

University of Bayreuth  
Faculty of Law, Business & Economics  
Chair of Institutional Economics

---

# How (not) to measure the willingness to pay for public goods

Challenges estimating willingness to pay for animal welfare with  
an ACBC

---

Niklas Gogoll & Felix Schlieszus  
University of Bayreuth

# 1 Introduction

From a theoretical point of view, autonomous and independent purchase decisions of individuals lead to the maximisation of their utilities when private goods are concerned. However, this is not the case for public goods, where individual purchase decisions only have a marginal impact on the level of the public good which leads to free-riding behaviour. The larger the public good, the higher the incentive to not participate in providing it. Therefore, intervention of some (public) entity is necessary. This (public) entity needs to be aware of how important a certain public good is for the individuals, in order to provide the optimal level of the public good. For this, it regularly relies on opinion studies and surveys of polling institutes.

One of these public goods in question which is publicly discussed frequently is for instance animal welfare. Typical questions like “How important is animal welfare to you?” are misleading though, as they don’t take any form of opportunity cost into account. Instead, polling institutes should rather focus on the willingness to pay. The willingness to pay for a good shows exactly, how much an individual is willing (and able) to pay for a certain good, which simultaneously implies a reduction in budget, hence, giving up the consumption of other goods.

However, measuring the willingness to pay is not straightforward for public goods. In Gogoll and Schlieszus (2021) we have argued in a theoretical model that “the” willingness to pay for a public good must be divided into two parts. One part is caused by social incentives, which are not part of the preference for the public good itself, but occur by measuring the willingness to pay on an individual level. The other part is the “true” willingness to pay for the public good and can only be measured, if the individual has an impact on its provision.

In this paper we aim to measure exactly these two willingness to pay for the public good using the example of animal welfare. Animal welfare is receiving more and more attention in German politics and German society in general. For instance, the German government is going to prohibit the killing of male chicks in laying hen breeding from 2022 onwards (Bundesministerium für Ernährung und Landwirtschaft 2021). Instead,

the gender of the chick has to be determined inside the egg or male chicks must be raised as well. We will use eggs and especially the killing of male chicks as an instrument for measuring the willingness to pay for animal welfare. As this property is not related to other criteria which potentially could have an influence on the willingness to pay for eggs, like taste (Bray and Ankeny 2017; Güney and Giraldo 2020) or health (Pettersson et al. 2016; Bray and Ankeny 2017), this instrument is appropriate.

Animal welfare also seems to be a good example to explain the difference of the two kinds of willingness to pay. In Germany for instance, even though organic food is increasing in popularity, its market share is still relatively low. In 2020, organic fresh eggs had the highest organic share of food products in the basket of goods of German households with “only” 15,4% according to Bund Ökologische Lebensmittelwirtschaft (2021). For all other products, the organic share was even smaller. On the other hand, some studies suggest, that the majority of Germans would support increasing animal welfare levels, if they were enforced on a public level (Bundesministerium für Ernährung und Landwirtschaft 2019; Sorg et al. 2021). This gap seems to be exactly what can be explained by the two types of willingness to pay we distinguish in our model.

In the survey presented in this paper, we aim to determine these respective levels of and the difference between these willingness to pay by using the example of eggs. Knowing these willingness to pay and their interdependencies should give a sophisticated foundation for policy implications regarding governmental intervention.

## 2 Methodology

### 2.1 Stated Willingness to Pay approaches

In Gogoll and Schlieszus (2021), we proposed, that the total willingness to pay for a public good – in this paper animal welfare – must be divided into two components as introduced above. The total willingness to pay in the case of private provision will only be based on individual preferences like social incentives or taste, if reciprocity does not play a role. In the case of public provision, the willingness to pay will additionally be based

on the willingness to pay for increasing animal welfare. In our model, we introduced an approach with which this willingness to pay for increasing animal welfare can potentially be measured: The Quasi-Monarch. As a Quasi-Monarch, an individual can determine the level of contribution of every individual including herself. Therefore, this individual has no incentive to not state her “real” willingness to pay, because her impact is not marginal anymore. Following this model, we would have to determine the difference in total willingness to pay of these two scenarios: One, where every individual contributes on her own and one, where she has the possibility of forcing everyone to participate in improving the level of the public good.

For measuring these willingness to pay, there are multiple methods available depending on whether the willingness to pay for the respective public good can be measured directly and whether there is real data of market transactions available. To be able to use this real data to determine the willingness to pay for animal welfare, one would need to fluctuate market prices on an extensive level and in a controlled environment, which is often not feasible. Therefore, economic literature uses stated willingness to pay approaches to determine the individual willingness to pay indirectly. One of them is the contingent valuation (CV), where participants have to either state their willingness to pay directly (open-ended question) or have to confirm binarily, whether they would be willing to pay a specific amount for a given product. Contingent valuation suffers from multiple biases though. The settings are for instance hypothetical in nature (hypothetical bias), focus on one specific aspect, that participants might not have thought of beforehand (prominence bias) or suffer from biased strategic answers, if participants see through the survey design. A more complete list of potential biases can be found in Perman et al. (2011) and Freeman et al. (2014).

Another possibility would be to use choice experiments which are broadly based on Lancaster (1966). Choice experiments are said to have multiple advantages over CV studies making them popular in economic literature (Adamowicz et al. 1998; Hanley et al. 1998; Freeman et al. 2014). It is for instance easier to include multiple different attributes into choice sets, which is why they have been highly used in market research (Louviere and Woodworth 1983; Adamowicz et al. 1998; Hanley et al. 1998). By using

a choice experiment, we would be able to include preferences for, in our example, the amount of eggs, the farming method or whether the killing of male chicks is permitted in only one study. This hypothetical multi-attribute setting is typically also better suited to model real scenarios, which leads to a smaller influence of biases.

But there are also disadvantages of choice experiments compared to CV studies. Choice experiments are typically harder to process cognitively (Adamowicz et al. 1998; Perman et al. 2011). Respondents might only focus on some aspects of the question without considering all options or they might focus on certain labels to make the choice easier. And while some biases might be weakened in choice experiments, multiple other biases – most importantly the hypothetical bias – still have to be taken into account.

Keeping these limitations in mind, we tried to measure the two willingness to pay separately. For each of them, we aimed to choose a hypothetical scenario that is similar to the one that individuals would face in reality. The individual willingness to pay will be revealed in a purchase scenario in a supermarket. The most similar indirect stated preference method would be a choice experiment. The Quasi-Monarch setting on the other hand will typically be presented in the form of a referendum, where individuals can choose whether they agree with a proposition or not. This is why we opted for a CV approach in the second step. We will go through both approaches separately.

## **2.2 Individual Willingness to Pay**

The most widespread choice experiment in market research for modelling individual purchase situations is the choice-based conjoint analysis (CBC) (Ku et al. 2017; Voleti et al. 2017). In a CBC, respondents typically choose the preferred alternative out of fixed or random choice sets, which are lists of a manageable amount of alternative products. They may also choose the “None” option, if no product is to their liking. Based on these choices, researchers determine utilities of different attributes of these products to ultimately estimate the willingness to pay for these respective attributes (Andrews et al. 2002; Evgeniou et al. 2007; Sonnier et al. 2007; Otter 2019). This offers the advantage of being able to focus on the willingness to pay for each attribute considered, while setting an indirect scenario that is closer to a real purchase process.

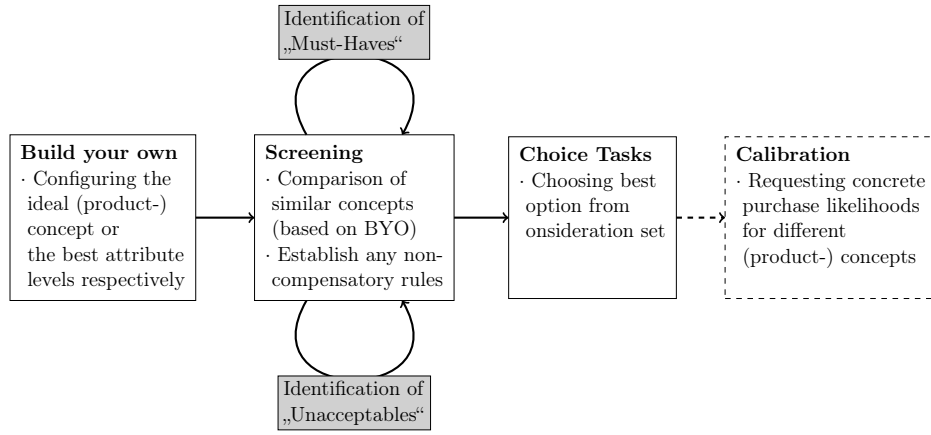
But basic CBCs suffer from multiple disadvantages as well (Brand and Baier 2020). Firstly, it is only possible to include a certain amount of attributes without overstraining participants (Meyerding and Merz 2018; Scherer et al. 2018; Brand and Rausch 2021). Some CBC studies are considered to be boring and monotonous, because respondents answer the same question (type) multiple times (Lines and Denstadli 2004; Bauer et al. 2015). This can partly be explained by respondents facing products, that might not be relevant to them, which are nevertheless fixed in the choice sets (Garver et al. 2012). The monotony might therefore lead to a simplification of the choice process, leading to rash decisions, where some attributes of the products might not be considered appropriately (Gilbride and Allenby 2004; Yee et al. 2007; Ryan et al. 2009; Scholz et al. 2010). In multiple studies respondents also suffer from extreme response behaviour, where they either do not select the “None” option enough (Sonnier et al. 2007; Natter et al. 2008; Parker and Schrift 2011) or choose it very extensively (Gilbride et al. 2008; Steiner and Meißner 2018). One problem with choosing the “None” option is, that it does not offer any information of whether the price of the presented products was just too high or whether the products were completely unacceptable for the respondents (Kamakura et al. 2001; Gunasti and Ross 2009; Gensler et al. 2012).

To tackle these biases, the marketing literature sometimes uses different modified versions of CBC, one of which is called adaptive choice based conjoint (ACBC) (Boesch and Weber 2012; Jervis et al. 2012; Heinzle et al. 2013; Hinnen et al. 2017; Brand and Rausch 2021). An ACBC is (ideally) structured in four stages (Johnson and Orme 2007; Sawtooth Software 2014):

- In the first stage called Build-Your-Own (BYO), respondents build their ideal product while having all possible attributes available. For each considered product, respondents are always confronted with the corresponding summed market price.
- Then respondents have to answer whether they can imagine purchasing different products for given prices in the Screening Section. Respondents can binarily identify products as “A possibility” or “Not a possibility”.

- In the third stage, respondents have to choose their most preferred option out of a specific number of concepts (product and price combinations). In most studies, three or four concepts are presented (Sawtooth Software 2014). It is also important to note, that there exists no “None” option in ACBC studies as the program should only consider products that are not excluded in the Screening Section.
- Finally, respondents are confronted with single concepts and have to choose how likely they are to purchase the respective products for a given price (typically on a 5-point Likert scale). This final stage is called Calibration Section.

To better illustrate the setting the following Figure 1 gives an overview of the four stages:



**Figure 1:** ACBC survey flow (Brand and Baier 2020)

Compared to the standard CBC approach, several advantages of using ACBC methods exist. For example, ACBC surveys adapt the response behaviour of participants. Respondents that systematically do not choose concepts with certain attributes will not be confronted with these attributes further. Therefore, it is possible to capture more information at the individual level while screening a wide variety of product concepts (Sawtooth Software 2014; Gamel et al. 2016; Salm et al. 2016). The screening section, where respondents binarily decide whether they would possibly buy a product, is in line with the strand of literature which argues that respondents utilize non-compensatory decision heuristics (Gilbride and Allenby 2004; Ryan et al. 2009). This means that respondents apply “cut-off rules” (minimum requirements, must-haves, unacceptables etc.)

when choosing possible concepts instead of compensating disliked attributes with liked attributes.

In ACBC settings, prices can fluctuate around a defined base price per concept instead of having to set fixed prices as in a CBC analysis. Respondents choosing a concept with a certain price will later on be confronted with the same concept but a higher price. This summed price approach is superior in handling extreme response behaviour as it applies price intervals (Schlereth and Skiera 2009; Wlömert and Eggers 2016; Schlereth and Skiera 2017). Additionally, while taking longer to answer, ACBC surveys are said to be more engaging and interesting to answer due to their varied design (Sawtooth Software 2014; Brand and Baier 2020). Therefore, ACBC surveys are considered to deliver more precise results (Johnson and Orme 2007; Chapman et al. 2009; Cunningham et al. 2010; Sawtooth Software 2014; Bauer et al. 2015; Wackershauser et al. 2018). With these theoretical advantages in mind, we conducted an ACBC study to determine the individual willingness to pay for different attributes of eggs.

In our survey, after answering some introductory questions, participants had to go through the stages: BYO, Screening, six choice tasks and six calibration questions. The number of choice tasks and calibration questions were based on the recommendations of Sawtooth Software (2021). In order to decide, which attributes to include, we based our decision on past research focusing on consumers' willingness to pay for eggs. A good overview can be found in Rondoni et al. (2020) who present the results of 34 studies in their meta-study. They conclude, that

- socio-cultural (e.g. income, attitude or education) (Andersen 2011; Norwood and Lusk 2011b, Yang 2018),
- extrinsic (e.g. origin, production or sustainability) product characteristics (Norwood and Lusk 2011a; Pettersson et al. 2016; Ochs et al. 2019),
- intrinsic (e.g. nutrient properties) product characteristics (Ahmad Hanis et al. 2013; Pettersson et al. 2016; Bray and Ankeny 2017)
- and psychological factors (lack of knowledge or health-related beliefs) (Ayim-Akonor and Akonor 2014; Pelletier 2017; Sass et al. 2018)



seem to be the most important attributes. According to Mesías et al. (2011), Ahmad Hanis et al. (2013) and Baba et al. (2017), a larger egg size is preferred in most countries for various reasons. Egg shell colour seems to be important in some countries as well (Chang et al. 2010; Heng et al. 2013; Pelletier 2017). To concentrate on the main attributes relevant for our research question, we avoided these attributes by showing closed cartons of eggs. Instead, we focused on:

- Size of the egg carton (6 or 10 eggs)
- Husbandry system (organic, free-range or barn)
- Male chick killing (Yes or No)

Choosing more attributes (e.g. regionality, egg shell colour or egg size) would have prolonged the survey significantly and has the caveat, that respondents typically only focus on a few attributes in surveys anyways, which they might not do in a real purchase situation. Regionality, which is also a very relevant attribute according to Lopez-Galan et al. (2013) and Gracia et al. (2014), is difficult to believably implement without too extensive explanations. This leaves too much scope for interpretation as the underlying preferences are hard to identify. Therefore, we omitted all other attributes for simplicity purposes or told the respondents that all eggs have certain attributes (in our case: Size L).

To keep the ACBC as close to a real purchase in a grocery store as possible, the input was represented as a picture of an egg carton, that could be found in any grocery store in Germany. Different examples can be found below:



**Figure 2:** Design of egg cartons

The design of the egg cartons was very similar, so it would not bias the respondents' answers. Additionally, respondents were presented with a price that fluctuated 50% around the regular price of these egg cartons in a German discounter. This fluctuation should lead to enough variance in order to predict the willingness to pay for eggs and animal welfare on an individual level.

## 2.3 The Quasi-Monarch

To compare these individual results to the Quasi-Monarch<sup>1</sup> willingness to pay for animal welfare, we implemented a referendum setting. As already stated, we mainly chose the example of eggs because of the possibility of using the killing of male chicks as an instrument. Generally, one would consider the husbandry system to be the most relevant attribute with respect to the preference for animal welfare. But husbandry systems might also be correlated with other preferences. It is for instance stated that organic eggs taste better (Bray and Ankeny 2017; Güney and Giraldo 2020) and are more healthy (Pettersson et al. 2016 and Bray and Ankeny 2017). Responses in our survey in which we controlled for this correlation supported this view strongly. However, the killing of male chicks has no individual utility apart from social incentives and can therefore be directly used to measure the willingness to pay for animal welfare.

To implement our referendum setting, we designed a two stage approach, being inspired by the literature with respect to referendums (Mitchell and Carson 1989; Arrow et al. 1993; Hanemann 1994; Schläpfer et al. 2004; Schläpfer and Hanley 2006). Individuals were presented with one of four forms of a referendum. In all of these hypothetical scenarios, respondents were told that the state is thinking about introducing a minimum standard with respect to male chick killing or the husbandry system. Here, we would be interested in the minimum price for a carton of 10 eggs until which respondents would approve a referendum. As respondents had problems with directly answering an open-ended question on how high their maximum willingness to pay was in the pre-test, we introduced the question with a binary choice beforehand. We stated that there would be no eggs available for a smaller than the given price. Respondents only had to choose whether they would

---

<sup>1</sup>One person determines the amount of money, everyone has to pay to improve animal welfare.

sign the referendum for this given price or not. We additionally randomized the given price to reduce the starting point bias inherent with these types of questions (Carson et al. 2003). To avoid social behaviour – for instance thoughts of how other individuals would be affected by the stated price – we told respondents to only focus on themselves. Afterwards, we posed the question which we are really interested in by asking respondents in an open-ended question until which price for a carton of 10 eggs they would be willing to support the referendum. This is the Quasi-Monarch willingness to pay. It was of course always possible to just disagree with the referendum entirely.

All respondents were confronted with two types of referendums, hence, four questions in total. In the first stage, respondents were randomly assigned to the following referendums:

- The minimum husbandry system is set to free-range (25% of the respondents).
- The minimum husbandry system is set to organic (25% of the respondents).
- Male chick killing is prohibited, but no minimum husbandry system is set (50% of the respondents).

In the second stage, we only constructed two groups. Half of the respondents, who had to answer the male chick killing setting, and all of the respondents from the free-range setting were asked their maximum willingness to pay for a minimum standard of free-range combined with a prohibition of male chick killing. All other respondents were confronted with the same referendum but with organic as the minimum husbandry system combined with a prohibition of male chick killing. By introducing these differing settings, we controlled for varying preferences for referendums as respondents considered the same referendum to not be far-reaching enough or too extensive to agree with them in our pre-tests.

Having acquired these two different forms of willingness to pay, we aimed to compare the individual willingness to pay without any referendums to the willingness to pay in the referendum. For a higher willingness to pay in the referendum, the difference can be assumed to be the willingness to pay for the public good animal welfare. But as the title

already suggests, we came upon some problems when measuring the willingness to pay, which are mostly associated with the ACBC method.

### 3 Data, Results & Challenges

Our survey was conducted by inviting respondents from the SoSci-Panel to participate in our questionnaire, which we implemented via Lighthouse Studio by Sawtooth Software. This led to 988 (96 of them incomplete) original responses of which we filtered out the ones with illogical response patterns. Respondents were for instance dropped, if they agreed with a certain referendum in the first stage and then stated a smaller willingness to pay as the already agreed upon minimum price in the first binary question. This leads to 661 remaining responses.

With this data we aim to analyze the willingness to pay for the collective good animal welfare and its components. In order to do so it is necessary:

- That the ACBC produces a reliable willingness to pay on average and for each individual.
- That participants understand animal welfare to be a public (and not a private) good. This would lead to a different willingness to pay caused by the preference of animal welfare in the individual compared to the referendum case.
- That respondents see a benefit of public compared to private provision. Only then would they differentiate their willingness to pay.

In the following we will argue that none of these conditions are fulfilled in our survey.

#### 3.1 Estimating individual willingness to pay with an ACBC

We estimated the individual willingness to pay, by applying a Hierarchical Bayes (HB) estimation on the data gathered by the ACBC questions in our survey. This leads to the most solid results according to Rossi and Allenby (1993), Arora and Huber (2001), Rossi et al. (2005) and Otter (2019) as it utilizes answers of other respondents in an

iterative process in order to determine individual-level partworth utilities. This means that each level of an attribute gets assigned a certain utility, which is zero-centered (the sum of the utilities of all levels of one attribute equals zero). So, the different part-worth utilities represent the importance of the respective levels of the attributes. To calculate these utilities as precise as possible, we ran 100.000 iterations (50.000 burn-in iterations) and included Otter’s task-specific scale factor analysis (Allenby et al. 2005; Otter 2007; Sawtooth Software 2014; Otter 2019) with which differing error levels can be taken into account. Increasing the burn-in iterations further had close to no impact on the resulting utilities.

The validity of ACBC studies is typically evaluated by different quality criteria. The root likelihood of our model, a parameter which can take values between 1 and 1 divided by the number of concepts per choice task (in our case  $1/3$ ), is estimated to be 0.742. This can be interpreted as a high internal consistency (Kalwani et al. 1994; Chrzan and Halversen 2020). Our pseudo R-Squared of 0.606 is said to speak for a high explanatory power as well (McFadden 1973; McFadden 1979).

We also included four different holdout tasks – standard conjoint questions with three concepts that are not used to evaluate the participants’ utilities. With these, the validity of the estimates can be checked even further by analyzing whether the respondents’ choice was also predicted by our model. Comparing the actual choices and the predicted choice of our HB estimation, we are able to determine around 82.6% of the respondents’ choices correctly with our model (first choice hit-rate (FCHR)), which is said to speak for a relatively precise estimate (Huber et al. 1993; Moore et al. 1998; Scholl et al. 2005; Wlömert and Eggers 2016). The mean absolute error (MAE) is also often used for verifying the validity of the estimates. Here, the means of the absolute differences between the actual shares of the concepts in the holdout task are compared to the predicted shares of the model. Our MAE is at 5.25%, which is similar to the ones in the studies mentioned above. In other words: According to the literature cited, our model should be relatively well-fitting.

As we are interested in the individual willingness to pay of each single respondent to be able to compare it to the willingness to pay in the referendum case, we have to

calculate the former first. There are several methods of how to estimate willingness to pay in ACBCs. Following Kohli and Mahajan (1991), Jedidi and Zhang (2002), Miller et al. (2011) and Papies et al. (2011), it is possible to compare the total utility of a product  $u_{i|-p}$  of individual  $i$  without the price  $p$  plus the utility of a given price  $v_i(p)$  to the utility of an estimated “None” variable  $u_i^*$ , which represents the utility of not buying a good. This estimation is necessary as there doesn’t exist a real “None” response in ACBC settings. In mathematical terms:

$$u_{i|-p} + v_i(p) \geq u_i^* \quad (1)$$

The willingness to pay for this product is at the point, where:

$$v_i(p) \geq u_i^* - u_{i|-p} \quad (2)$$

To estimate the utilities of the different prices, we apply a piecewise linear approach including five breakpoints in our price range from [0.49;4.89]. The willingness to pay is exactly at the minimum  $v_i(p)$ , for which (2) still holds. Using the inverse of  $v_i(p)$ , the willingness to pay can be formulated as (Miller et al. 2011):

$$WTP = v_i^{-1}(u_i^* - u_{i|-p}) \quad (3)$$

There are two problems with this calculation. First it is very dependent on the utility of the “None” variable. This “None” variable  $u_i^*$  is estimated through the respondents’ answers in the calibrations tasks, the fourth stage of an ACBC. In these calibration tasks, respondents are asked how likely it is that they would buy a single concept, with which they are confronted. In our case, they could communicate their decision on a 5-point Likert scale.  $u_i^*$  is then calculated by assuming which value on that 5-point Likert scale will actually lead to a purchase. Assuming a threshold value of 4 means that only answers between “likely” and “very likely” will be considered as a purchase decision.

The effect of different “None” thresholds on the resulting willingness to pay is quite significant. Or in other words: The resulting willingness to pay is very sensitive to small

changes in the “None” variable. Let’s consider “None” thresholds between 3 and 3.75 in our example. For an organic carton of 10 eggs without chick killing, the resulting different  $u_i^*$  lead to a willingness to pay of 4.12 Euro (threshold 3) and -5.2 Euro (threshold 3.75) only when looking at the average. Participants only have a positive average willingness to pay up to a threshold of 3.4 for the respective egg carton. For the same thresholds, the willingness to pay for other products – especially the ones with lower utilities – is even more inconsistent due to the high difference in “None” values, even when for instance excluding the outliers.

We have to conclude, that estimating the willingness to pay of each single individual this way, is not feasible, as there does not exist a reference willingness to pay for eggs with which we could compare our data in order to specify the range of the threshold value. Even if we had reference points (for instance an average willingness to pay), it would be impossible to tell how this translates into the different individual willingness to pay. It can only follow, that the willingness to pay acquired by using formulas (1) to (3) is highly unreliable if not just a random number, as the influence of the “None” variable is too severe while not being backed with any data. Still, lots of studies estimate willingness to pay in this manner with comparable magnitude of utilities (see e.g. Jedidi and Zhang 2002; Miller et al. 2011; Papies et al. 2011; Wlömert and Eggers 2016). So, this is not an unique problem of our estimation. It may be that the average of our individual willingness to pay results in a realistic number for a few (but never all) concepts.

But there exist other methods with which it is possible to at least estimate the average willingness to pay. Orme (2001 and 2021) argues that the calculation introduced above estimates the willingness to pay as if there was no other alternative on the market. Therefore, the results must be imprecise. He proposes market simulations (offered by Sawtooth Software), where multiple competitors – in our case five – compete for market shares by varying prices and attributes. By doing this, it is possible to estimate at least the average willingness to pay for all attribute levels. In these market simulations, the raw data can additionally be transformed with the help of different exponents (below one). A lower exponent dampens the effect of outliers on the overall result.

As there was no real data available with which we could compare the resulting willingness to pay, we couldn't be sure which exponent to use in our simulations. Hence, we applied different exponents between 0.3 and 0.9 to evaluate the predictive quality of our model. This leads to highly differing results while the explanatory power remains relatively high.<sup>2</sup> For an organic carton of 10 eggs without chick killing they lie between 7.1 Euro (exponent 0.3) and 4.7 Euro (exponent 0.9). A very representative sample and extensive real market data as reference points would again be necessary to decide which of these willingness to pay and therefore settings are realistic. Unfortunately, none of the two above is available. Therefore, even our estimations of the average willingness to pay for the different levels of the attributes are highly unreliable.

ACBCs – and this should be transferable to conjoint analyses in general – may be useful for simulating market shares for existing products when real market data is already available, but it is highly questionable whether they can be used

- to acquire individual willingness to pay even if real market data was available as well, or
- to acquire average willingness to pay, if no real market data was available and the sample was not highly representative.

As we cannot estimate the willingness to pay for eggs this way, it is impossible to estimate the willingness to pay for single attributes (in our case male chick killing). Therefore, any comparison to the results of the referendum is unfeasible.

## 3.2 The assessment of animal welfare as a public good

In economics, a public good is defined as a non-rival and non-excludable good. Interpreting animal welfare as the overall (or average) welfare of animals, non-excludability and non-rivalry are clearly given. Nobody can be excluded from the utility of a higher overall animal welfare and the utility gained by one individual – for instance due to better husbandry systems – doesn't decrease the utility of another person. Following this

---

<sup>2</sup>The FCHR with an exponent of 0.3 is still at 81.9%.



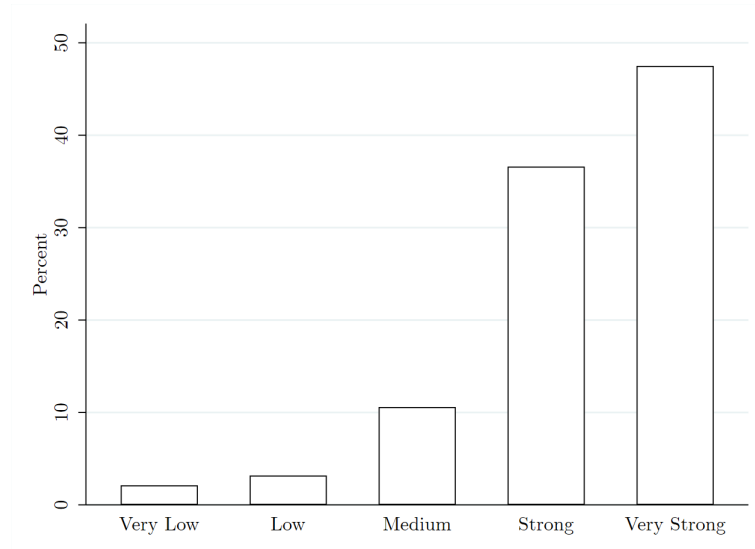
argumentation, the property non-excludability establishes the incentive to free-ride and not participate in the provision of the public good as one's own influence on the overall level of animal welfare is marginal. Because of this property, we expect the individual willingness to pay to be lower in the individual case than in the referendum one.<sup>3</sup>

Apart from these two properties a third one is important: The size of the public good. Small sized public goods can be provided – even without governmental intervention – using different mechanisms. Olson (1971) already differentiated these mechanisms into selective incentives (for those who participate in providing the public good), social sanctions and a rich sponsor. All these mechanisms lead at least to a partial provision of the public good. The first and second argument are based on reciprocal behaviour. The third one is more applicable to small public goods as the investment of a sponsor would have to be very high otherwise. As there are around 45 million laying hens in Germany (Bundesanstalt für Landwirtschaft und Ernährung 2021), overall animal welfare can definitely be viewed as a large public good. For an individual, it is almost impossible to change the animal welfare via financial sponsoring or hoping for reciprocal behaviour. Comparing this result to the already cited market data underlines the view that the overall well-being of hens is a public good. “Only” 15.4% of the fresh eggs that are purchased by German households are organically produced (Bund Ökologische Lebensmittelwirtschaft 2021). On the other hand, some studies suggest that the majority of Germans would support increasing animal welfare levels, if they were enforced on a public level, which speaks for an existing (high) preference for animal welfare (Bundesministerium für Ernährung und Landwirtschaft 2019; Sorg et al. 2021).

This is in line with our Quasi-Monarch model. But in order to actually have a different willingness to pay in the individual and referendum case, our respondents need to share the view, that animal welfare is a public good. To verify this, we asked them to what extent they share the following statement: “With my purchase of eggs I personally have an influence on the well-being of chicken.”

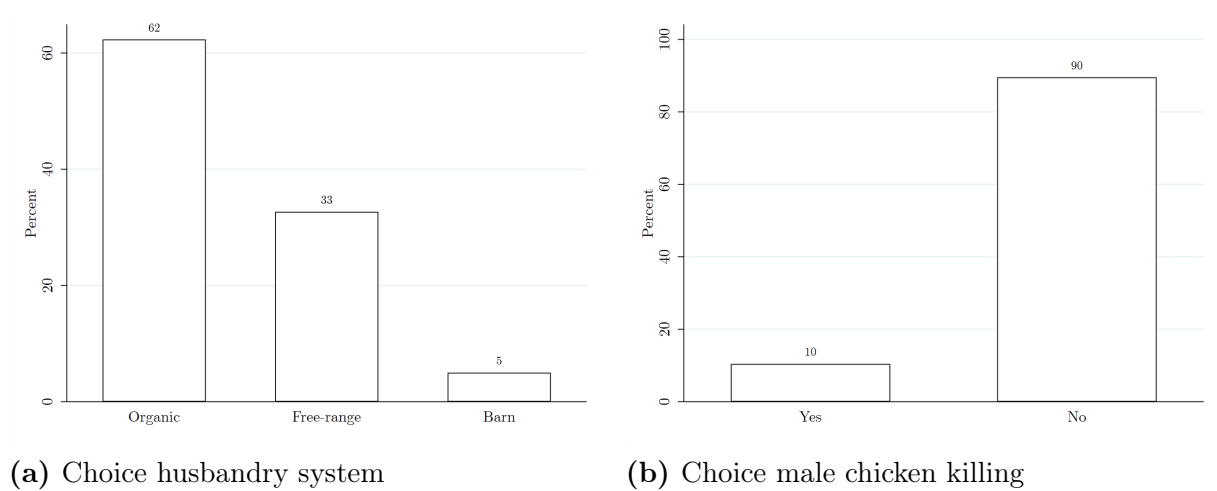
---

<sup>3</sup>It is important to note that there might exist a willingness to pay for social incentives that are linked to animal welfare in the individual case.



**Figure 3:** Well-being of chicken and personal choice

As Figure 3 shows, about 85% of the participants state, that with their purchase they have a strong or even very strong influence on the well-being of chicken. Respondents also state a high preference for organic eggs as the results of our build-your-own question indicate, where respondents have to build their “favourite” product for given market prices.



**(a)** Choice husbandry system

**(b)** Choice male chicken killing

**Figure 4:** Aggregated choices of “build-your-own” section of ACBC

How can these responses be explained in comparison to the 15.4% market share of organic eggs in Germany?

- The survey participants of the SoSci-Panel are not a representative draw of the population. Therefore, a sample-selection bias might be present. This can be supported

by the socio-demographic factors of the survey participants compared to the whole population. Especially the education of participants in our sample is greatly above the German average. However, there is only a slight negative correlation between the educational degree and the question regarding personal choice and the well-being of chicken.

- Another explanation is a strong hypothetical bias which is leading the participants to overestimate their individual willingness to pay in this survey. Even though our sample is not representative, the very high willingness to buy organic eggs might support this argument.

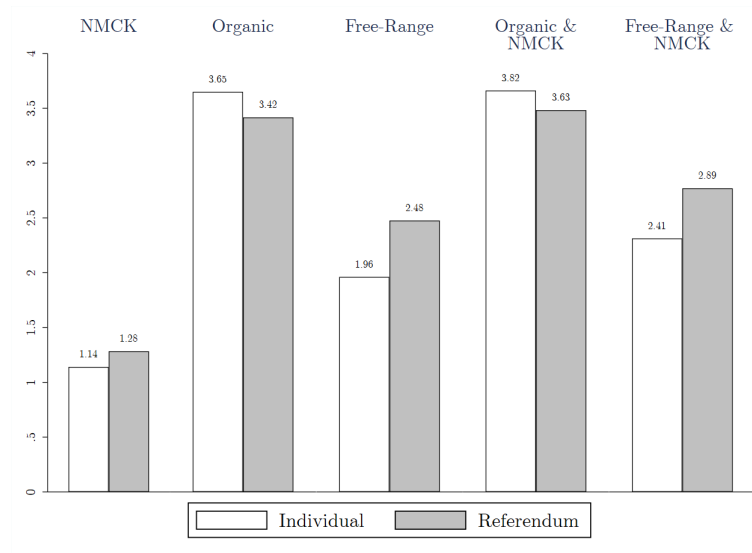
Apart from these potential biases between revealed and stated preferences, it is worth to explore at least the direction of the results. One possible explanation might be, that individuals do not understand animal welfare as a public good. As the aggregate of animal welfare consists of the welfare of single animals, consumers might focus on the well-being of these single animals which they support with their choice of the product. For an individual it is more important to not be responsible for one or some badly treated animals instead of being really interested in an improvement of the average or overall well-being of animals. In this case, the good “animal welfare” is a private one (or at least a quasi-public good) as there exists excludability. The individual purchase decision leads to an increase or decrease of a single animal’s welfare. The assessment of the individual impact on animal welfare (Figure 3) speaks for this argument. Then, the difference of the individual willingness to pay and the referendum answers cannot be interpreted as the willingness to pay for the public good animal welfare anymore.

If they knew that overall animal welfare was actually a public good, the answers would indicate that there is a high willingness to pay for social incentives related to animal welfare but not for animal welfare itself (Gogoll and Schlieszus 2021). This is supported by literature, that estimates the willingness to pay for social incentives, silencing one’s conscience for instance, to be quite significant (Ostrom 1990; Blamey 1998; Yoeli et al. 2013).

### 3.3 The willingness to pay for public intervention

Due to the lack of reliable estimations for the individual willingness to pay in our ACBC, we conducted a smaller second survey which was extended by directly asking for the individual willingness to pay after the ACBC section. The structure was identical to the referendum questions. 255 participants (68 incomplete) took part in the second survey. After removing illogical response patterns 114 answers remained.

We would hypothetically expect the willingness to pay for the referendum to be above the individual ones, if individuals had a preference for the public good. In a referendum, (the sum of all) individuals can impact the public good which is not the case on a private level. Figure 5 shows the different means of the willingness to pay (WTP) for certain criteria and products.<sup>4</sup>



**Figure 5:** Individual and referendum willingness to pay

The resulting willingness to pay cannot be interpreted straightforward. For example, the willingness to pay for eggs without the killing of male chicks seems to be significantly larger in the referendum. However, around 50% of the respondents state identical individual willingness to pay compared to the referendum response. This pattern can largely be observed in all of the settings.

<sup>4</sup>No male chick killing is abbreviated with NMCK.

	NMCK	Organic	Free-Range	Organic & NMCK	Free-Range & NMCK
$WTP_I > WTP_R$	24%	37%	21%	24%	14%
$WTP_I = WTP_R$	53%	43%	29%	54%	49%
$WTP_I < WTP_R$	24%	20%	50%	22%	37%

**Table 1:** Difference of Willingness to Pay in Individual Setting and Referendum

A large number of participants supposedly does not see a difference between paying individually or public intervention. This phenomenon might be explained by the following:

- There may exist a lack of knowledge, which is twofold. First, people do not understand animal welfare as a public good. Second, our respondents do not see the benefit of a publicly forced provision of the public good. However, the second argument is crucial for finding differences in the willingness to pay. If people do not understand the rules of the game, we can fairly expect them to plausibly distinguish between the two scenarios. This is supported by a strand of literature suggesting that individuals have to understand the rules of the game to maximize their utility. Then, repeated public goods games may start with cooperation in the first iterations. But this cooperation breaks down after the players understand the rules of the game (see e.g. Andreoni 1995; Gale et al. 1995; Roth and Erev 1995; Palfrey and Prisbrey 1997; Cooper and Stockman 2002; Guillen et al. 2007; Feige et al. 2014). This would mean that a large number of respondents may not have thought enough about animal welfare to understand it as a public good and the need of public provision through establishing collective rules.
- Our responses could also suffer from a “prominence bias”. This occurs, when surveys focus on a topic which respondents normally do not focus upon in their decision making which leads to a higher attention compared to a real shopping situation. As respondents might guess that the survey is about animal welfare, they may overstate their willingness to pay.

- Biases are in general very prominent in CV approaches, which might therefore not be feasible to measure the willingness to pay – at least according to Diamond and Hausman (1994) and Hausman (2012). Schläpfer and Hanley (2006) for instance argue that the real willingness to pay in referendums in Switzerland is actually considerably lower than the one measured via CV beforehand. So, the stated individual and referendum willingness to pay in our second survey may both be biased. The problem is, that we cannot say in which direction and in which magnitude these biases influence the resulting stated willingness to pay. However, the ACBC hardly gives better results, as argued above.

Further, for some respondents the willingness to pay is higher on an individual basis than in the referendum case. One reason for this behaviour might be that participants feel restricted in their free choice if the state intervened. To maintain this freedom, they are willing to surrender some level of the public good. Especially for organic eggs (and combinations with this criterion), the mean willingness to pay on an individual level is significantly higher than the one of the referendum. Another explanation is that individuals link certain properties with the label “organic”. These properties are excludable, hence only have an influence on the consuming person. For instance, the data indicates clearly that participants of the survey connect a better husbandry system with increasing taste and own health. The consuming (and no other) person gains utility from the better taste and by improving her health – i.e. excludability is given. When focusing on these properties, there is no reason why a liberal person would require public intervention to force others to follow her example.

Only when looking at free-range eggs the stated behaviour is as expected in our starting hypothesis. Besides some contradicting effects, which also appear in this case, the referendum willingness to pay is significantly above the individual one in the mean as well as in total. This might indicate that there is a willingness to pay for the public good. However, as other willingness to pay are also involved (for instance individual reasons, information asymmetries and missing knowledge), the former willingness to pay for the public good will be somewhat superimposed.

## 4 Conclusion

Many public good problems that we face today cannot be solved individually. Instead, collective action is necessary as an individual's influence often is marginal. But especially for large public goods, collective action is hard to implement reciprocally, as free-riding is omnipresent. This free-riding problem can only be solved sustainably by forcing individuals to cooperate with the help of a (public) entity. This (public) entity should not just provide any amount of the public good, but focus on providing the optimal level. For this, it needs information on the willingness to pay for the respective public good. Theoretically, this would be the amount of money an individual was willing to pay herself for the provision, if all others were forced to pay exactly the same amount as well, which we call the Quasi-Monarch.

In this paper, we explored one potential approach to measure this willingness to pay. Focusing on animal welfare and using the example of eggs, we aimed to estimate the individual willingness to pay for individual reasons and the Quasi-Monarch one by employing two stated preference methods. We introduced an ACBC setting to measure the individual and a CV approach for the collective willingness to pay. Choice experiments, of which the ACBC is one, are said to be more precise when estimating individual willingness to pay, as their multi-attribute setting better simulates a real purchase scenario. The CV approach comes closest to the real setting of a referendum, where individuals state their willingness to pay by agreeing or disagreeing in a vote.

Unfortunately, our results are extensively biased due to multiple potential reasons. First, we implement an HB estimation. While achieving a good model fit according to several indicators, the resulting willingness to pay is highly unreliable in the individual and in the average case due to many crucial assumptions and biases. This is not based on our data or our survey, but on the way in which the willingness to pay are estimated in ACBC analyses. ACBC surveys in general have these problems by design, if extensive real data is not available.

Second, in order for individuals to have a higher willingness to pay in the Quasi-Monarch case compared to the individual one, they need to assess animal welfare as

a public good. Our results indicate that this is not the case and a large number of respondents focus on the welfare of one single animal instead of the overall animal welfare (when purchasing eggs). The effect of this assessment is unclear though, so we cannot determine in which direction both of the willingness to pay are influenced. Here, additional research is necessary.

Third, individuals also need to see a benefit in a (public) entity providing a public good in order to have a higher willingness to pay in that scenario. The apparent equivalence of individual and collective willingness to pay leads to the conclusion that this is not the case, at least in our study. This may be due to not understanding the underlying incentives in public good problems, which leads to overestimating the impact of one's own consumption decision or hoping on reciprocal behaviour.

From these findings it directly follows that there might be other – more obvious – public goods that are misinterpreted as private or quasi-public goods as well. There, individuals might also overestimate their impact leading to a sub-optimal provision of the respective public goods. This should be explored in further research.



## References

- Adamowicz, Wiktor L., Peter C. Boxall, Michael Williams, and Jordan J. Louviere. 1998. "Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation." *American Journal of Agricultural Economics* 80 (1): 64–75.
- Ahmad Hanis, Izani Abdul Hadi, Shamsudin Mad Nasir, Selamat Jinap, Radam Alias, and Ab Karim, Muhammad Shahrim. 2013. "Consumer's preferences for eggs attributes in Malaysia: Evidence from conjoint survey." *International Food Research Journal* 20 (5): 2865–2872.
- Allenby, Greg M., Geraldine Fennell, Joel Huber, Thomas Eagle, Timothy J. Gilbride, Dan Horsky, Jaehwan Kim, et al. 2005. "Adjusting Choice Models to Better Predict Market Behavior." *Marketing Letters* 16 (3-4): 197–208.
- Andersen, Laura Mørch. 2011. "Animal Welfare and Eggs - Cheap Talk or Money on the Counter?" *Journal of Agricultural Economics* 62 (3): 565–584.
- Andreoni, James. 1995. "Cooperation in Public-Goods Experiments: Kindness or Confusion?" *The American Economic Review* 85 (4): 891–904.
- Andrews, Rick L., Andrew S. Ainslie, and Imran S. Currim. 2002. "An Empirical Comparison of Logit Choice Models with Discrete versus Continuous Representations of Heterogeneity." *Journal of Marketing Research* 39 (4): 479–487.
- Arora, Neeraj, and Joel Huber. 2001. "Improving Parameter Estimates and Model Prediction by Aggregate Customization in Choice Experiments." *Journal of Consumer Research* 28 (2): 273–283.
- Arrow, Kenneth J., Robert M. Solow, Paul R. Portney, Edward E. Leamer, Roy Radner, and Howard Schuman. 1993. "Report of the NOAA panel on Contingent Valuation." *Federal Register* 58 (10): 4601–4614.

- Ayim-Akonor, Matilda, and Papa Toah Akonor. 2014. "Egg consumption: Patterns, preferences and perceptions among consumers in Accra metropolitan area." *International Food Research Journal* 21 (4): 1457–1463.
- Baba, Yasmina, Zein Kallas, and Carolina Realini. 2017. "Application of the analytical hierarchy process to evaluate consumer acceptance and preferences for omega-3 enriched eggs." *British Food Journal* 119 (7): 1459–1472.
- Bauer, Robert, Klaus Menrad, and Thomas Decker. 2015. "Adaptive Hybrid Methods for Choice-Based Conjoint Analysis: A Comparative Study." *International Journal of Marketing Studies* 7 (1).
- Blamey, Russell K. 1998. "Contingent valuation and the activation of environmental norms." *Ecological Economics* 24 (1): 47–72.
- Boesch, Irene, and Michael Weber. 2012. "Processor's Preferences and Basic Differentiation Strategies for Potatoes, Milk, and Wheat in Switzerland." *Journal of Agricultural & Food Industrial Organization* 10 (1).
- Brand, Benedikt M., and Daniel Baier. 2020. "Adaptive CBC: Are the Benefits Justifying its Additional Efforts Compared to CBC?" *Archives of Data Science, Series A* 6 (1).
- Brand, Benedikt M., and Theresa Maria Rausch. 2021. "Examining sustainability surcharges for outdoor apparel using Adaptive Choice-Based Conjoint analysis." *Journal of Cleaner Production* 289:125654.
- Bray, Heather J., and Rachel A. Ankeny. 2017. "Happy Chickens Lay Tastier Eggs: Motivations for Buying Free-range Eggs in Australia." *Anthrozoös* 30 (2): 213–226.
- Bund Ökologische Lebensmittelwirtschaft. 2021. *Branchen Report 2021: Ökologische Lebensmittelwirtschaft*. Accessed August 5, 2021. [https://www.boelw.de/fileadmin/user\\_upload/Dokumente/Zahlen\\_und\\_Fakten/Brosch%C3%BCre\\_2021/B%C3%96LW\\_Branchenreport\\_2021\\_web.pdf](https://www.boelw.de/fileadmin/user_upload/Dokumente/Zahlen_und_Fakten/Brosch%C3%BCre_2021/B%C3%96LW_Branchenreport_2021_web.pdf).

- Bundesanstalt für Landwirtschaft und Ernährung. 2021. *Legehennenhaltung in Deutschland*. Accessed August 26, 2021. <https://www.praxis-agrar.de/tier/gefluegel/legehennenhaltung-in-deutschland>.
- Bundesministerium für Ernährung und Landwirtschaft. 2019. *Deutschland, wie es isst: Der BMEL-Ernährungsreport 2019*. [https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/Ernaehrungsreport2019.pdf;jsessionid=1B824A46FDA118A6C5E97877AAE2586B.live831?\\_\\_blob=publicationFile&v=4](https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/Ernaehrungsreport2019.pdf;jsessionid=1B824A46FDA118A6C5E97877AAE2586B.live831?__blob=publicationFile&v=4).
- . 2021. *Vorgehen zum Umbau der Tierhaltung bekräftigt*. Accessed August 5, 2021. <https://www.bmel.de/SharedDocs/Pressemitteilungen/DE/2021/078-borchert-kommission.html;jsessionid=388178362740E5812D0B9E44C99398CA.live841>.
- Carson, Richard T., Robert C. Mitchell, Michael Hanemann, Raymond J. Kopp, Stanley Presser, and Paul A. Ruud. 2003. “Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill.” *Environmental and Resource Economics* 25 (3): 257–286.
- Chang, Jae Bong, Jayson L. Lusk, and F. Bailey Norwood. 2010. “The Price of Happy Hens: A Hedonic Analysis of Retail Egg Prices.” *Journal of Agricultural and Resource Economics* 35 (3): 406–423.
- Chapman, Christopher N., James L. Alford, Chad Johnson, and Ron Weidemann. 2009. “CBC vs. ACBC: Comparing Results with Real Product Selection.” *Sawtooth Software Research Paper Series*.
- Chrzan, Keith, and Cameron Halversen. 2020. “Diagnostics for Random Respondents.” *Sawtooth Software European Conference*.
- Cooper, David J., and Carol Kraker Stockman. 2002. “Fairness and learning: an experimental examination.” *Games and Economic Behavior* 41 (1): 26–45.
- Cunningham, Charles E., Ken Deal, and Yvonne Chen. 2010. “Adaptive choice-based conjoint analysis: a new patient-centered approach to the assessment of health service preferences.” *The patient* 3 (4): 257–273.

- Diamond, Peter A., and Jerry A. Hausman. 1994. "Contingent Valuation: Is Some Number Better than No Number?" *Journal of Economic Perspectives* 8 (4): 45–64.
- Evgeniou, Theodoros, Massimiliano Pontil, and Olivier Toubia. 2007. "A Convex Optimization Approach to Modeling Consumer Heterogeneity in Conjoint Estimation." *Marketing Science* 26 (6): 805–818.
- Feige, Christian, Karl-Martin Ehrhart, and Jan Krämer. 2014. "Voting on contributions to a threshold public goods game - an experimental investigation." *KIT Working paper series in economics* 60.
- Freeman, Albert Myrick, Joseph A. Herriges, and Catherine L. Kling. 2014. *The measurement of environmental and resource values: Theory and methods*. 3rd ed. Abingdon: Resources for the future.
- Gale, John, Kenneth G. Binmore, and Larry Samuelson. 1995. "Learning to be imperfect: The ultimatum game." *Games and Economic Behavior* 8 (1): 56–90.
- Gamel, Johannes, Klaus Menrad, and Thomas Decker. 2016. "Is it really all about the return on investment? Exploring private wind energy investors' preferences." *Energy Research & Social Science* 14:22–32.
- Garver, Michael S., Zachary Williams, G. Stephen Taylor, and William R. Wynne. 2012. "Modelling choice in logistics: a managerial guide and application." *International Journal of Physical Distribution & Logistics Management* 42 (2): 128–151.
- Gensler, Sonja, Oliver Hinz, Bernd Skiera, and Sven Theysohn. 2012. "Willingness-to-pay estimation with choice-based conjoint analysis: Addressing extreme response behavior with individually adapted designs." *European Journal of Operational Research* 219 (2): 368–378.
- Gilbride, Timothy J., and Greg M. Allenby. 2004. "A Choice Model with Conjunctive, Disjunctive, and Compensatory Screening Rules." *Marketing Science* 23 (3): 391–406.
- Gilbride, Timothy J., Joseph P. Guiltinan, and Joel E. Urbany. 2008. "Framing effects in mixed price bundling." *Marketing Letters* 19 (2): 125–139.

- Gogoll, Niklas, and Felix Schlieszus. 2021. *Why Being a Frequent Flyer and an Environmental Activist is no Contradiction: The Willingness to Pay for Public Goods and its Components*. University of Bayreuth, Bayreuth. Accessed August 7, 2022. [https://www.vwl5.uni-bayreuth.de/pool/dokumente/Working-Paper/Gogoll-\\_-Schlieszus---Frequent-Flyer-Environmental-Activist.pdf](https://www.vwl5.uni-bayreuth.de/pool/dokumente/Working-Paper/Gogoll-_-Schlieszus---Frequent-Flyer-Environmental-Activist.pdf).
- Gracia, Azucena, Jesús Barreiro-Hurlé, and Belinda López Galán. 2014. “Are Local and Organic Claims Complements or Substitutes? A Consumer Preferences Study for Eggs.” *Journal of Agricultural Economics* 65 (1): 49–67.
- Guillen, Pablo, Christiane Schwieren, and Gianandrea Staffiero. 2007. “Why feed the Leviathan?” *Public Choice* 130 (1-2): 115–128.
- Gunasti, Kunter, and William T. Ross. 2009. “How Inferences about Missing Attributes Decrease the Tendency to Defer Choice and Increase Purchase Probability.” *Journal of Consumer Research* 35 (5): 823–837.
- Güney, Osman Inanç, and Luca Giraldo. 2020. “Consumers’ attitudes and willingness to pay for organic eggs.” *British Food Journal* 122 (2): 678–692.
- Hanemann, Michael. 1994. “Valuing the Environment Through Contingent Valuation.” *Journal of Economic Perspectives* 8 (4): 19–43.
- Hanley, Nick, Robert E. Wright, and Wiktor L. Adamowicz. 1998. “Using Choice Experiments to Value the Environment.” *Environmental and Resource Economics* 11 (3/4): 413–428.
- Hausman, Jerry A. 2012. “Contingent Valuation: From Dubious to Hopeless.” *Journal of Economic Perspectives* 26 (4): 43–56.
- Heinzle, Stefanie Lena, Augustin Boey Ying Yip, and Melissa Low Yu Xing. 2013. “The Influence of Green Building Certification Schemes on Real Estate Investor Behaviour: Evidence from Singapore.” *Urban Studies* 50 (10): 1970–1987.

- Heng, Yan, Hikaru Hanawa Peterson, and Xianghong Li. 2013. "Consumer Attitudes toward Farm-Animal Welfare: The Case of Laying Hens." *Journal of Agricultural and Resource Economics* 38 (3): 418–434.
- Hinnen, Gieri, Stefanie Lena Hille, and Andreas Wittmer. 2017. "Willingness to Pay for Green Products in Air Travel: Ready for Take-Off?" *Business Strategy and the Environment* 26 (2): 197–208.
- Huber, Joel, Dick R. Wittink, John A. Fiedler, and Richard Miller. 1993. "The Effectiveness of Alternative Preference Elicitation Procedures in Predicting Choice." *Journal of Marketing Research* 30 (1): 105–114.
- Jedidi, Kamel, and Z. John Zhang. 2002. "Augmenting Conjoint Analysis to Estimate Consumer Reservation Price." *Management Science* 48 (10): 1350–1368.
- Jervis, Suzanne M., John M. Ennis, and Maryanne A. Drake. 2012. "A Comparison of Adaptive Choice-Based Conjoint and Choice-Based Conjoint to Determine Key Choice Attributes of Sour Cream with Limited Sample Size." *Journal of Sensory Studies* 27 (6): 451–462.
- Johnson, Richard M., and Bryan K. Orme. 2007. "A New Approach to Adaptive CBC." *Sawtooth Software Research Paper Series*.
- Kalwani, Manohar U., Robert J. Meyer, and Donald G. Morrison. 1994. "Benchmarks for Discrete Choice Models." *Journal of Marketing Research* 31 (1): 65–75.
- Kamakura, Wagner, Rinus Haaijer, and Michel Wedel. 2001. "The No—Choice Alternative in Conjoint Choice Experiments." *International Journal of Market Research* 43 (1): 1–12.
- Kohli, Rajeev, and Vijay Mahajan. 1991. "A Reservation-Price Model for Optimal Pricing of Multiattribute Products in Conjoint Analysis." *Journal of Marketing Research* 28 (3): 347–354.

- Ku, Yu-Cheng, Tsun-Feng Chiang, and Sheng-Mao Chang. 2017. “Is what you choose what you want?—outlier detection in choice-based conjoint analysis.” *Marketing Letters* 28 (1): 29–42.
- Lancaster, Kelvin J. 1966. “A New Approach to Consumer Theory.” *Journal of Political Economy* 74 (2): 132–157.
- Lines, Rune, and Jon M. Denstadli. 2004. “Information Overload in Conjoint Experiments.” *International Journal of Market Research* 46 (3): 297–310.
- Lopez-Galan, Belinda, Azucena Gracia, and Jesús Barreiro-Hurlé. 2013. “What comes first, origin or production method? An investigation into the relative importance of different attributes in the demand for eggs.” *Spanish Journal of Agricultural Research* 11 (2): 305.
- Louviere, Jordan J., and George Woodworth. 1983. “Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data.” *Journal of Marketing Research* 20 (4): 350–367.
- McFadden, Daniel. 1973. *Conditional Logit Analysis of Qualitative Choice Behavior*. Berkeley, CA: Institute of Urban and Regional Development, University of California.
- . 1979. “Quantitative Methods for Analysing Travel Behaviour of Individuals: Some Recent Development.” In *Behavioural Travel Modelling*, edited by David A. Hensher and Peter R. Stopher, 279–318. London: Croom Helm.
- Mesías, Francisco J., Federico Martínez-Carrasco, José M. Martínez, and Paula Gaspar. 2011. “Functional and organic eggs as an alternative to conventional production: a conjoint analysis of consumers’ preferences.” *Journal of the science of food and agriculture* 91 (3): 532–538.
- Meyerding, Stephan G.H., and Nicolas Merz. 2018. “Consumer preferences for organic labels in Germany using the example of apples – Combining choice-based conjoint analysis and eye-tracking measurements.” *Journal of Cleaner Production* 181:772–783.

- Miller, Klaus M., Reto Hofstetter, Harley Krohmer, and Z. John Zhang. 2011. "How Should Consumers' Willingness to Pay be Measured? An Empirical Comparison of State-of-the-Art Approaches." *Journal of Marketing Research* 48 (1): 172–184.
- Mitchell, Robert C., and Richard T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Hoboken, NJ: Taylor and Francis.
- Moore, William L., Jason Gray-Lee, and Jordan J. Louviere. 1998. "A Cross-Validity Comparison of Conjoint Analysis and Choice Models at Different Levels of Aggregation." *Marketing Letters* 9 (2): 195–207.
- Natter, Martin, Andreas Mild, Udo Wagner, and Alfred Taudes. 2008. "Practice Prize Report —Planning New Tariffs at tele.ring: The Application and Impact of an Integrated Segmentation, Targeting, and Positioning Tool." *Marketing Science* 27 (4): 600–609.
- Norwood, F. Bailey, and Jayson L. Lusk. 2011a. "A calibrated auction-conjoint valuation method: Valuing pork and eggs produced under differing animal welfare conditions." *Journal of Environmental Economics and Management* 62 (1): 80–94.
- . 2011b. *Compassion, by the pound: The economics of farm animal welfare*. Oxford: Oxford University Press.
- Ochs, Dan, Christopher A. Wolf, Nicole Olynk Widmar, Courtney Bir, and John Lai. 2019. "Hen housing system information effects on U.S. egg demand." *Food Policy* 87 (101743).
- Olson, Mancur. 1971. *The logic of collective action: Public goods and the theory of groups*. 2. ed. Cambridge, MA: Harvard University Press.
- Orme, Bryan K. 2001. "Assessing the Monetary Value of Attribute Levels with Conjoint Analysis: Warnings and Suggestions." *Sawtooth Software Research Paper Series*.
- . 2021. "Estimating WTP Given Competition in Conjoint Analysis." *Sawtooth Software Research Paper Series*.



- Ostrom, Elinor. 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge: Cambridge University Press.
- Otter, Thomas. 2007. “HB Analysis for Multi-Format Adaptive CBC.” *Sawtooth Software Conference Proceedings*.
- . 2019. “Bayesian Models.” In *Handbook of Market Research*, edited by Christian Homburg, Martin Klarmann, and Arnd Vomberg, 1–64. Cham: Springer International Publishing.
- Palfrey, Thomas R., and Jeffrey E. Prisbrey. 1997. “Anomalous Behavior in Public Goods Experiments: How Much and Why?” *The American Economic Review* 87 (5): 829–846.
- Papies, Dominik, Felix Eggers, and Nils Wlömert. 2011. “Music for free? How free ad-funded downloads affect consumer choice.” *Journal of the Academy of Marketing Science* 39 (5): 777–794.
- Parker, Jeffrey R., and Rom Y. Schrift. 2011. “Rejectable Choice Sets: How Seemingly Irrelevant No-Choice Options Affect Consumer Decision Processes.” *Journal of Marketing Research* 48 (5): 840–854.
- Pelletier, Nathan. 2017. “Life cycle assessment of Canadian egg products, with differentiation by hen housing system type.” *Journal of Cleaner Production* 152:167–180.
- Perman, Roger, Yue Ma, Michael S. Common, David Maddison, and James McGilvray. 2011. *Natural resource and environmental economics*. 4th ed. Boston, MA: Addison Wesley.
- Pettersson, Isabelle Claire, Claire Alexandra Weeks, Lorna Rachel Maven Wilson, and Christine Janet Nicol. 2016. “Consumer perceptions of free-range laying hen welfare.” *British Food Journal* 118 (8): 1999–2013.
- Rondoni, Agnese, Daniele Asioli, and Elena Millan. 2020. “Consumer behaviour, perceptions, and preferences towards eggs: A review of the literature and discussion of industry implications.” *Trends in Food Science & Technology* 106:391–401.

- Rossi, Peter E., and Greg M. Allenby. 1993. "A Bayesian Approach to Estimating Household Parameters." *Journal of Marketing Research* 30 (2): 171–182.
- Rossi, Peter E., Greg M. Allenby, and Robert McCulloch. 2005. *Bayesian Statistics and Marketing*. Chichester: John Wiley & Sons, Ltd.
- Roth, Alvin E., and Ido Erev. 1995. "Learning in extensive-form games: Experimental data and simple dynamic models in the intermediate term." *Games and Economic Behavior* 8 (1): 164–212.
- Ryan, Mandy, Verity Watson, and Vikki Entwistle. 2009. "Rationalising the 'irrational': a think aloud study of discrete choice experiment responses." *Health economics* 18 (3): 321–336.
- Salm, Sarah, Stefanie Lena Hille, and Rolf Wüstenhagen. 2016. "What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany." *Energy Policy* 97:310–320.
- Sass, Carla A. B., Shigeno P. Kuriya, Gabriela V. Da Silva, Hugo L. A. Silva, Adriano G. Da Cruz, Erick A. Esmerino, and Monica Q. Freitas. 2018. "Completion task to uncover consumer's perception: a case study using distinct types of hen's eggs." *Poultry science* 97 (7): 2591–2599.
- Sawtooth Software. 2014. "ACBC Technical Paper." *Sawtooth Software Technical Paper Series*.
- . 2021. *Design Tab (ACBC)*. Accessed August 20, 2021. [https://sawtoothsoftware.com/help/lighthouse-studio/manual/hid\\_web\\_designtab.html](https://sawtoothsoftware.com/help/lighthouse-studio/manual/hid_web_designtab.html).
- Scherer, Christoph, Agnes Emberger-Klein, and Klaus Menrad. 2018. "Consumer preferences for outdoor sporting equipment made of bio-based plastics: Results of a choice-based-conjoint experiment in Germany." *Journal of Cleaner Production* 203:1085–1094.
- Schläpfer, Felix, and Nick Hanley. 2006. "Contingent Valuation and Collective Choice." *Kyklos* 59 (1): 115–135.

- Schläpfer, Felix, Anna Roschewitz, and Nick Hanley. 2004. "Validation of stated preferences for public goods: a comparison of contingent valuation survey response and voting behaviour." *Ecological Economics* 51 (1-2): 1–16.
- Schlereth, Christian, and Bernd Skiera. 2009. "Schätzung von Zahlungsbereitschaftsintervallen mit der Choice-Based Conjoint-Analyse." *Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung* 61 (8): 838–856.
- . 2017. "Two New Features in Discrete Choice Experiments to Improve Willingness-to-Pay Estimation That Result in SDR and SADR: Separated (Adaptive) Dual Response." *Management Science* 63 (3): 829–842.
- Scholl, Armin, Laura Manthey, Roland Helm, and Michael Steiner. 2005. "Solving multi-attribute design problems with analytic hierarchy process and conjoint analysis: An empirical comparison." *European Journal of Operational Research* 164 (3): 760–777.
- Scholz, Sören W., Martin Meißner, and Reinhold Decker. 2010. "Measuring Consumer Preferences for Complex Products: A Compositional Approach Based on Paired Comparisons." *Journal of Marketing Research* 47 (4): 685–698.
- Sonnier, Garrett, Andrew S. Ainslie, and Thomas Otter. 2007. "Heterogeneity distributions of willingness-to-pay in choice models." *Quantitative Marketing and Economics* 5 (3): 313–331.
- Sorg, Diana, Anne Klatt, Nils Ole Plambeck, and Lea Köder. 2021. "Perspektiven für eine umweltverträgliche Nutztierhaltung in Deutschland." *Umweltbundesamt*.
- Steiner, Michael, and Martin Meißner. 2018. "A User's Guide to the Galaxy of Conjoint Analysis and Compositional Preference Measurement." *Marketing ZFP* 40 (2): 3–25.
- Voleti, Sudhir, V. Srinivasan, and Pulak Ghosh. 2017. "An approach to improve the predictive power of choice-based conjoint analysis." *International Journal of Research in Marketing* 34 (2): 325–335.

- Wackershauser, Verena, Marcel Lichters, and Bodo Vogt. 2018. “Predictive Validity in Choice-Based Conjoint Analysis: A Comparison of Hypothetical and Incentive-Aligned ACBC with Incentive-Aligned CBC: An Abstract.” In *Back to the Future: Using Marketing Basics to Provide Customer Value*, edited by Nina Krey and Patricia Rossi, 815–816. Developments in Marketing Science: Proceedings of the Academy of Marketing Science. Cham: Springer International Publishing.
- Wlömert, Nils, and Felix Eggers. 2016. “Predicting new service adoption with conjoint analysis: external validity of BDM-based incentive-aligned and dual-response choice designs.” *Marketing Letters* 27 (1): 195–210.
- Yang, Yu-Chen. 2018. “Factors affecting consumers’ willingness to pay for animal welfare eggs in Taiwan.” *International Food and Agribusiness Management Review* 21 (6): 741–754.
- Yee, Michael, Ely Dahan, John R. Hauser, and James Orlin. 2007. “Greedoid-Based Non-compensatory Inference.” *Marketing Science* 26 (4): 532–549.
- Yoeli, Erez, Moshe Hoffman, David G. Rand, and Martin A. Nowak. 2013. “Powering up with indirect reciprocity in a large-scale field experiment.” *Proceedings of the National Academy of Sciences of the United States of America* 110 (2): 10424–10429.