that impacts on welfare. In contrast, a single score is probably the simplest way to communicate the welfare status of animals on a continuous scale (we chose 0 to 100), providing it is communicated as a credible, holistic welfare measure, despite the relative technical complexity of the production of such a welfare score with various weightings and other considerations. The welfare scoring system presented to respondents in the survey valuation exercise can be related to the Welfare Quality® index as summarised in Table 1. Welfare Class 0 (ie 'unclassified') is represented by a welfare score of less than 40, where 40 is defined as representing the level achieved by compliance with legal minimum standards for welfare. Thus, a score of 40–60 represents Welfare Class 1, Welfare Class 2 is 61–80 and Welfare Class 3 is 81–100. The method allows for the bands for each Welfare Class to be defined differently to that used above but clearly whatever system is used it needs to be consistent and provide a reasonable reflection of the relative levels of animal welfare represented by each Welfare Class.










The welfare scoring system was presented to participants in the valuation exercise by means of the following statement:

In the last year in the UK, 2.6 million cattle and calves, 9.5 million pigs and 798.3 million chickens were killed for meat production. Animal welfare scientists and veterinarians now have developed a system for measuring the welfare of individual animals that takes account of the varying needs of different species, ages etc. The system scores the extent to which the needs and wants of the animal are met and results in an overall score on a scale of 0–100 which accurately represents the welfare

Figure 1

Suppose you could only choose one from the three baskets below. Which basket would you choose?
Please circle only one!

↓

		Welfare scores of your meat		
Basket A	Increase in monthly meat expenditure £ 16.00 (£ 192 per year)	 90	 60	 70
Basket B	Increase in monthly meat expenditure £ 18.00 (£ 216 per year)	 90	 70	 50
Basket C	Increase in monthly meat expenditure £ 0.00 (£ 0.00 per year)	 40	 40	 40

or

Don't know.

Example choice set (meat expenditure).

of the animal in terms of its freedom from hunger, thirst, discomfort, pain, injury, disease, fear and distress, and the extent to which the animal can express natural behaviours and has a happy and contented life. A score of zero would denote extreme suffering whereas a score of 100 would denote the highest level of welfare that could possibly be achieved. The system applies over the entire life of the animal from birth to slaughter and involves regular independent monitoring of the animal's welfare throughout its life.

Participants were also told that a score of 40 represented the current legal minimum of animal welfare within the UK.

CE valuation method

The welfare scoring system described above was then used as the basis for a CE survey to elicit values of improvements in animal welfare signified by an increase in welfare score. A questionnaire was designed with the following main elements: questions about people's attitudes, opinions and consumption of meat; information about the welfare score; the choice exercise; and debriefing and socio-economic questions.

The questionnaire was pre-tested both in a focus group and in a number of personal interviews and then piloted on a sample of 50 respondents. Open-ended willingness-to-pay levels were also elicited from a sample of shoppers to help define the WTP amounts used in the CE exercise. A random sample of citizens in Great Britain was used, stratified according to socio-economic group. These were then telephoned to recruit them to the survey. Those who agreed to take part were then either interviewed immediately if they

had access to the internet or an interview was arranged for a few days later. Information about the welfare scoring system and the CE exercise (including provision of the choice sets) was made available on the internet for those with access or sent by post prior to interview. Around 300 respondents participated in the survey from over 2,700 people contacted, of which around a quarter agreed to be interviewed (some of which were not then used once the 300 quota had been reached).

Respondents were told 'Assume that in your usual food store there is a section that sells meat and meat products with high welfare scores. The farmers who supply this meat will be monitored by the RSPCA. If you buy meat with a welfare score above the legal minimum (40) your weekly expenditure will rise. We now ask you to make six choices'. Respondents were then given some additional guidance before being presented with six different choice sets. This guidance included a reminder to them that their budget is limited and that more money spent on meat may mean less money to spend on other things. An example choice set is shown in Figure 1.

Respondents were asked to choose one alternative only out of A, B or C (*status quo*) or could choose a 'Don't know' option. After completing the choice experiment they were asked which attributes they considered when making their choices. The choice sets contained four attributes: (i) welfare score for beef cattle; (ii) welfare score for chickens; and (iii) welfare score for pigs (to explore people's WTP across farmed species) — with score levels of 40, 50, 60, 70

Table 2 Mean (\pm SD) WTP for a one point increase in welfare (£).

	Increase in monthly meat expenditure	Increase in annual meat expenditure
Beef/cattle welfare	0.437 (\pm 0.652)	5.24
Pork/pig welfare	0.381 (\pm 0.479)	4.57
Chicken/chicken welfare	0.425 (\pm 0.527)	5.10

and 90 used — and; (iv) a price attribute which was their additional expenditure on meat (at £0, £6, £8, £12, £16 and £24 per month extra). Meat expenditure was therefore used as the ‘payment vehicle’ to obtain people’s WTP for welfare changes of each of the three species. The prices of goods are most commonly used in WTP studies because people are particularly used to paying for something in this way.

Analytical method

WTP was derived from the CE data using the mixed logit model. This model captures variations in the values respondents place on each of the attributes. It allows for unrestricted substitution patterns meaning that the relative odds of choosing one alternative over another are not assumed to be the same irrespective of other available alternatives and it can take into account any unobserved factors that persist over time for a given respondent (Train 2003). The model was estimated using Bayesian inference which involves the use of simulation methods to obtain a probability distribution summarising parameter uncertainty given the data and the model.

The utility function explains choices between the alternatives solely as a function of their attributes with the utility of the n th respondent of alternative i in choice set t given by:

$$U_{nit} = g(\beta_{1n})Beef_{nit} + g(\beta_{2n})Pork_{nit} + g(\beta_{3n})Chick_{nit} + g(\beta_{4n})Cost_{nit} + e_{nit} \quad (1)$$

where the $g(\beta_n)$ are the marginal utility coefficients describing the tastes of the n th individual, and $g(\cdot)$ is a transformation of the utility coefficient. The error term e_{nit} is assumed to be independent and identically distributed extreme value. It represents choice specific shocks to individual n ’s tastes. The specification in (1) implies constant marginal utility. The assumption of constant marginal utility is employed in the vast majority of choice modelling studies. It is, of course, an approximation. However, a fully flexible approach that allows the possibility of diminishing marginal utilities by treating welfare scores as discrete levels could not be estimated because the sample size did not allow estimation of a model with such a large number of parameters. Following a common approach in the CE literature (Hensher *et al* 2005; Puckett & Hensher 2008), respondents were assigned zero utility ($\beta_{n\Delta} = 0$) if they stated to have ignored an attribute in the choice experiment.

The mixed logit model is a highly flexible model that can capture preference heterogeneity and approximate any

random utility choice model to any degree of accuracy through appropriate specifications of the marginal utility coefficients (McFadden & Train 2000). After testing different transformations $g(\cdot)$, the preferred model that achieved the highest log-marginal likelihood specified the marginal utility coefficients of the species attributes to be normally distributed and the cost coefficient to be fixed.

The Bayesian procedure for estimating the mixed logit model was carried out as described by Train (2003). Markov Chain Monte Carlo (MCMC) simulation was used to obtain the parameter estimates in the model. Convergence was monitored by conducting a modified t -test for the hypothesis of ‘no-difference’ between the first and second half of the sampled values on the sequences of parameters.

Estimated coefficients derived from the mixed logit model can then be used to compute WTP for a one point increase in welfare by scaling (ie dividing) each welfare coefficient by the price coefficient.

Results

In terms of meat purchasing behaviour, average weekly meat expenditure was £17.65 with 86% of respondents eating chicken, 68% beef, 54% pork and 55% other meat. Less than 5% said they did not consume meat. Thirty-eight per cent of respondents felt well informed about the way in which farm animals are treated and over 72% were concerned about the way farm animals are treated.

In terms of attitudes and beliefs, 96% of respondents agreed that we have a moral obligation to safeguard the welfare of animals. Eighty-one per cent thought that meat from animals with high welfare has better food safety, 78% that it was healthier, 71% that it had better nutritional value and 69% that it tasted better, whilst 79% thought it was also better for the environment.

Table 2 shows people’s estimated mean WTP for a one point increase in welfare for each of the three meat species.

It can be seen from Table 2 that WTP is highest for cattle welfare followed by chicken welfare, although all three WTP estimates are of similar magnitudes. The standard deviations show substantial variation in individual WTP which was linked (positively correlated) to their consumption of the three different meats.

Discussion

The study presented here has shown that a single welfare score, based on the Welfare Quality® index, can be used to elicit people’s valuations of changes in the level of welfare of different animal species as a result of policy and husbandry changes that affect welfare. The simple scoring system presented to survey participants was accepted by them as credible and was clearly understood by them (for example, as demonstrated in focus group discussions and survey respondents’ comments in the open-ended debriefing question). The advantage of using a single welfare score to describe the welfare status of animals is that we can then obtain people’s valuation of defined changes in animals’ welfare rather than their valuation of a husbandry or other system change that might impact on welfare as obtained by

previous animal welfare valuation studies. Assuming that this welfare valuation is transferable regardless of the husbandry or other means by which a change in welfare status is brought about, then policy-makers no longer need to commission repeated valuation studies for their impact assessments every time there is a (proposed) change in animal production practices (eg requiring a change in legislation).

Of course, potential problems remain as to both the ethical underpinnings of this simple system and its practical application. Although the Welfare Quality® system does generate a single welfare outcome, this is not based on a cardinal scale. However, the approach does produce cardinal scales for four areas, or principles, of welfare. The authors of the Welfare Quality® system argue that these principles of welfare are important and that they are non-substitutable, for example, bad feeding cannot be compensated for by good housing (eg see Botreau *et al* 2007a,b). Combining these principles, they argue, causes two problems, first it results in the theoretical problem that it implies that substitution is possible; and second it could obscure negative extreme outcomes by averaging up, or down. Veissier *et al* (2011) discuss both ethical and practical aspects in relation to the Welfare Quality® scoring system and conclude pragmatically that the ethical decisions involved in the system were widely agreed across experts and stakeholders, that it reflects widely accepted views on animal welfare in Europe (acknowledging that these need to be checked over time) and that it represents a considerable improvement on previous scoring systems to provide an overall assessment of welfare, with a balance being struck between ‘theoretical aspirations and what can be realistically achieved in practice’. The challenge for animal welfare scientists is to be able to provide both ex-ante and ex-post welfare assessments of policy changes that can then be used within an impact assessment of policy that includes an economic assessment that values animal welfare benefits as put forward in this paper.

In terms of the Farm Animal Welfare Council’s (FAWC 2009) recommendations concerning ‘a life worth living’ and a ‘good life’ for animals, a score of less than 40 on the welfare scoring assessment system used here might represent a life not worth living and one of 40 or above a life worth living. It is debatable at what score animals would be considered to have a good life (something substantially above 40), and clearly with a welfare scale of 0–100 there are different degrees of good life that are possible.

The WTP estimates obtained from using the method outlined in this paper seem credible in terms of their orders of magnitude. For example, across the three meats, people were willing to pay an average 16% increase in meat expenditure for a ten-point increase in welfare score. Moreover, a separate survey (with an entirely separate sample, not reported here) was undertaken at the same time as the one presented here which also used the welfare scoring system but which used the CV method instead of the CE method and elicited values of similar orders of magnitude. Thus, over the 40–80 welfare score range, the CE survey results

gave a £147 per year per 10 pt increase in welfare score for the three meats together whilst the CV survey results gave £114 per year per 10 pt.

The survey presented here found that people’s stated WTP was not only for welfare *per se* but also includes their valuation of attributes that they perceive to be associated with food produced by animals with good welfare, such as improved food quality. In this sense, we are not eliciting a ‘pure’ value for animal welfare but people’s WTP are a reflection of the benefits that they perceive to accrue to them from having higher levels of animal welfare. Of course, the valuations presented here are ‘private benefits’ relating to personal consumption and not social ones (see Bennett 1995). People’s WTP for meat from animals with higher welfare does not take into account the benefits to others in society that accrue from these others knowing that people who consume higher welfare meat are promoting good animal welfare. This is a ‘positive externality’ of private consumption decisions (these externalities can be negative also, for example where people’s consumption is perceived as promoting animal suffering) and takes the form of a ‘public good’ where all of those in society who care about the welfare of animals (the vast majority in the UK as shown by this and previous surveys) experience a benefit (or cost) associated with the behaviour of others that they perceive to be resulting in good or bad animal welfare.

This points to a limitation in the valuation methodology used in the survey presented here since it fails to adequately capture the total economic value of benefits associated with animal welfare improvements.

Theoretically, one way of obtaining a better measure of total economic value is to elicit people’s WTP for regulation (eg legislation) to improve animal welfare but this too has its problems, especially where an increase in government taxation is involved as a vehicle for payment for improvements to welfare brought about by legislation because, in the UK and elsewhere, many people have a strong dislike of government taxation.

Animal welfare implications and conclusion

Unless they are made economically explicit and quantified on a measurement scale that can be readily understood and used for comparative purposes (ie in money terms) there is a danger that the benefits to society of protecting animal welfare and of animal welfare improvements will go unrecognised and under-valued and hence that the welfare of animals is likely to be over-exploited (as for any resource that appears to be free).

There has been substantial attention paid in the past to the costs associated with improved levels of animal welfare — in terms of producer costs, effects on competitiveness, costs to international trade in animal products — with the benefits of improved animal welfare neglected largely because they have been assumed to be intangible. The method proposed here uses the tangible measures of welfare developed by the science community and integrates it with the valuation methodologies developed by social scientists/economists to

make animal welfare benefits not only tangible but measured in the same currency as costs which can then be weighed against each other and compared with the costs and benefits associated with other policy initiatives, including those in areas other than animal welfare.

The valuation method itself can be used to assess the costs associated with poorer animal welfare as well as the benefits of improved welfare, since it is possible to move down the scale of the welfare score as well as up. Moreover, potential benefits (to human welfare) of an increase in animal welfare score of different species can be made explicit with the valuation method, which then begs the questions as to how we might increase the scores, what it will cost and whether the benefits justify such a move.

Valuation of animal welfare benefits, using methodologies such as the one outlined here, is essential to make transparent the benefits to society of measures to protect and improve the welfare of farm, and other, animals. Explicit valuation of benefits helps provide justification and encouragement for decision-makers to implement such policy measures.

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