

Willingness to Pay for Other Species' Well-Being

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Abstract

Benefit-cost analysis of environmental policies typically focuses on benefits to human health and well-being. For other species, economists have attempted to measure human WTP for changes in the numbers of individuals for different types of wildlife, and to preserve biodiversity. When it comes to humans' WTP for improvements in the *quality-of-life* for other species, however, the evidence is limited. Morbidity and quality-of-life considerations may be particularly important to the task of valuing non-fatal harm to wildlife in the wake of an environmental disaster. We argue that the other-species morbidity-reduction component of WTP should be calculated net of any "outrage" component associated with the cause of the harm. This net WTP is likely to be correlated with the premium that people are willing to pay for chicken products from birds for which the quality of life has been enhanced by improved animal welfare measures. This paper uses a conjoint choice stated preference survey to reveal the nature of systematic heterogeneity in preferences for "humanely raised" versus "conventionally raised" chicken. We also use latent class analysis to distinguish between two classes of people – those who are willing to pay a premium for humanely raised chicken, and those who are not.

Keywords: animal welfare; stated preference; conjoint analysis; willingness to pay; other species well-being; other species morbidity valuation

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1 Introduction

Benefit-cost analysis of environmental policies typically pays a great deal of attention to benefits in the form of protection or enhancement of the health and well-being of humans. Researchers have therefore produced an abundance of evidence about willingness to pay (WTP) for reductions in human mortality risks. There is also considerable evidence regarding WTP for reductions in human morbidity risks, and other quality-of-life benefits such as improved visibility or reduced noise. For environmental risks to *other species*, researchers have also had some success in measuring people's WTP to increase the abundance of an endangered species, for example, or to preserve biodiversity (see [Richardson and Loomis \(2009\)](#) for a meta-analysis). However, these values are mostly for reductions in *mortality* risks for other species. There is considerably less evidence concerning WTP for reductions in *morbidity* risks for other species, or to protect other aspects of their quality of life.

It is important for economists to consider human values for other-species morbidity risk reductions because environmental economists are often criticized for their anthropocentric view of the value of environmental quality. Morbidity risk reductions for other species have standing in conventional benefit-cost analyses only if humans are willing to pay something for these reductions. Accordingly, this study seeks to isolate additional evidence of human WTP for quality-of-life improvements for other species.

Of course, the view one takes of environmental valuation efforts depends upon one's philosophical framework. Many people take a deontological view. They feel that the protection of other species is a categorical imperative and that the well-being of other species has intrinsic value, independent of the relationship between these species and humans. Other observers, however, subscribe to a teleological view, where other species have utilitarian value to the extent that their well-being matters (ultimately) to the well-being of humans. As economists, we take the more pragmatic teleological view. We steer away from normative ethical issues and address the positive question of people's willingness to pay for improve-

ments in the well-being of other species. Our work is motivated by recognition that benefits stemming from the well-being of non-human species should be represented more frequently in environmental benefit-cost analyses.

This component of environmental benefits is rarely included in benefit-cost analyses because there has been relatively little research available. For example, consider a benefit-cost analysis of a prospective environmental regulation that would reduce the chance of a coastal oil spill, for example. It would be inappropriate to attempt to transfer, to all potentially injured birds, a measure of WTP to prevent the death of a brown pelican. Brown pelicans are atypical, since they have been recently de-listed as an endangered species. Likewise, suppose we were considering an estimate of the benefits of a regulation aimed at preventing non-fatal rodenticide poisoning of common barn owls. Such a benefits estimate should not rely upon measures of WTP to protect endangered spotted owls, whose survival has been linked to the preservation of old-growth forests. If we want to isolate a component of WTP that pertains solely to the well-being of the animal itself, while it is still alive, we need a context that is not confounded by endangered species status or symbolic values. We need estimates of WTP limited to the well-being of the living animal, not conflated with other values such as WTP associated only with reductions in mortality. WTP to improve the quality-of-life of farm animals would seem to be the ideal measure of this component of value, since these animals tend to be numerous and ordinary. This WTP, if anything, would serve as a lower bound for WTP to improve the well-being of a more charismatic species. Furthermore, the reduction of mortality risks is not an issue, in this case, because most of these animals are raised specifically to be killed for food.

Human WTP on behalf of other humans, of course, requires consideration of the nature of the altruism involved and the prospect for double counting.¹ However, double-counting

¹If altruism is non-paternalistic, in the sense that people care only about other people's levels of utility, then aggregate WTP may be merely the sum of individual WTP amounts. If altruism is paternalistic, so that people care about other people's levels of consumption of specific goods, then there is sometimes room to include people's WTP on behalf of others as well as on their own behalf.

is not a concern when animal well-being is involved because the animals themselves are not part of the franchise for benefit-cost analysis and animals' WTP values on their own behalf will not otherwise be counted.

A challenge in this line of research is that there are relatively few familiar market contexts in which consumers need to consider their willingness to incur the costs necessary to provide clean air or water or an otherwise safe and healthy environment for both wild and domesticated animals. In this paper, we assume that consumers' WTP for these types of benefits will be correlated with their willingness to pay higher supermarket prices so that farm animals raised for food can be provided with a better quality of life.

In this study, we use survey data to measure consumers' incremental willingness to pay for "free range" and "humanely raised" poultry versus "conventionally raised" poultry, and demonstrate numerous statistically significant dimensions of heterogeneity in preferences for animal welfare improvements. We find that the per-pound premium willingly paid for the humanely raised product varies inversely with household size and with the respondent's rating of his or her own ideological conservatism. In contrast, this premium varies directly with educational attainment and the extent to which the respondent is concerned about antibiotics, growth hormones, and genetic engineering. It also varies directly with the extent to which the respondent believes that the humanely raised product is healthier for humans and with the extent to which he or she believes that humane standards for farm animal care actually improve the well-being of these animals.

Additionally, we explore a model where we identify two distinct latent preference classes. Both classes are sensitive to prices, but one preference class derives positive utility from free-range and humanely raised products, and the other is clearly unwilling to pay any premium at all for free-range or humanely raised products.

This paper is organized as follows. Section 2 outlines the rationale for our approach as a function of the institutional context and then briefly reviews the scope of the related

literature and differentiates our inquiry from other existing work. Section 3 describes our data and Section 4 lays out our model and the corresponding estimating specification. Section 5 presents our results and some discussion, and Section 6 concludes.

2 Institutional Context and Broader Literature

2.1 A Missing but Potential Market

Our study is based upon a consumer survey that involves so-called “stated preferences,” elicited via sets of conjoint choice experiments, to determine which types of consumers are more or less willing to pay for improved farm animal welfare, as well as the magnitude of this WTP.² A stated preference survey is necessary to assess WTP for humane treatment of farm animals because there is no uniform set of criteria permitting an unambiguous definition of “humanely raised” meats. Thus the product in question is not yet well-defined. U.S. Federal law currently requires only that animals raised for meat be made unconscious before being slaughtered, because farm animals are exempt from other federal animal welfare laws (US Code: Humane Methods for Livestock Slaughter, Title 7, chapter 8). Conventional methods of raising animals for food have proven cost-effective for farmers, and these practices often include maximizing the density of animals, using growth-inducing hormones, and using feed that includes animal by-products. Raising animals in high densities forces many farms to physically alter the animals by, for example, cutting tails, toes, and beaks so that they cannot injure one another. It also forces producers to regularly administer antibiotics to control disease.

While “humanely raised” products are not widely available, many grocery stores do carry meat products labeled “free-range” which fetch a substantial price premium—in some in-

²Methods such as these are widely used in the marketing and transportation choice literatures, as well as in environmental and health economics contexts. They are sometimes the only available method for measuring prospective demand for new products or non-market demands for public goods.

stances as much as four times the price of conventionally raised meats. However, a portion of the premium that consumers are willing to pay for free-range meats has been attributed to concerns for human health and safety as well as ethical concerns – both for the environment and for the welfare of the animals themselves. Unfortunately, a “free-range” label has essentially no legal meaning or standard certifying body, so this designation does not correspond to a well-defined product either. Nevertheless, existing price premia for free-range meats suggest that there may also be a substantial unmet demand for some form of certification ensuring that the animal in question has been raised humanely.

Of course, it is an empirical challenge to attribute a WTP premium for free-range or humanely raised meats solely to the consumer’s interest in animal welfare. In the choice scenarios presented in our survey, we are careful to stipulate that “The store offers three brands of chicken breasts that look the same. The color, size and fat content of each brand are very similar. The only visible difference is that one brand is marked ‘Conventional,’ one brand is marked ‘Free-range,’ and the third brand is marked ‘Humane.’ ” But consumers may believe that the products are likely to differ in other ways that are not visible. For example, they may believe that free-range or humanely raised products are more (or less) healthy for human consumption, that they are more tender (or tougher), or that they are more or less tasty than conventionally raised products. It seemed improbable that all consumers would accept that the three types of products would be identical on all of these dimensions, so we have been careful to elicit each respondent’s subjective perceptions on these three quality dimensions: healthiness, tenderness, and tastiness. This permits us to control for these perceptions and, if necessary, to simulate counterfactually what consumers would have been willing to pay had they perceived that all three products were identical on these dimensions as well.³

³A set of five online Appendices accompanies this paper. Online Appendix A contains a few additional institutional details. These appendices are available at:
http://pages.uoregon.edu/cameron/EcolEcon/VanderNaald_Cameron_appendix_2011.pdf

2.2 Relevant Literature

Farm animal welfare has been a topic of growing interest in recent years in the agricultural economics literature, but we seek via this study to increase the attention of environmental and ecological economists to analogous concerns about wildlife, including how these concerns might factor into benefit-cost analysis of environmental policies.

Well-being of other species.—Relatively little work has yet been published that emphasizes other-species morbidity reductions as a potentially important source of concomitant social benefits from environmental regulations, and none appears to have been formally economic in nature. However, [Blumstein \(2010\)](#) describes how forest management practices can create noise, frighten animals, and lead to heightened glucocorticoid levels in wildlife, along with disruption to their communication and reproduction. [Mathews \(2010\)](#) describes how agricultural activity can affect wild animal welfare and conservation, arguing in particular that the suffering of pest animals has traditionally been undervalued. [Paquet and Darimont \(2010\)](#) confirm our premise by noting that “the notion that animal welfare applies to wildlife has escaped many animal welfarists and conservationists.” These authors adopt a deontological perspective and focus on the example of the grey wolf and how habitat destruction and impoverishment causes trauma, suffering, and death for this species. We argue that these considerations are potentially important in formal benefit-cost analyses as well.

Economic animal welfare studies.—This literature seems to begin with [Bennett \(1997\)](#), followed by [Bennett \(1998\)](#), [Bennett et al. \(2002\)](#), [Bennett and Blaney \(2002\)](#), and [Bennett and Blaney \(2003\)](#). This early work relies most heavily upon contingent valuation methods. [Glass et al. \(2005\)](#) find that a significant subset of the population appears to be unwilling to pay anything at all for the welfare of pigs (and this heterogeneity is fully consistent with the findings of the present paper). [Schnettler et al. \(2009\)](#) find that consumers care both about humane treatment and the geographic origin of their beef. [Taylor and Signal \(2009\)](#) find that certain demographic characteristics, such as age, income, and gender, are important in

determining WTP for humane practices for food animals. This last paper is perhaps closest to our own work, although a number of other papers also use animal welfare questions as a vehicle for an examination of important methodological issues; these include [Chilton et al. \(2006\)](#), [Carlsson et al. \(2007\)](#) and [Bateman et al. \(2008\)](#).

Confounding attributes.—Other potentially confounding product attributes are considered in some studies. [Carlucci et al. \(2009\)](#) and [Napolitano et al. \(2008\)](#) have used an auction procedure to study yogurt products. Along with animal welfare as a product attribute, they include other competing attributes such as sensory properties of the product. These are akin to the attributes of perceived healthiness, tastiness, and tenderness employed in our own study, as discussed above. Similarly, [Nilsson et al. \(2006\)](#) consider broader features like food safety, environmental degradation, and animal welfare as competing attributes which affect WTP for a product.

Biodiversity.—There are several papers which seek to estimate WTP to preserve biodiversity or to retain numbers of individuals belonging to an endangered species. For example, in selected recent work, [Han and Lee \(2008\)](#) use both stated and revealed preference methods to assess WTP values for preservation of Manchurian black bears in South Korea. [Eiswerth and van Kooten \(2009\)](#) use a model of optimal management policy to determine the economically optimal stock of the greater sage grouse in Nevada. Meta-analytic methods are used by [Richardson and Loomis \(2009\)](#) to reveal that WTP for preservation of endangered fauna has increased over time. It is likely that some types of people will care only about *numbers* of live animals in these contexts, but some people may also be concerned about the quality-of-life, including non-fatal illnesses (morbidity), among other species. Others will place little or no value on either the lives or the well-being of other species. We seek to identify systematic patterns in the distribution, across the population, of these different patterns of concern. This knowledge will help define the different constituencies in terms of support for proposed policies or regulations.

Demand for food attributes.—A few other papers investigate consumer WTP for animal-based food products as a function of the attributes of that food. There is a considerable literature that focuses on WTP for organic foods or consumer preferences regarding genetically modified organisms (GMOs). However, this literature focuses on the impact on the environment of different farming methods, or to the uncertain risks to humans and other species stemming from alterations to the global gene pool, food security, and human health implications. Examples of this research include [Larue et al. \(2004\)](#), [Farina and Almeida \(2003\)](#), and [Grunert and Bech-Larsen \(2005\)](#). Further, [Balcombe et al. \(2009\)](#) find that people prefer bread made with wheat that has been grown with reduced levels of pesticides, while [Bougherara and Combris \(2009\)](#) find that it is difficult to tease out private and public components of WTP for environmentally friendly products, even in a controlled experiment.

Sustainable agriculture.—Our paper is also related, although less closely, to the literature on sustainable agriculture, where the interaction between food production and ecosystems is a common theme. While the emphasis is more commonly upon endangered species, the well-being of some type of wild species is also implicit in the concerns about natural capital which are noted in most cases. Some notable papers in this area of research include [Goodland \(1997\)](#), [Johnston et al. \(2001\)](#), [Rigby et al. \(2001\)](#), [Wilson and Tisdell \(2001\)](#), and [Van Passel et al. \(2007\)](#)

Attitudes about animal welfare.—A number of authors in other social science disciplines have surveyed consumers to learn about their attitudes concerning animal welfare. For example, [Tonsor et al. \(2009\)](#) examined animal welfare considerations for swine. [Frewer et al. \(2005\)](#) have looked at attitudes about livestock welfare in general, while [Schröder and McEachern \(2004\)](#) considered value conflicts for consumers in their purchasing decisions. [Harper and Makatouni \(2002\)](#) find that consumers typically have trouble separating the quality of meat from the welfare of the animal. Some studies merely ask whether the consumer would be willing to pay any positive premium over conventional products for a

humanely raised alternative (for example, [Martelli \(2009\)](#) and [Ellis et al. \(2009\)](#)). Recently, [Nocella et al. \(2010\)](#) found that among certain EU countries, trust between consumer and producer had a positive influence on consumer WTP for certified animal friendly products.

Methodological issues.—Several papers focus on methodological issues but employ an animal welfare question as the vehicle for an empirical illustration. Choice experiments were used by [Carlsson et al. \(2007\)](#) to derive WTP in the context of animal welfare considerations for cattle and broilers. [Liljenstolpe \(2008\)](#) explores a random parameters logit model in this context. [Bateman et al. \(2008\)](#) employ animal welfare related survey data, but the main focus of their analysis is methodological. As always, stated preference methods have received the expected scrutiny. [Chilton et al. \(2006\)](#) use a farm animal welfare application to raise questions about the reliability of stated preference methods because they do not find strong convergence between WTP based methods and matching methods for identical populations.

Voting data.—There is some revealed preference data that can convey attitudes about improvements to animal welfare in the form of voting behavior on a handful of propositions (referenda) in a few U.S. states. [Vederas \(2006\)](#) considers a 2002 Florida ballot proposal to limit farming practices that were deemed to be cruel to pigs. To explain county-level voting data, religion was a statistically and economically relevant variable, but political preferences and socio-economic factors are determined to be of greater importance than religious affiliation.

Other approaches.—[Frank \(2008\)](#) asks whether there is a type of Kuznets Curve for animal welfare. [Thiermann and Babcock \(2005\)](#) consider globalization, interest in animal welfare worldwide, and the prospect for international standards on animal welfare. Other voices raise familiar questions from the non-economic community, for example [Mann \(2005\)](#), who argues that the design of “ethological” farm programs should be based on “broad public discussions as described by deliberation theorists rather than willingness-to-pay studies.

3 Survey Data

Our stated preference survey is presented to respondents as data collection to support background research concerning the viability of a potential new meat-certifying and labeling program. Randomized baseline prices are quoted for a “conventional” product, and randomized price premia for “free-range” and “humanely raised” products are used to generate the prices quoted for these other products.

Our conjoint choice stated preference survey was designed and fielded in 2006. To obtain a relatively random sample of the adult population of one county in the U.S. at relatively low cost, we collected responses from the jury pool at the county courthouse in our own jurisdiction. The jury pool population consists of adults selected at random from lists of registered voters and licensed drivers residing in the county.⁴

In our survey, respondents were presented with choice scenarios where they were asked to consider whether to purchase a given quantity and type of chicken breasts, assuming that they were on a typical food shopping trip. We analyze two such choices for each individual in our sample. Each choice involves three packages of chicken breasts of a specified common weight (between 1.5 to 3 pounds) and three different types (conventional, free-range, or humanely raised), as well as a no-purchase option. Since certified humanely raised products were not widely available at the time of our survey, respondents clearly had to base their expectations about their potential demand for these products on the descriptions of humane farming practices provided in our survey and extrapolation from the characteristics of various free-range or organic products more commonly available at the time. Few respondents would

⁴Survey booklets were hand-delivered to the jury assembly room. The survey was announced with a neutral description of its topic and the fact that it was the basis for an academic research project at the local university. A sealed “ballot box” was provided for the return of completed surveys, and additional surveys were left near the box with a placard containing the same explanation that had been delivered verbally. Survey completion was not monitored. The completed surveys were collected later. The result is a sample of convenience, and there is no way to measure response rates accurately. The sample is similar to the general population of the U.S. on many observable dimensions other than race, but there is no way to assess the possibility of systematic selection on unobservables.

have had any actual experience with certified humanely raised products. Online Appendix B describes our survey design and the resulting data in greater detail. Table 1 provides summary statistics for the variables used in our estimating specification.⁵

One concern with stated-preference surveys is that some respondents may tend to overstate their willingness to pay. Possible reasons for this include an attempt to please the researcher or the hope that by overstating WTP, the good or service in question will be provided and the respondent’s option to buy the good in the future will be preserved. To limit this behavior, respondents were informed that a charitable organization funded by other concerned individuals would be established to certify meat as “humanely raised.” However, this would happen only if it was determined that a large enough share of the general population was willing to pay the necessary price premium in the hypothetical shopping scenarios presented in the survey. Respondents were further reminded that it was important for this organization to receive realistic information about potential demand. Should the organization go ahead with the meat-certifying program, they would not be able to fund other worthy causes that the respondent might also care about. This framing of the choice task represents an effort to make the respondent’s choices “consequential.”

Another concern with survey data is that respondents may attempt to second-guess the motivation of the research team in asking these questions. To minimize any perception of bias in our survey, we were careful to present both the pros and the cons of the proposed programs. We also posed a direct query about researcher bias in our debriefing questions: “Think about the way the information in this survey was presented. How important do you think it is to this research team for people to buy humanely raised meat products?” Perceptions ran the gamut from “1 = Not at all important” to “4 = Neutral” to “7 = Extremely important.” We were pleased to see that the modal value was 4, but more people gave high ratings than low ratings. Of course, it is difficult to avoid completely the impression that we care about

⁵Since several of the attitudinal variables employ a seven-point rating scale, Figure B1 in Online Appendix B also provides histograms for the complete distributions of each of these ratings.

humane treatment of farm animals since respondents will impute this to a certain extent from the fact that we are conducting the study at all. Fortunately, use of this variable as a potential shifter of estimated preference parameters yielded no statistically significant effects.⁶

4 Model and Estimating Specification

There are two standard ways to use stated preference methods to derive WTP measures for non-market or pre-test-market goods. One technique, sometimes called “stated behavior,” describes a possible market to respondents and asks how many units of the product in question they would choose to purchase per period, say per month or per year. These data on quantities demanded per period can then be modeled as functions of income and prices, based on the microeconomic construct known as a Marshallian demand curve. The other common technique, employed here, involves asking respondents about single choice occasions, where a given selection would be made under a particular set of conditions. When the choice scenario involves multiple alternatives and multiple varying attributes for each alternative, this method is commonly called “conjoint choice” analysis. If the choice is merely to buy a specified product (vote for a public good) or not, this method is often called a “contingent valuation”. Consumer choices are then explained using a so-called discrete-choice “random utility” econometric model where the parameters to be estimated are interpreted as marginal utilities associated with net income and with the quantities of each attribute. Given these estimated marginal utilities, it is straightforward to solve for the implied Marshallian demands. The conjoint choice approach asks only that respondents contemplate specific choice occasions, rather than ponder their cumulative purchases across many choice

⁶Best-practice protocols for the conduct of stated preference survey were observed to the fullest extent permitted by the resources available for this study. Many standard conventions for mail surveys are relevant in this context. See [Dillman \(2000\)](#), for example.

occasions. Conjoint choice tasks are thus viewed by many researchers to be easier for survey respondents.

We will develop our model in the context of Choice Scenario #1, an example of which is depicted in Figure 1. Respondents encountered this first choice set on the sixth page of the survey instrument. Indirect utility for each alternative in the choice set is considered to be a function of (1) the individual's income remaining after the purchase decision and (2) the quantity of the product purchased. The “no-purchase” alternative, of course, involves no cost. The simple equations below describe utility U_i^j as a function only of the cost of the package, c_i^j , and quantity of product contained in the package, q_i^j , described to subject i for each alternative $j = C, F, H, N$ (where C = conventionally raised, F = free-range, H = humanely raised, and N = no purchase). For the moment, we ignore the differences in utility that might stem from different attributes of each type of meat, so the indirect utility function involves only two parameters: β_Y , the marginal utility of net income, and β , the marginal utility of a pound of chicken:

$$\begin{aligned} U_i^j &= \beta_Y(Y_i - c_i^j) + \beta q_i^j + \eta_i^j, & j = C, F, H \\ U_i^N &= \beta_Y(Y_i) + \eta_i^N \end{aligned}$$

Net indirect utilities for the model, calculated relative to the “no-purchase” or “status-quo” option, are then:

$$\Delta U_i^j = (U_i^j - U_i^N) = \beta_Y(-c_i^j) + \beta q_i^j + (\eta_i^j - \eta_i^N) = \Delta V_i^j + \epsilon_i^j \quad j = C, F, H \quad (1)$$

McFadden's conditional logit choice model ([Greene \(2008\)](#), p. 846-847) assumes that subjects will prefer the alternative that conveys the highest attainable indirect utility in the choice set. The stochastic structure of the conditional logit model (i.e. the distributions typically assumed for ϵ_i^C , ϵ_i^F , and ϵ_i^H) leads to choice probabilities that can be expressed in

terms of the observable portions of utility for product types $j = C, F, H$ and the no-purchase alternative, N :

$$P_i^j = \frac{\exp(V_i^j - V_i^N)}{\exp(V_i^C - V_i^N) + \exp(V_i^F - V_i^N) + \exp(V_i^H - V_i^N) + 1}$$

$$P_i^N = \frac{1}{\exp(V_i^C - V_i^N) + \exp(V_i^F - V_i^N) + \exp(V_i^H - V_i^N) + 1}$$

To estimate the main unknown utility parameters β_Y (the marginal indirect utility for income) and β (the marginal utility per generic pound of chicken, for example) the following log-likelihood function is maximized:

$$L = \prod_{i=1}^n [P_i^C]^{C_i} [P_i^F]^{F_i} [P_i^H]^{H_i} [P_i^N]^{N_i} \quad (2)$$

where $C_i = 1$ if person i chooses the conventionally raised product and $C_i = 0$ otherwise; similarly for F_i , H_i and N_i .

Once the parameters of the indirect utility function are estimated, it is possible to solve for the individual's maximum WTP for a package of chicken of a specified weight. This maximum WTP is the price at which the individual would be just indifferent between paying for and consuming the product, and not paying for the product, thereby forgoing consumption. Indifference implies identical utility between these two options, or a zero utility *difference*, so we set the estimated indirect utility difference relative to the numeraire alternative equal to zero for $j = C, F, H$ and solve for the package cost, c_i^{j*} , that satisfies the equality $0 = \Delta V_i^j = \beta_Y(-c_i^{j*}) + \beta q_i^j + \epsilon_i^j$. This implies:

$$\beta_Y(c_i^{j*}) = \beta q_i^j + \epsilon_i^j \Rightarrow c_i^{j*} = \frac{\beta q_i^j + \epsilon_i^j}{\beta_Y} = \left(\frac{\beta}{\beta_Y}\right) q_i^j + \left(\frac{\epsilon_i^j}{\beta_Y}\right) \quad (3)$$

where $\epsilon_i^j = (\eta_i^j - \eta_i^N)$. This amount, c_i^{j*} , calculated from the maximum likelihood estimates of the two utility parameters, is interpreted as the maximum WTP for q_i^j . We note that

this can be expected to match the market equilibrium price for chicken breasts only for the marginal consumer. For inframarginal consumers, this WTP can be expected to exceed the market equilibrium price.

The error term in equation (3), ϵ_i^j/β_Y , is symmetric around zero, so its expected value can be assumed to be zero. The expected value of maximum WTP for a package of generic chicken is thus β/β_Y times the quantity (pounds) of chicken in the package, q_i^j . In other words, maximum WTP *per pound* of chicken is given by the ratio of the marginal utility per pound of chicken, β , to the marginal utility per dollar of income, β_Y .

In this study, however, our main research question concerns differences across types of chicken in this WTP amount. Thus we allow the marginal utility per pound of chicken to vary systematically with the type of chicken (conventional, free-range or humanely raised.) The baseline marginal utility, β_C , will be assigned to conventionally raised chicken, but the marginal utility per pound of chicken will be a systematic varying parameter that shifts by δ_F if the chicken is free-range, and by δ_H if the chicken is humanely raised. Thus the indirect utility-differences for $j = C, F, H$ that drive the choices will be generalized via appropriate interaction terms:

$$\begin{aligned}\Delta U_i^j &= \beta_Y(-c_i^j) + (\beta_C + \delta_F F_i^j + \delta_H H_i^j)q_i^j + \epsilon_i^j \\ &= \beta_Y(-c_i^j) + \beta_C q_i^j + \delta_F F_i^j q_i^j + \delta_H H_i^j q_i^j + \epsilon_i^j\end{aligned}\tag{4}$$

where $F_i^j = H_i^j = 0$ if the product is conventional, $F_i^j = 1$ if the product is free-range (0 otherwise), and $H_i^j = 1$ if the product is humanely raised (0 otherwise). Solving for the maximum WTP for a package of chicken yields

$$\text{Max WTP} = c_i^{j*} = \frac{(\beta_C + \delta_F F_i^j + \delta_H H_i^j)q_i^j}{\beta_Y} + \frac{\epsilon_i^j}{\beta_Y}\tag{5}$$

A statistical test of the hypothesis that respondents are willing to pay no more for free-

range meats than for conventional meats is a test of $\delta_F = 0$. Likewise, a test of the hypothesis that respondents are willing to pay no more for humanely raised meats is a test of $\delta_H = 0$. If these parameters prove to be positive and statistically significantly different from zero, then a point estimate of the per-pound *premium* willingly paid for the free-range product is δ_F/β_Y and a point estimate of the per-pound *premium* willingly paid for the humanely raised product is δ_H/β_Y .

To accommodate systematic heterogeneity in preferences across our sample, as a function of individual characteristics and perceptions, we next generalize *each* scalar preference parameter in equation (4) to be a systematic varying parameter. We introduce potentially different types and numbers of shift variables for each marginal utility, including variables Z_i for the marginal utility of income, and variables X_i^C , X_i^F , and X_i^H for the marginal utility of the conventionally raised product and the *differentials* in marginal utility for the free-range and humanely raised products. Each vector of variables also includes a constant term. The resulting more-general utility difference can be written to emphasize these systematically varying marginal utilities, or to establish the specific second- and third-order interaction terms required to estimate the four parameter vectors:

$$\begin{aligned}\Delta U_i^j &= (\beta_Y Z_i) (-c_i^j) + \left[(\beta_C X_i^C) + (\delta_F X_i^F) F_i^j + (\delta_H X_i^H) H_i^j \right] q_i^j \\ &= \beta_Y (-Z_i c_i^j) + \left[\beta_C (X_i^C q_i^j) + \delta_F (X_i^F F_i^j q_i^j) + \delta_H (X_i^H H_i^j q_i^j) \right]\end{aligned}\quad (6)$$

If we assume linearity as in equation (6), this generalization means that the fitted TWTP for a package of chicken (of weight q_i^j pounds) is given by

$$TWTP_i^j = \left(\frac{1}{\beta_Y Z_i} \right) \left[(\beta_C X_i^C) + (\beta_F X_i^F) F_i^j + (\beta_H X_i^H) H_i^j \right] q_i^j \quad (7)$$

Then the per-pound premium for the free-range and humanely raised product will be simply

the partial derivatives with respect to the type and the quantity:

$$\frac{\partial^2 TWT P_i^j}{\partial F_i \partial q_i^j} = \frac{\delta_F X_i^F}{\beta_Y Z_i}; \quad \frac{\partial^2 TWT P_i^j}{\partial H_i \partial q_i^j} = \frac{\delta_H X_i^H}{\beta_Y Z_i} \quad (8)$$

These ratios are nonlinear functions of the asymptotically joint normal maximum likelihood parameter estimates, so we use simulation methods to build up a sampling distribution of values for these key derivatives with respect to each statistically significant shift variable. Ultimately, we are interested in the further derivatives of these premia with respect to the variables in Z_i and X_i^F .

5 Results and Discussion

Table 2 presents parameter estimates for the simplest possible homogeneous-preferences specification that still permits an estimate of the premium for the humanely raised product. The marginal utilities are assumed to be common across all individuals and the only distinction made is between the three different types of products. Calculated simply as δ_H/β_Y , these estimates suggest a WTP premium for the humanely raised product of about \$0.58 per pound.

However, we are particularly interested in evidence of systematic heterogeneity in these WTP amounts. If we understand the patterns in WTP for humanely raised products, we will understand better the types of constituencies which will be especially important when it comes to benefit-cost analysis of environmental regulations (or other public policies) where one type of benefit is prevention of non-fatal harm to other species. Table 3 provides the maximum likelihood parameter estimates for our preferred (parsimonious) model with heterogeneous preferences. This is again one single model, although the estimates in the middle section of the table are arranged in three columns to highlight the base marginal utility for the conventional product in the first column and the differentials in marginal utility for the

free-range and humanely raised products in the next two columns, with each of the rows showing the dimensions of statistically significant heterogeneity in this base marginal utility and the two differentials.⁷

The first interesting result in Table 3 is the effect of gender on the parameter which gives the marginal utility of income. Females display a marginal utility of income that is greater than that for males, which tends on average to decrease their willingness to pay for anything (a fairly typical result in consumer choice analysis). A tendency for women to be less willing to pay for any of these products, including any premium for the humanely raised products, contrasts with the attitudinal study by Prickett et al. (2010) where support for animal welfare measures is particularly strong for females. It seems their higher marginal utilities of income dominate their greater sentiments for animal welfare in an economic analysis.^{8,9}

In this paper, however, we are particularly interested in the third column in the body of Table 3. The per-pound WTP premium for the humanely raised product is given by δ_H divided by the marginal utility of income (which is β_{Y0} for males and $(\beta_{Y0} + \beta_{Y1})$ for females). Since δ_H varies according to the values of several respondent characteristics and attitudes, so will the WTP premium for humanely raised products. Table 3 thus illustrates that WTP varies *inversely* with household size and with the respondent's rating of his or her

⁷As usual, this specification is a result of extensive exploration across a larger array of potential sources of heterogeneity. The basic homogenous-preferences specification in Table 2 demonstrates that there is a statistically significant utility differential for humanely raised products. All of the other specifications we have considered are generalizations of that simple model. The surviving covariates in Table 3 are retained because they tend to be robustly statistically significant across alternative specifications. Note that the coefficient on the negative of total price, in a model that is linear in net income, gives the marginal utility of income.

⁸Although one usually expects declining marginal utilities of income, the estimated marginal utility of income in our sample does not seem to change as income increases. We find this result despite having introduced income into the model in a variety of different ways in our exploratory analyses.

⁹An anonymous referee asked about the preferences of respondents who reported that they did not know the prices of the conventional or free-range products they consume. We provide online Appendix E with some additional results. Table E-1 reports results for two models which use indicators for respondents who buy conventional or free-range products but do not know the typical price of the product. These models reveal evidence consistent with these individuals having a lower marginal utility of income (implying a less binding budget constraint and therefore a higher WTP).

own degree of ideological conservatism.¹⁰ In contrast, the WTP premium varies *directly* with educational attainment and the extent to which the respondent is concerned with farming practices that involve antibiotics, growth hormones, and genetic engineering¹¹. It also varies *directly* with the extent to which the respondent believes that the humanely raised product is healthier for humans¹² and the extent to which he or she believes that humane standards actually improve the well-being of animals.¹³ While we collected numerous other attitudinal variables, sufficient orthogonality to permit identification of separate effects was present only for these few variables. To the extent that these variables are collinear with other attitudes, of course, these included variables (used alone) will pick up some of these other effects.

Interestingly, in an alternative specification not reported here, we find no statistically significant lump-sum effect on fitted indirect utility associated solely with the product being conventional, free range, or humanely raised. Product type affects the marginal utility *per pound*, not just the overall utility level per package. Thus, the WTP premium for the humanely raised product is expected not to be associated merely with the act of purchasing this type of product, but with the quantity actually purchased. This makes it more likely that the premium reflects concern about other-species well-being, rather than just potential “warm glow” from buying the more socially desirable product. Furthermore, a simple distinction between the no-purchase alternative and any of the three products also makes no statistically significant difference in expected utility, despite the fact that many conjoint choice studies with a no-purchase alternative find a significant “status quo” effect.¹⁴

¹⁰Survey question D.12: In terms of politics, how do you consider yourself? (1 = Extremely liberal, ..., 4 = Moderate, ..., 7 = Extremely conservative)

¹¹Survey question C.3: In choosing among different brands of chicken breasts, to what extent were you thinking about antibiotics, growth hormones, or genetic engineering and how these might affect chicken products? (1 = Not at all, ..., 7 = A lot)

¹²Survey question A.6: Do you think that humanely raised meats might be more or less healthy for people to eat than conventional meats? (1 = Much less health than conventional meats, ..., 4 = Equally healthy, ..., 7 = Much more healthy than conventional meats)

¹³Survey question A.4: How much do you think these requirements would actually improve the wellbeing of livestock and poultry raised on certified farms? (1 = Not at all, ..., 7 = a lot)

¹⁴Other alternative specifications are discussed in online Appendix C.

It is not surprising that people are willing to pay a higher premium for the humanely raised product if they believe that it is healthier for humans. We expected that we might also see systematic effects on the WTP premium when respondents believed that the humanely raised product was more desirable in other ways as well, for example if it was expected to be tastier or more tender than the conventional product. Opinions relating to the overall quality of humanely raised versus conventional products tend to be somewhat positively correlated, so it proves difficult to include all of them in a single specification and to achieve statistically significant coefficients on each interaction term. Since the perceived “healthiness” attribute seems to dominate, our preferred specification includes only that control for these desirable attributes beyond simply the animal welfare dimension. Of course, we acknowledge that the coefficient on the “healthiness” will certainly pick up some of the explanatory power that would otherwise be attributed to tastiness or tenderness, had there been more independent variation in the three types of perceptions.

The quantitative WTP implications of these parameter estimates are conveyed in Table 4. This table describes distributions for the calculated value of the per-pound WTP premium for the “humanely raised” product, based upon 1000 random draws from the assumed joint normal distribution of the maximum likelihood parameters estimates.¹⁵ It appears that female respondents are willing to pay a per-pound premium for the humanely raised product that is about \$0.19 lower for each extra person in their household. Likewise, the more ideologically conservative this female respondent rates herself to be, the lower is the expected WTP premium for the humanely raised product. Each rating point on the attitudinal scales for healthiness and improvement to animal well-being increases the expected female WTP premium for the humanely raised product by about \$0.25 per pound. Concerns about antibiotics, growth hormones, and genetic engineering have the greatest effects, with each rating point increasing the premium by an average of \$0.30 per pound for females. All of

¹⁵A full table of results, including those for the “free-range” alternative, is included in online Appendix D.

the corresponding simulated WTP premiums for male respondents are greater, of course, because the estimated marginal utility of income (which appears in the denominator in each case) is smaller for males.

However, we are interested in simulating individual WTP for animal welfare improvements alone; that is, WTP for reductions in morbidity for the species in question, *net* of any WTP for the related human health impacts resulting from consumption of these animals. For this purpose, it seems appropriate to impose the following counterfactual condition: healthiness set at 4 = “equally healthy.” However, there remains the question of the appropriate values to simulate for the other attitudinal variables: “H. (humane standard) improves well-being” and “antibiotic concerns.” We relegate this exploration to the online Appendices accompanying this paper, but we will summarize the results here. Online Appendix Table D-2 begins by reporting the size of the premium for the humanely raised product, evaluated first at the marginal means of the data, across individuals, for each of the variables that contribute to heterogeneity in these values. This premium is approximately \$0.70 per pound, with a 95% interval that between \$0.33 and \$1.02 per pound. ¹⁶

In considering which of the WTP simulation results in Table D2 might be most appropriate, we are inclined to allow respondents to retain their own subjective opinions about the extent of any ill treatment that farm animals receive under conventional farming methods. At the same time, we want to net out any component of WTP that is explicitly due to the selfish perception that the humanely raised product would be better for humans to consume (as opposed to being better for the farm animal). Unfortunately, it is somewhat difficult to ensure that we have completely achieved this goal. For the concerns about antibiotics, growth hormones, and genetic engineering, we posed the question specifically in terms of “how these might affect chicken *products* [emphasis added]” as opposed to the birds

¹⁶Subsequent rows of online Appendix Table D-2 display simulations for specified departures from the overall sample mean values of the relevant variables, and asterisks highlight cases where the fitted premium is bounded away from zero.

themselves. However, we cannot rule out that respondents might reasonably have been worried about the latter. If farming practices are not healthy for humans who consume these products, then they are likely to be unhealthy for the animals in question as well.

With these considerations in mind, we believe that the best estimate of the humanely raised premium may be the WTP calculated otherwise at the means of the data, but with the “healthy” and “antibiotic concerns” ratings set equal to their *neutral* values (i.e. 4). Fortunately, the mean value of the latter rating is 3.86, so the distinction between the sample mean and the simulated value is minimal. This implies that our best estimate of average household WTP for average subjective improvements in animal welfare is about \$0.34 per pound, but the 95% interval includes everything from -\$0.23 to +\$0.82. For greater perceived improvements in animal well-being, however, it is clear that people are willing to pay substantially more for the humanely raised product.

5.1 Latent Class models

When heterogeneity in preferences is introduced by allowing individual utility parameters to vary systematically with observable characteristics and elicited attitudes of the consumer, there are, in principle, as many unique different sets of preferences as there are unique combinations of these characteristics and attitudes. Sometimes, however, it is helpful to learn whether there might be some smaller number of roughly distinct preference types. These can be construed as distinct “market segments,” as opposed to the near-continuum of consumer types identified in models like that in Table 3. A latent class model may be appropriate in this case.

Latent class models are based on the supposition that some small finite number of different preference functions can be used to explain most people’s choices. If membership in a preference class could be treated as deterministic, indicator variables for each preference class could simply be used to shift each preference parameter in the model. In a latent

class model, however, membership in preference classes is unobserved, and must be inferred by the researcher. A two-class latent class model typically involves a class separation sub-model where respondent characteristics are used to predict preference class membership. Then, conditional on (stochastic) class membership, a distinct set of preference parameters is estimated for each class.

We have explored a number of latent class specifications to determine how many distinct preference types might be discerned in our data. It turns out that at most two distinct preference classes are identifiable, as described in Table 5.¹⁷ In the top portion of Table 5, it can be seen that individuals with both Class 1 and Class 2 preferences are sensitive to prices. Individuals with Class 1 preferences, however, derive statistically significantly greater utility from either the free-range or the humanely raised product compared to the conventional product. In contrast, individuals with Class 2 preferences derive statistically significantly *less* utility from either the free-range or the humanely raised product than from the conventional product.

The lower portion of Table 5 reveals that it is somewhat difficult to pin down a good separation index for these two classes, but if anything Class 2 preferences are *more* likely for respondents who have larger households (and potentially for individuals who view themselves as ideologically more conservative); Class 2 preferences are *less* likely for people who believe that humane standards will make more of an improvement in animal welfare (and potentially for people who report being concerned about antibiotics, growth hormones, or genetic engineering and how these might affect chicken products).¹⁸

¹⁷We programmed our latent class estimator in Matlab. Note that the numbering of the preference classes as Class 1 and Class 2 is completely arbitrary. We also note that we tried a variety of three-class models, but none could be coaxed to convergence. Point estimates may be construed to suggest the possibility of a third preference class minimally distinct from Class 2 in Table 5, but there appears to be insufficient information in the data to identify this third preference class.

¹⁸Gender appears to have no discernible effect on class membership; having at least a bachelor’s degree *may* reduce the chance of being in Class 2 (in some specifications, for a slightly different subsample of the data), as may the opinion that the humanely raised product is healthier. However, inclusion of the “H. (humanely raised product) healthiness” variable causes the coefficient on the “antibiotic concerns” variable to become even less significant. It is worth noting that these perceptions (healthiness and antibiotic concerns)

While all of the preference coefficients for Class 2 are individually statistically significant, the implied premiums willingly paid per pound for the free-range or humanely raised products for this Class are negative. This occurs despite the fact that the free-range or humanely raised options were never priced *lower* than the conventional option, so the best we can do is to interpret these coefficients as implying a definite zero incremental willingness to pay for the humanely raised product for this market segment.

Thus the latent class model seems to be telling us that there is one market segment that views free-range and humanely raised products favorably and another that cares nothing for them. Had the separation equation been more precisely estimated, the latent class model might be something we could pursue. Of course, there may be other discernible classes in this market if one had sufficient data to be able to discriminate between them. Given the tenuousness of the separating equation, however, our preferred specification involves the systematically varying parameters in Table 3.

5.2 Caveats and suggestions for further research

In this study, we chose to elicit from each individual their perceived levels for several attributes of humanely raised products. For example, we asked whether they thought that humanely raised standards would improve animal well-being (“H. improves well-being”). Ideally, one would like to be able to “treat” each respondent with exogenously defined information about humane standards for farm animals and to have them completely accept this information. Then it might be possible to contemplate an exogenous change in this information to derive answers to the question of “How would WTP change when animal welfare is changed?” We might have attempted to *assert* to respondents (rather than eliciting their subjective ratings about) the extent of animal welfare improvements under certification, the relative healthiness of humanely raised products versus conventional products, and how

are somewhat correlated. These correlations are discussed in online Appendix C.

much worry is appropriate concerning antibiotics, growth hormones, and genetic engineering. These exogenous product design “attributes” could then have been added to the minimal list of product attributes in the current choice sets. Or, we could have asked respondents (explicitly) to assume *no* difference in healthiness, and *no* human health effects from consumption of conventional products that are not also present in the humanely raised product. However, we know that people tend to adjust the stated attributes in choice scenarios to reflect their own opinions. The attributes imputed by individuals, in some cases, are a mix of the stated attribute and the person’s own opinion on the matter.¹⁹

People’s prior opinions about product attributes, for example the extent to which these proposed standards would improve the well-being of animals, are subjective. These opinions depend upon the individual’s perceptions of how badly farm animals are currently treated on the average industrial farm. Many people devote little or no thought to the quality-of-life of the animals they consume as food. Similarly, many different peer group opinions and other influences affect the individual’s subjective assessment of the healthiness of humanely raised meats relative to conventional meats, as well as the extent to which the individual will be thinking about antibiotics, growth hormones, or genetic engineering, and how these might affect chicken products. These key attitudinal variables may need to be considered to be jointly endogenous with the individual’s willingness to pay a premium for either free-range or humanely raised products.

The main implication of endogeneity in these attitudinal variables is that we must exercise caution in simulating how WTP is likely to differ when attitudes differ. If unobserved heterogeneity (not controlled for by our observable respondent characteristics) affects all three attitudinal variables and WTP, it is technically not possible to change one attitudinal variable independently from all the rest to assess its impact upon WTP, even if the three different attitude measures make individually statistically significant contributions to the

¹⁹Respondents’ modifications of stated probabilities is addressed in [Burghart et al. \(2007\)](#) and “scenario adjustment” is investigated in [Cameron et al. \(2009\)](#)

explanation of choices.

One of our final caveats involves the generalizability of our results. The sociodemographic cross-section of our sample is fairly representative of the state and nation as a whole, with the exception of race. Less than 5% of our sample specifically reports themselves to be nonwhite, which is substantially lower than the national average of 23%. This lack of racial heterogeneity limits how much we can generalize our results to other areas of the country that contain more racial heterogeneity than for the county used for our sample.

To further refine a survey like ours, it would be important to explore ways to gain better experimental control with respect to individuals' subjective perceptions of current animal welfare. It would also be helpful to determine whether there is some way to distinguish between WTP for improved animal welfare itself and WTP simply for more reliable guarantees that claims of humanely raised products are accurate. It may also be possible to exercise additional creativity with respect to the problem of isolating selfish considerations behind a WTP premium, versus exclusively "other-regarding" preferences with respect to non-human species.

6 Conclusions

It is often considered somewhat futile to attempt to disaggregate total willingness to pay for an environmental asset when total WTP is comprised of use demand, option demand, bequest demand and existence demand. For example, WTP to protect members of an endangered species from jeopardy probably involves more nuances of environmental value than just the well-being of the individual animal. In this paper, therefore, we have sought to identify a WTP measure for other-species morbidity reductions that is distinct from other reasons for people's WTP. We argue that it may be possible to identify WTP simply to reduce other-species *morbidity* if there is a premium for humane treatment of animals even

in the context of a common and ubiquitous “food animal.” Animals that we eat have no particular symbolic value, as would be the case for the spotted owl as a barometer of the health of old-growth forest, for example. Likewise, they cannot be classed as “charismatic megafauna,” as would be the case for a recently de-listed endangered species like the brown pelican.

For people who consume an animal as food, it is hard to argue that they hold much value for preventing mortality, although vegetarian and vegan consumers may have positive values associated with reduced mortality for these species. If we want to isolate a component of WTP that pertains solely to the well-being of the animal itself, we need a context that is not confounded by symbolic values or endangered species status. We need this information because many of the species which are harmed in an environmental accident (such as the birds that are often affected by a coastal oil spill, for example) are neither endangered nor charismatic species. These relatively anonymous, non-symbolic wild birds sometimes suffer and die in the tens or hundreds of thousands, and it is important to know something about likely patterns in the public’s willing to pay (in advance) to protect these birds. We have thus sought evidence of people’s willingness to pay to reduce harm to the quality of life of other species in a context that is largely divorced from any moral outrage over the source of this harm.

It is worth mentioning that an increase in the well-being of a specific animal, in the context examined in this paper, may be viewed as an essentially private good. At the point of each purchase, the consumer can choose whether to pay a premium for improvements in one animal’s well-being, with certainty. This is in contrast to the case of a referendum on a public policy that would mandate increased protection (reduced risks) for many non-specifically identified individual birds and animals, the cost of which everyone pays.

Our research suggests that, on average for our sample, people are willing to pay perhaps on the order of about \$0.35/lb more for chicken breasts from humanely raised chicken than

for conventionally raised chicken, conditional on the assumption (1) that the humanely raised product is no more or less healthy for humans and (2) that people have only moderate levels of concern about antibiotics, growth hormones, and genetic engineering. It is tempting to try to scale the per-pound premium to predict the premium willingly paid for an entire humanely raised chicken, and then to contemplate whether this WTP can be further transferred to each seagull or sandpiper that is harmed by a coastal oil spill, for example. However, this type of extrapolation is probably inappropriate. We have estimated people’s WTP for one physical part of a single identifiable chicken, with certainty. Namely, the particular chicken that the individual is buying on this shopping trip. At most, this same premium might apply to all packages of chicken breasts purchased over the year. However, we have strong suggestive evidence (based on the negative effects of household size, even if we control for income) that the WTP premium is likely to be declining in the number of chickens, per unit time, that are protected by humane standards as a result of the consumer’s choices.

While we are not yet able to scale the WTP premia derived in this study to the problem of valuing reductions in other-species morbidity as a purely public good, our results are unambiguous that certain segments of the population are willing to give up other goods and services to improve the well-being of other species. These benefits from reduced other-species morbidity are *in addition* to benefits from avoided other-species mortality. In terms of a “benefits transfer” to the case of oil-related harm to wildlife in the event of a major oil spill, morbidity-risk values like these would apply to injured birds which survive, and to dying birds between the time they have been oiled and the time they succumb.

Most previous research has focused only upon mortality losses for wildlife, without attempting to value harm to non-human species from non-fatal morbidity or stresses caused by harm to their habitat or disruption of their natural habits. Our research represents a beginning effort to benchmark a disembodied estimate of an average value for morbidity reductions among other species that is independent of the cause of this harm.

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Table 1: Descriptive Statistics (240 respondents, 2 choice sets each)

Variable	Definition	N	Mean	Std. Dev.	Min.	Max.
<i>By choice set:</i>						
pounds (q_i^j)	package weight	480	2.24	0.567	1.5	3
total price	conventional product	480	5.88	1.87	2.68	10.47
	free-range product	480	7.14	2.46	2.84	15.57
	humanely raised product	480	8.61	2.94	3.13	18.27
price per pound	conventional product	480	2.63	0.48	1.79	3.49
	free-range product	480	3.20	0.71	1.84	5.19
	humanely raised product	480	3.86	0.88	1.94	6.09
<i>Across respondents:</i>						
1(female)	=1 if female	240	0.652	-	-	-
household size ^a	including respondent	236	2.71	1.32	1	8
1(college grad)	=1 if college grad	240	0.402	-	-	-
conservatism	approx. linear in rating ^b	240	3.61	1.56	1	7
H. healthiness*	"	240	5.38	1.29	1	7
H. improves well-being*	"	240	5.20	1.78	1	7
antibiotic concerns ^a	"	199	3.86	2.23	1	7

*H = humanely raised product

^a A handful of subjects did not answer the household size question; the question about antibiotic concerns was a late addition. Indicator variables are used to control for missing values, and slopes are conditional on data being available.

^b We cannot statistically reject assumptions that these ratings enter linearly, so they will be treated as continuous variables, to control the size of the parameter space.

Table 2: Simple Model, Homogeneous Preferences (240 respondents, 480 choices)

Variable		Coefficients		
-(total price)		(β_Y) 0.4282*** (0.0727)		
	1(Conventional) base coefficient	1(Free-range) differential	1(Humane) differential	
pounds (q_i^j)	(β_C) 2.368*** (0.288)	(δ_F) 0.1066 (0.071)	(δ_H) 0.2464**	(0.101)
Log L		-541.578		

^a Asymptotic standard errors in parentheses (***significant at the 1% level, **significant at the 5% level). Coefficients arrayed to emphasize baseline marginal utility and differentials for free-range and humanely raised products, to be generalized in Table 3. Parameter estimates in these two models are produced by Stata's clogit algorithm, with errors clustered on the respondent identifier.

Table 3: Parsimonious Model, Heterogeneous Preferences (240 respondents, 480 choices)

Variable		Coefficients ^a				
-(total price)		(β_Y)	0.4927***			
			(0.102)			
-(total price)			0.1691**			
× 1(female)			(0.079)			
		1(Conventional)	1(Free-range)	1(Humane)		
		base coefficient	differential	differential		
pounds (q_i^j)	(β_C)	10.7029***	(δ_F)	-0.0760	(δ_H)	-1.4942**
		(0.560)		(0.502)		(0.712)
× household size		-0.2479***		-0.1108**		-0.1278*
		(0.093)		(0.056)		(0.069)
× 1(college grad)		-0.8934**		0.2566*		0.2930*
		(0.362)		(0.146)		(0.164)
× conservatism		-		-0.0855*		-0.1194*
				(0.047)		(0.061)
× H. healthiness		-				0.1606**
						(0.068)
× H. improves well-being		-		0.1719***		0.1615***
				(0.038)		(0.056)
× antibiotic concerns		-		0.1670***		0.1988***
				(0.039)		(0.052)
Log L			-436.718			

^a Asymptotic standard errors in parentheses (***significant at the 1% level, **significant at the 5% level, *significant at the 10% level). Coefficients arrayed to emphasize baseline marginal utility and differentials for free-range and humanely raised products. Parameter estimates are produced by Stata's clogit algorithm, with errors clustered on the respondent identifier. Note that panel data methods are unnecessary because the explanatory variables are either fixed or randomized, and therefore do not covary with any individual heterogeneity, observed or unobserved. Model also includes unreported incidental parameters on indicators for the availability of data on “household size” for all three product types and on “antibiotic concerns” for the free-range and humanely raised products.

Table 4: Derivatives of marginal WTP premium for humane product

<i>With respect to:</i>	<i>For Females:</i>	<i>For Males:</i>
household size (# of persons)	-\$0.19 (-\$0.42, \$0.01)	-\$0.25 (-\$0.62, -\$0.02)
1(college grad) (0,1)	\$0.45 (-\$0.04, \$1.05)	\$0.61 (-\$0.05, \$1.49)
conservatism (1 to 7)	-\$0.18 (-\$0.36, \$0.00)	-\$0.24 (-\$0.53, \$0.00)
H. healthiness (1 to 7)	\$0.24 (\$0.04, \$0.47)	\$0.33 (\$0.05, \$0.73)
H. improves well-being (1 to 7)	\$0.25 (\$0.06, \$0.43)	\$0.33 (\$0.08, \$0.70)
antibiotic concerns (1 to 7)	\$0.30 (\$0.15, \$0.47)	\$0.41 (\$0.20, \$0.74)

We report medians and 2.5th and 97.5th percentiles of the distribution of the calculated derivative, based on 1000 draws from the assumed joint normally distributed maximum likelihood parameter estimates. Intervals thus reflect the precision of parameter estimates. For full results, see Appendix Table D-1.

Table 5: Two-Class Latent Class Model (240 respondents, 480 choices)

Variable	Preference Classes	
	<i>Class 1</i>	<i>Class 2</i>
-(Total price)	0.240*** (0.0742)	0.175* (0.0983)
pounds (q_i^j)	1.31*** (0.234)	1.48*** (0.294)
... × free-range	0.385*** (0.100)	-0.510*** (0.142)
... × humanely raised	0.430*** (0.143)	-0.646*** (0.187)
Variable	Class separation index (propensity to be in Class 2)	
constant	12.7 (8.99)	
household size	1.17* (0.686)	
conservatism	0.212 (0.303)	
H. improves well-being	-1.34* (0.711)	
antibiotic concerns	-1.64 (1.05)	
<i>Incidental (Non-missing value indicators)</i>		
have(household size)	-10.5 (7.06)	
have(antibiotics concerns)	5.50* (3.25)	
Max Log L	535.52	
asymptotic standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1		

Figure 1 - One example of a choice set

- If every product in a choice scenario seems too expensive, choose “None.”
- If you would look for something else instead, choose “None.”
- If you never buy the meat product(s) being described, choose “None.”

Choice Scenario #1 (Chicken Breasts)

Suppose you have come to your usual food store. You are considering whether to buy a 1.5-pound package of chicken breasts. The store offers three brands of chicken breasts that look the same. The color, size and fat content of each brand are very similar. The only visible difference is that one brand is marked “Conventional,” one brand is marked “Free-range,” and the third brand is marked “Humane.” The prices are also different.

Keeping in mind your household budget, which would you choose? (check ONE)

	A	B	C	None
Type	Conventional	Free-range	Humane	
Package size	1.5 lbs	1.5 lbs	1.5 lbs	
Price	\$ 3.09/lb	\$ 4.09/lb	\$4.84/lb	
Total cost	\$4.63	\$ 6.14	\$ 7.26	\$ 0
I prefer:	☐	☐	☐	☐